INSTRUCTIONS

To the

SURVEYORS GENERAL OF PUBLIC LANDS

Of

THE UNITED STATES

For those

SURVEYING DISTRICTS ESTABLISHED IN AND SINCE THE YEAR 1850;

Containing, also,

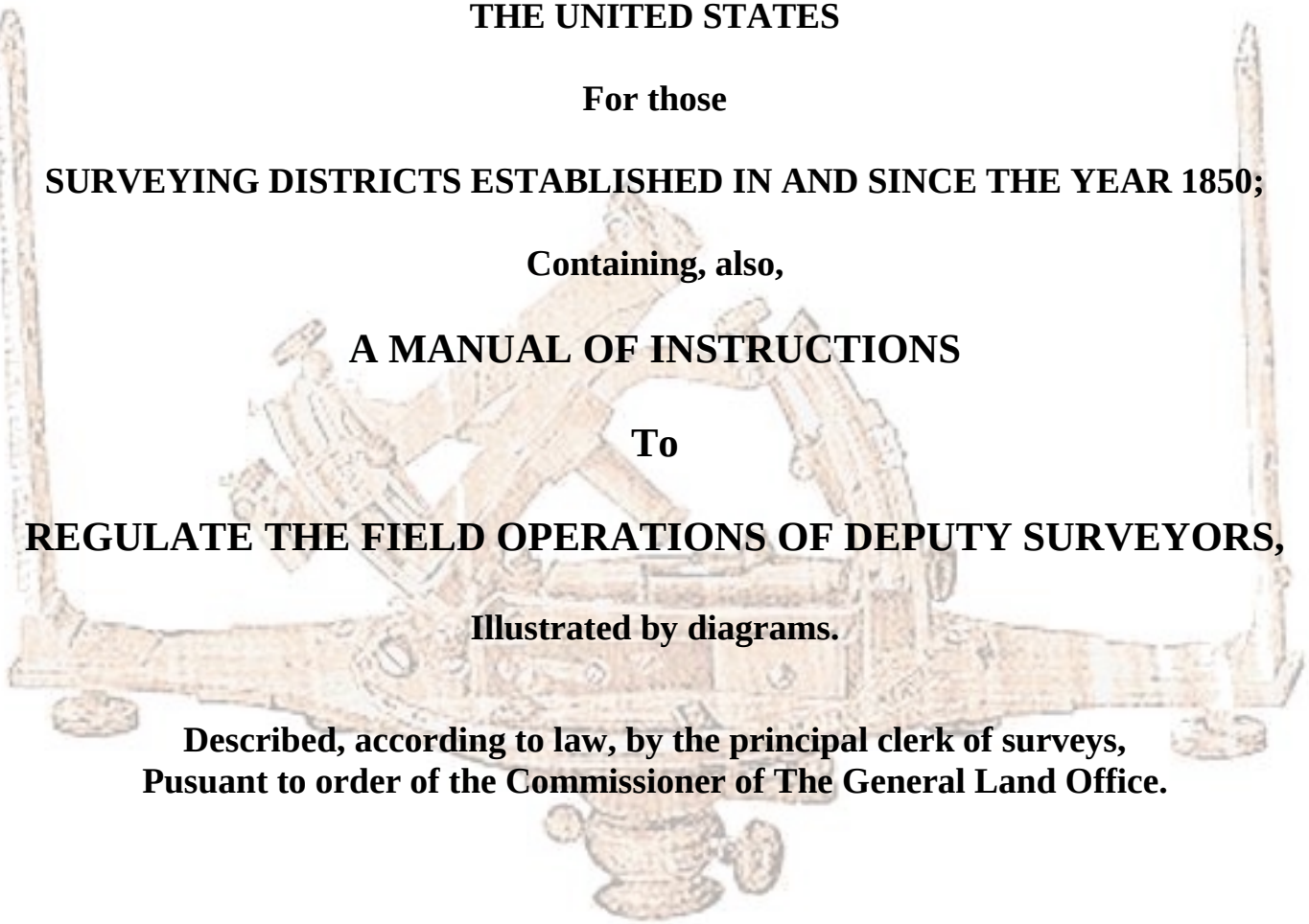
A MANUAL OF INSTRUCTIONS

To

REGULATE THE FIELD OPERATIONS OF DEPUTY SURVEYORS,

Illustrated by diagrams.

Described, according to law, by the principal clerk of surveys,
Pusuant to order of the Commissioner of The General Land Office.



WASHINGTON:
A.O.P. Nicholson, Public Printer

1855

Reprinted by the Kansas Society of Land Surveyors, 1996
Adapted to PDF format by the Kansas Society of Land Surveyors, 1999

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OF

THE UNITED STATES

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ILLUSTRATED BY DIAGRAMS

PRESCRIBED, ACCORDING TO LAW, BY THE PRINCIPAL CLERK OF SURVEYS, PURSUANT TO ORDER OF THE COMMISSIONER OF THE GENERAL LAND OFFICE.

WASHINGTON:
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TO THE SURVEYORS GENERAL

OF

PUBLIC LANDS OF THE UNITED STATES

FOR SURVEYING DISTRICTS ESTABLISHED IN AND SINCE THE YEAR 1850.

By the direction of the COMMISSIONER OF THE GENERAL LAND OFFICE, the accompanying instructions are prescribed for your official government, including a MANUAL OF INSTRUCTIONS to regulate the field operations of your deputy surveyors. The latter is a revision of the Manual of Surveying Instructions prepared for Oregon in 1851, the edition of which is now exhausted,) and presents, in some respects, more copious illustrations, both in the specimen field notes and in the diagrams, than could be furnished amidst the pressure of the exigency under which the former had to be prepared. It will be observed that, in the former edition, the township and section lines south of the base are made to start therefrom, and close on the first standard parallel south; whereas, under the present instructions, such lines are made to start from the first standard parallel south, and to close to the north on the base and standard lines. Such modification is introduced for the sake of entire uniformity of method in new fields of survey, and will not, of course, affect any past operations under the original instructions.

The starting corners on the base line and on the standards will, of course, be common to two townships or to two sections lying on and north of such lines; and the closing corners on such lines, from the south, should be carefully connected with the former by measurements to be noted in the field book.

Where STONE can be had to perpetuate corner boundaries, such, for obvious reasons, should always be preferred for that purpose, and the dimensions of the stone, as herein prescribed (on page 9,) are to be regarded as the *minimum size;* but in localities where it is found practicable to obtain a stone of *increased dimensions,* it is always desirable to do so, particularly for TOWNSHIP CORNERS, and especially for those on base, meridian, and standard lines; and to such purport the deputy surveyor is to be specially instructed.

Prior to entering upon duty, the deputy surveyor is to make himself thoroughly acquainted with the official requirements in regard to field operations in all the details herein set forth, and to be apprized of the weighty moral and legal responsibilities under which he will act.

Unfaithfulness in the execution of the public surveys will be detected by special examinations of the work to be made for that purpose, and, when detected, will immediately subject the delinquent deputy and his bondsmen to be sued by the district attorney of the United States, at the instance of the proper surveyor general ---the institution of which suit will act at once as a lien upon any property owned by him or them at that time; and such delinquency, moreover, is an offence punishable by the statute, with all the pains and penalties of perjury, (see act of 1846, quoted on pages 19 and 20 hereof,) and will of necessity debar the offending deputy from future employment in like capacity. Hence, in the execution of contracts for surveying public lands, there is every incentive to fidelity that can address itself either to the moral sense, or to motives of private interest.

By order of the Commissioner:

JOHN M. MOORE,
Principal Clerk of Surveys

GENERAL LAND OFFICE,
February 22, 1855

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SYSTEM

OF

RECTANGULAR SURVEYING

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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 are laid off, in the first place, into bodies of land of six miles square, called *Townships*, containing as near as may be 23,040 acres. The townships are subdivided into thirty-six tracts called *Sections*, of a mile square, 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 connexion 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 township assuming something of a trapezoidal form, which inequality developes itself more and more as such the higher latitude of the surveys. It is doubtless in view of these circumstances that the law provides (see sec. 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 sec. 3 of the act of 10th May, 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 six miles, the excess or deficiencey 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 A, will serve to illustrate the method of running out the exterior lines of townships, as well on the *north* as on the *south* side of the base line; and the order and mode of subdividing townships will be found illustrated in the accompanying specimen field notes, conforming with the township diagram B. 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 is believed, is practible.

The section lines are surveyed from *south* to north on true meridians, and from *east* to west, in order to throw the excesses or deficiences in measurements on the north and west sides of the township, as required by law.

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.

5. STANDARD PARALLELS (usually called correction lines) are established at stated intervals to provide for or counteract, the error that otherwise would result from the convergency of meridians, and also to arrest error arising from inaccuracies in measurements in meridian lines, which, however must be studiously avoided. On the *north* of the paincipal* base line it is proposed to have these standards run at distances of every *four* townships, or twenty-four miles, and on the *south* of the principal base, at distances of every *five* townships or thirty miles.

OF MEASUREMENTS, CHAINING, AND MARKING.

1. Where uniformity in the variation of the needle is not found, the public surveys must be made with an instrument operating independently of the magnetic needle. Burt’s *improved solar compass*, or other instrument of equal quality, 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 may be used in subdividing and meandering.

* principal, misspelled in original document.

2. The township lines, and the subdivision lines, will usually be measured by a two-pole chain of thirty-three feet in length, consisting of fifty links, and each link being seven inches and ninety-two hundredths of an inch long. On uniform and level ground, however, the four-pole chain may be used. Your measurements will, however, always be represented according to the four-pole chain of one hundred links. The deputy surveyor must also have with him a measure of the standard chain, wherewith to compare and adjust the chain in use, from day to day, with punctuality and carefullnes; and must return such standard chain to the Surveyor Generals office for examination when his work is completed.

OF TALLY PINS.

3. You will use eleven tally pins made of steel, not exceeding fourteen inches in length, weighty enough towards 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.

4. In measuring lines with a two-pole chain, every *five* 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 setting the pins that he has taken up, so that one is forward in all the odd, and the other in all the even tallies. Such procedure, it is believed, tends to insure accuracy in measurement, facilitates the recollection of distances to objects on the line, and renders a mistally almost impossible.

LEVELLING THE CHAIN AND PLUMBING THE PINS.

5. The length of every line you run is to be ascertained by precise horizontal measurement, as nearly approximating to an air line as is pos-

sible in practice on the earth's surface. This all important object can only be attained by a rigid adherence to the following three 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 *levelled*. 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 obtain precisely *the spot* where they should be stuck. The more uneven the surface, the greater the caution needed to set the pins.

MARKING LINES.

6. 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,*" "*line trees,*" or "*station trees.*"

A sufficient number of other trees standing nearest to your line, on either side of it, are to be *blazed* on two sides diagonally, or quartering towards 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 further 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.

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 line, 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.

INSUPERABLE OBJECTS ON LINE ----- WITNESS POINTS.

7. 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; and the deputy is to have always at hand the necessary implements for keeping his marking irons in order; for which purpose a rat-tail file and a small whetstone will be found indispensable.

ESTABLISHING CORNER BOUNDARIES

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 corner boundary is the consummation of the work, for which all the previous pains and expenditures have been incurred. If, therefore, the corner boundary be not perpetuated in a permanent and workmanlike manner, the *great aim* of the surveying service will not have been attained. A boundary corner, in a timbered country is to be a *tree*, if one be found at the precise spot; and if not, *a post* is to be planted thereat; and the position of the corner post is to be indicated by trees adjacent, the angular bearings and distances of which from the corner are facts to be ascertained and registered in your field book. (See article, “Bearing trees.”)

In a region where stone abounds the corner boundary will be a small *monument of stones* along side of a single marked stone for a township corner, and a single stone for all other corners.

In a region where timber is not near, and stone not found, the corner will be a *mound of earth*, of prescribed size, varying to suit the case.

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

1. For township boundaries, at intervals of every six 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 on east and west lines, as explained hereafter.

[The half quarter section boundary is not marked in the field, but is regarded by the law as a point of intermediate between the half mile, or quarter section corners. See act of 24th April, 1820, entitled "An act making further provision for the sale of the public lands," which act refers to the act of Congress passed on the 11th of February, 1805, entitled "An act concerning the mode of surveying the public lands of the United States," for the manner of ascertaining the corners and contents of half quarter sections.]*

4. MEANDER CORNER POSTS are planted at all those points where the township or section lines intersect the banks of such rivers, bayous, lakes, or islands, as are by law directed to be meandered.

The courses and distances on meandered navigable streams govern the calculations wherefrom are ascertained the true areas of the tracts of land (sections, quarter sections, &c.) known to the law as *fractional*, and binding on such streams.

MANNER OF ESTABLISHING CORNERS BY MEANS OF POSTS.

Township, sectional, or mile corners, and quarter sectional or half mile corners, will be perpetuated by planting a post at the place of the corner, to be formed of the most durable wood of the forest at hand.

The posts must be set in the earth by digging a hole to admit them two *feet* deep, and must be very securely rammed in with the earth, and also with stone, if any be found at hand. The portion of the post which protrudes above the earth must be *squared* off sufficiently smooth to admit if receiving the marks thereon, to be made with appropriate marking irons, indicating what it stands for. Thus the sides of *township*

*The subdivision of the half-quarter section into quarter-quarter sections is authorized by "An act supplementary to the several laws for the sale of the public lands," approved April 5, 1832.

corner posts should square at least *four* inches, (the post itself being *five* inches in diameter,) and must protrude *two feet* at least above the ground; the sides of *section corner posts* must square at least *three inches*, (the post itself being *four* inches in diameter,) and protrude *two feet* from the ground; and the *quarter section corner posts* and *meander corner posts* must be *three* inches *wide*, presenting *flattened* surfaces, and protruding *two* feet from the ground.

Where a township post is a corner common to *four* townships, it is to be set *diagonally*, thus:

On each surface of the post is to be marked the number of the particular township, and its range, which it *faces*. Thus, if the post be a common boundary to four townships --- say *one* and *two*, south of the base line, of range *one*, west of the meridian; also to townships *one* and *two*, south of the base line, of range *two*, west of the meridian, it is to be marked thus:

From N. to E.	R. 1 W. T. 1 S. S. 31	from E. to S.	1 W. 2 S. 6
From N. to W.	2 W. 1 S. 36	from W. to S.	2 W. 2 S. 1

These marks are not only to be distinctly but *neatly* cut into the wood, at least the eighth of an inch deep; and to make them yet more *conspicuous* to the eye of the anxious explorer, the deputy must apply to all of them a *streak of red chalk*.

Section or mile posts, being corners of sections, and where such are common to *four* sections, are to be set *diagonally* in the earth, (in the manner provided for township corner posts;) and on each side of the squared surfaces (made smooth, as aforesaid, to receive the marks) is to be marked the appropriate *number* of the particular one of the *four sections*, respectively, which such side *faces;* also on one side thereof are to be *marked* the numbers of its *township* and *range;* and to make such marks yet more *conspicuous*, in manner aforesaid, a streak of *red chalk* is to be applied.

In every township, subdivided into thirty-six sections, there are twenty-five interior section corners, each of which will be *common* to *four* sections.

A quarter section, or half mile post, is to have no other mark on it than ¼ S., to indicate what it stands for.

NOTCHING CORNER POSTS.

Township corner posts, common to four townships, are to be notched with *six* notches on each of the four angles of the squared part set to the cardinal points.

All mile posts *on township lines* must have as many notches on them, on two opposite *angles* thereof, as they are miles distant from the town – ship corners respectively. Each of the posts at the corners of sections in the *interior* of a township must indicate, by a number of notches on each of its four corners directed to the cardinal points, the corresponding number of miles that it stands from the *outlines* of the township. The four sides of the post will indicate the number of the section they respectively *face*. Should a tree be found at the place of any corner, it will be marked and notched as aforesaid, and answer for the corner in lieu of a post, the kind of tree and its diameter being given in the field notes.

BEARING TREES.

The position of all corner posts, or corner trees, of whatever description, that may be established, is to be evidenced in the following manner, viz: From such post or tree the courses must be taken and the distances measured to two or more adjacent trees in opposite directions, as nearly as may be, and these are called “bearing trees.” Such are to be distinguished by a *smooth blaze*, with a *notch* at its lower end, facing the corner, and in the blaze to be marked the number of the *range, township,* and *section;* but at quarter section corners nothing but ¼ S. need be marked. The letters B. T. (bearing tree) are also to be marked upon a smaller blaze directly under the large one, and as near the ground as practicable.

At all township corners, and at all section corners, on range or township lines, *four* bearing trees are to be marked in this manner, one in each of the adjoining sections.

At interior section corners *four* trees, one to stand within each of the four sections to which such corner is common, are to be marked in manner aforesaid, if such be found.

A tree supplying the place of a corner post is to be marked in the manner directed for posts; but if such tree should be a beech, or other *smooth bark* tree, the marks may be made on the *bark*, and the tree notched.

From quarter section and meander corners two bearing trees are to be marked, one within each of the adjoining sections.

Where the requisite number of "bearing trees" is not to be found at convenient and suitable distances, such as are found are to be marked as herein directed; but in all such cases of deficiency in the number of bearing trees (unless, indeed, the boundary itself be *a tree*,) a *quadrangular trench*, with sides of *five* feet, and with the angles to the cardinal points, must be spaded up outside the corner, as a centre, and the earth carefully thrown on the inside, so as to form a range of earth, which will become covered with grass, and present a small square elevation, which in aftertime will serve to mark, unmistakably, the spot of the corner.

CORNER STONES.

Where it is deemed best to use STONES for boundaries, in lieu of posts, you may, at *any* corner, insert endwise into the ground, to the depth of 7 or 8 inches, a stone, the number of cubic inches in which shall not be less than the number contained in a stone 14 inches long, 12 inches wide, and 3 inches thick – equal to 504 cubic inches – the edges of which must be set north and south, on north and south lines, and east and west, on east and west lines; the dimensions of each stone to be given in the field notes at the time of establishing the corner. The kind of stone should also be stated.

MARKING CORNER STONES.

Stones at township corners, common to four townships, must have *six* notches, cut with a pick or chisel on each edge or side towards the cardinal points; and where used as section corners on the range and town – ship lines, or as section corners in the interior of a township, they will also be notched, to correspond with the directions given for notching posts similarly situated.

Posts or stones at township corners on the base and standard lines, and which are common to two townships on the north side thereof, will have *six* notches on each of the *west, north,* and *east* sides or edges; and where such stones or posts are set for corners to two townships *south* of the base or standard, *six* notches will be cut on each of the west, *south,* and east sides or edges.

Stones, when used for quarter section corners, will have ¼ cut on them – on the west side on north and south lines, and on the north side on east and west lines.

MOUNDS.

Whenever bearing trees are not found, mounds of earth, or stone, are to be raised *around posts* on which the corners are to be marked in the manner aforesaid. Wherever a mound of earth is adopted, the same will present a conical shape; but at its base, on the earth's surface, a *quadrangular trench* will be dug; by the "trench" (here meant) is to be understood a *spade deep* of earth thrown up from the four sides of the line, *outside* the trench, so as to form a *continuous elevation along its outer edge.* In mounds of earth, common to *four* townships or to *four* sections, they will present the *angles* of the quadrangular trench (*diagonally*) towards the cardinal points. In mounds common only to *two* townships or *two* sections, the sides of the quadrangular trench will *face* the cardinal points. The sides of the quadrangular trench at the base of a township mound are to be *six* feet, the height of the mound *three* feet.

At section, quarter section, and meander corners, the sides of the quadrangular trench at base of mounds are to be *five* feet, and the conical height *two and a half feet.*

Prior to piling up the earth to construct a mound, there is to be dug a spadefull or two of earth from the corner boundary point, and in the cavity so formed is to be deposited a *marked stone* or a portion of *charcoal*, (the quantity whereof is to be noted in the field book;) or in lieu of charcoal or marked stone, a *charred stake* is to be driven twelve inches down into such centre point: either of those will be a *witness* for the future, and whichever is adopted, the fact is to be noted in the field book.

When mounds are formed of *earth*, the spot from which the earth is taken is called the "*pit,*" the centre of which ought to be, wherever practicable, at a uniform distance and in a uniform direction from the centre of the mound. There is to be a "pit" on *each* side of every mound., distant eighteen inches outside of the trench. The trench may be expected hereafter to be covered by tufts of grass, and thus to indicate the place of the mound, when the mound itself may have become obliterated by time or accident.

At meander corners the "pit" is to be directly on the line, *eight links* further from the water than the mound. Whenever necessity is found for deviating from these rules in respect to the "pits," the course and distance to each is to be stated in the field books.

Perpetuity in the mound is a great desideratum. In forming it with light alluvial soil the surveyor may find it necessary to make due allowance for the future settling of the earth, and thus making the mound

more elevated than would be necessary in a more compact and tenacious soil, and increasing the base of it. In so doing, the relative proportions between the township mound and other mounds is to be preserved as nearly as may be.

The earth is to be pressed down with the shovel during the process of piling it up. Mounds are to be *covered* with sod, grass side up, where sod is to be had: but, in forming a mound, *sod* is NEVER to be *wrought up* with the earth, because sod decays, and in the process of decomposing it will cause the mound to become porous, and therefore liable to premature destruction.

POSTS IN MOUNDS

must show above the top of the mound ten or twelve inches, and be notched and marked precisely as they would be for the same corner without a mound.

MOUND MEMORIALS.

Besides the *charcoal*. marked *stone* or *charred stake*, one or the other of which must be lodged in the earth at the point of the corner, the deputy surveyor is recommended to plant *midway* between each pit and trench, seed of some trees, (those of fruit trees adapted to the climate being always preferred,) so that, in course of time, should such take root, a small clump of trees may possible hereafter note the place of the corner. The facts of planting such seed, and the kind thereof, are matters to be truthfully noted in the field book.

WITNESS MOUNDS TO TOWNSHIP OR SECTION CORNERS.

If a township or section corner, in a situation where bearing or witness trees are not found within a reasonable distance therefrom, shall fall within a ravine, or in any other situation where the nature of the ground, or the circumstances of its locality, shall be such as may prevent, or prove unfavorable to, the erection of a mound, you will perpetuate such corner by selecting in the immediate vicinity thereof a suitable plot of ground as a site for a bearing or *witness mound*, and erect thereon a mound of earth in the same manner and conditioned in every respect, with *charcoal*, or *charred stake* deposited beneath, as before directed; and measure and state in your field book the distance and course from the position of the true corner of the bearing or witness mound so placed and erected.

DOUBLE CORNERS.

Such corners are to be nowhere except on the base and standard lines, whereon are to appear both the corners which mark the intersections of the lines which close thereon, and those from which the surveys start on the north. On these lines, and at the time of running the same, the township, section, and quarter section corners are to be planted, and each of these is a corner common to *two*, (whether township or section corners,) on the north side of the line, and must be so marked.

The corners which are established on the standard parallel, at the time of running it, are to be known as "*standard corners*," and, in addition to all the *ordinary* marks, (as herein prescribed,) they will be marked with the letters S. C. Closing corners will be marked with the letters C. C. in addition to other marks.

The standard parallels are designed to be run *in advance* of the contiguous surveys on the south of them, but circumstances may exist which will *impede* or temporarily delay the *due* extension of the standard; and when, from uncontrollable causes, the *contiguous townships* must be surveyed in advance of the time of extending the standard, in any such event it will become the duty of the deputy who shall after- wards survey any such standard to plant thereon the *double set* of corners, to wit, the standard corners to be marked S. C., and the closing ones which are to be marked C. C.; and to make such measurements as may be necessary to connect the closing corners and complete the unfinished meridianal lines of such contiguous and prior surveys, on the principles herein set forth, under the different heads of "exterior or township lines," and of "diagram B."

You will recollect that the corners, (whether township or section corners,) which are *common* to *two*, (two townships or two sections) are not to be planted *diagonally* like those which are common to *four*, but with the flat sides facing the cardinal points, and on which the marks and notches are made as usual. This, it will be perceived, will serve yet more fully to distinguish the standard parallels from all other lines.

THE MEANDERING OF NAVIGABLE STREAMS.

1. Standing with the face looking *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 ariver* or stream.

*"a river" was printed as one word in the original document.

2. Both banks of *navigable* rivers are to be meandered by taking the courses and distances of their sinuosities, and the same are to be entered in the field book.

At those points where either the township or section lines intersect the banks of a navigable stream, POSTS, or, where necessary, MOUNDS of *earth* or *stone*, 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 on the township line, coursing the banks, and measuring the distance of each course from your commencing corner to the next "meander corner," upon the same or another boundary of the same township, carefully noting your intersection with all intermediate meander corners. 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 is to be ascertained by triangulation, in order that the river may be protracted with entire accuracy. The particulars to be given in the field notes.

3. You are also to meander, in manner aforesaid, all *lakes* and deep ponds of the area twenty-five acres and upwards; also navigable bayous; *shallow* ponds, readily to be drained, or likely to dry up, are not to be meandered.

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

4. 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 connexion 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.

5. In meandering lakes, ponds, or bayous, you are to commence at a meander corner upon the township line, and proceed as above directed for the banks of a navigable stream. But where a lake, pond, or bayou

lies entirely within the township boundaries, you will commence at a meander corner established in subdividing, and from thence take the courses and distances of the entire margin of the same, noting the intersection with all the meander corners preciously established thereon.

6. To meander a 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, you will establish a *witness* point, by fixing a post in the ground, and taking bearings to adjacent trees, or, if necessary, raising a mound.

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.

7. In taking the connexion 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 meander corner nearest to such island. 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.

The field notes of meanders will be set forth in the body of the field book according to the dates when the work is performed, as illustrated in the specimen notes annexed. They are to state and describe particularly the meander corner from which they commenced, each one with 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.

9. No blazes or marks of any description are to be made on the lines meandered between the established corners, but 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.

OF FIELD BOOKS.

The FIELD NOTES afford the elements from which the plats and calculations in relation to the public surveys are made. They are the source wherefrom the description and evidence of locations and boundaries are officially delineated and set forth. They, therefore must be a faithful, distinct and minute record of every thing officially done and observed by the surveyor and his assistants, pursuant to instructions, in relation to running, measuring, and marking lines, establishing boundary corners, &c.; and present, as far as possible, a full and complete *topographical description* of the country surveyed, as to every matter of useful information, or likely to gratify public curiosity.

There will be sundry separate and distinct field books of surveys, as follows:

Field notes of the MERIDIAN and BASE lines, showing the establishment of the *township, section* or mile, and *quarter section* or half mile, boundary corners thereon; with the crossings of streams, ravines, hills, and mountains; character of soil, timber, minerals, &c.

Field notes of the "STANDARD PARALLELS, or correction lines," will show the establishment of the township, section, and quarter section corner, besides exhibiting the topography of the country on line, as required on the base and meridian lines.

Field notes of the EXTERIOR lines of TOWNSHIPS, showing the establishment of corners on lines, and the topography, as aforesaid.

Field notes of the SUBDIVISIONS of TOWNSHIPS into sections and quarter sections.

The field notes must in all cases be taken precisely in the order in which work is done on the ground, and the *date* of each day's work must follow immediately after the notes thereof. The *variation of the needle* must always occupy a *separate line* preceding the notes of measurements on line.

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

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

Noabbreviations* of words are allowable, except of such words as are *constantly* occurring, such as "*sec.*" for "*section*;" "*in. diam.*," for

*"No abbreviations" was printed as one word in the original document.

"*inches diameter;*" "*chs.*" for "*chains;*" "*lks.*" for "*links;*" "*dist.*" for "*distance,*" &c. Proper names must never be abbreviated, however often their recurrence.

The nature of the subject-matter of the field book is to form its title page, showing the State or Territory where such survey lies, by whom surveyed, and the dates of commencement and completion of the work. The second page is to contain the names and duties of assistants, Whenever a new assistant is employed, or the duties of any one of them are changed, such facts, with the reasons therefor, are to be stated in an appropriate entry immediately preceding the notes taken under such changed arrangements. With the notes of the *exterior* lines of townships, the deputy is to submit a plat of the lines run, on a scale of two inches to a mile, on which are to be noted all the objects of topography on line necessary to illustrate the notes, viz: the distances 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 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 section lines on such boundaries whereon he is to close, the magnetic variation of each mile, and the particular description of each corner. P. in M. signifies post in mound. 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 points on line at which the same occur, but also the direction and position of each between the lines, or within each section, so that every object of topography may be properly completed or connected in the showing.

These notes must be distinctly written out, in language precise and clear. And their figures, letters, words, and meaning are always to be unmistakable. No leaf is to be cut or mutilated, and none is to be taken out, whereby suspicion might be created that the missing leaf contained matter which the deputy believed it in his interest to conceal.

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 (earth or stone) of which MOUNDS are constructed----the fact of their being conditioned according to instructions---- with the course and distance of the "*pits*," from the centre of the mound, where necessity exists for deviating from the *general* rule.

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 inter- section; 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 distance 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, or third 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 the depth of water, and whether it be pure or stagnant.

13. *Improvements*. Towns and villages; Indian towns and wigwams; houses or cabins' fields, or other improvements; sugar tree groves, sugar camps, mill seats, forges, and factories.

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 in 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 height of their fall in feet.

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

18. *Natural curiosities*, interesting fossils, petrifactions, organic remains, &c.; 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 memory,) the deputy will subjoin, at the conclusion of his book, such further description or information touching any matter or thing connected with the township (or other survey) which he may be able to afford, and may deem useful in the *aggregate*, as respects the face of the country, its soil and geological features, timber, minerals, waters, &c.

SWAMP LANDS.

By the act of Congress approved September 28, 1850, swamp and overflowed lands “unfit for cultivation,” are granted to the State in which they are situated. In order clearly to define the quantity and locality of such lands, the field notes of surveys, in addition to the other objects of topography required to be noted, are to indicate the points at which you enter all lands which are evidently subject to such grant, and to show the distinctive character of the land so noted; whether it is a swamp or marsh, or otherwise subject to inundation to an extent that, without artificial means, would render it “unfit for cultivation.” The depth of inundation is to be stated, as determined from indications on the trees where timber exists; and its frequency is to be set forth as accurately as may be, either from your own knowledge of the general

character of the stream which overflows, or from reliable information to be obtained from others. The words “unfit for cultivation” are to be employed in addition to the usual phraseology in regard to entering or leaving such swamps, marshy, or overflowed lands. It may be that sometimes the margin of bottom, swamp, or marsh, in which such uncultivable land exists, is not identical with the margin of the body of land “unfit for cultivation;” and in such cases a separate entry must be made for each opposite the marginal distance at which they respectively occur.

But in cases where lands are overflowed by *artificial* means, (say by dams for milling, logging, or for other purposes,) you are not officially to regard such overflow, but will continue your lines across the same without setting meander posts, stating particularly in the notes the depth of the water, and how the overflow was caused.

SPECIAL INSTRUCTION RESPECTING THE NOTING OF SETTLERS’ CLAIMS IN OREGON, WASHINGTON, AND NEW MEXICO.

The law requires that such claims should be laid down temporarily on the township plats; in order to do which, it is indispensably necessary to obtain, to some extent, connexions of these claims with the lines of survey. Under the head of “intersection by line of land objects,” the deputy is required to note the *points* in line *whereat* it may be intersected by such claims; but, in addition thereto, there must be obtained at least *one angle* of each claim, with its course and distance either from the point of intersection, or from an established corner boundary, so that its connexion with the regular survey will be legally determined. If the settler’s *dwelling* or barn is visible from line, the bearings thereof should be carefully taken from *two* points noted on line, and set forth in the field notes.

AFFIDAVITS TO FIELD NOTES.

At the close of the notes and the *general description* is to follow an affidavit, a form for which is given; and to enable the deputy surveyor fully to understand and appreciate the responsibility under which he is acting, his attention is invited to the provisions of the second section of the act of Congress, approved August 8th, 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 offence; 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."

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 noted of township No. ---------- of the BASE LINE of range No. ---------- of the --------- MERIDIAN, showing the respective capacities in which they acted."

FORM OF OFFICIAL OATHS TO BE TAKEN PRIOR TO ENTERING UPON DUTY.

For a deputy surveyor.

I, A. B., having been appointed a deputy surveyor of the lands of the United States in ---------, do solemnly swear (or affirm) that I will well and faithfully, and to the best of my skill and ability, execute the duties confided to me pusuant to a contract with C. D., surveyor general of public lands in -------, bearing date the --------- day of ---------, 185__, according to the laws of the United States and the instructions received from the said surveyor general.

(To be sworn and subscribed before a justice of the peace, or other officer authorized to administer oaths.)

For chainman.

I, E. F., do solemnly swear (or affirm) that I will faithfully execute the duties of chain carrier; that I will level the chain upon uneven ground, and plumb the tally pins, whether by sticking or dropping the

same; that I will report the true distance to all notable objects, and the true length of all lines that I assist in measuring, to the best of my skill and ability.

(To be sworn and subscribed as above.)

For flagman or axeman.

I, G. H., do solemnly swear (or affirm) that I will well and truly perform the duties of ----------, according to instructions given me, and to the best of my skill and ability.

(To be sworn and subscribed as above.)

EXTERIORS OR TOWNSHIP LINES.

The principal meridian, the base line and the standard parallels having been first run, measured, and marked, and the corner boundaries thereon established, according to instructions, the process of running, measuring, and marking the exterior lines of townships will be as follows:

Townships situated NORTH *of the base line, and* WEST *of the principal meridian.*

Commence at No. 1, (see figures on Diagram A,) being the southwest corner of T. 1 N.---R. 1 W., as established on the base line; thence north, on a true meridian line, four hundred and eighty chains, establishing the section and quarter section corners thereon, as per instructions, to No. 2, whereat establish the corner of Tps. 1 and 2 N.---Rs. 1 and 2 W.; thence east, on a random or trial line, setting *temporary* section and quarter section stakes, to No. 3, where measure and note the distance at which the line intersects the eastern boundary, north or south of the *true* or established corner. Run and measure westward, on the true line, (taking care to note all the land and water crossings, &c., as per instructions,) to No. 4 which is identical with No. 2, establishing the section and quarter section PERMANENT CORNERS on said line. Should it happen, however, that such random line falls short, or overruns in length, or intersects the eastern boundary of the township at more than three chains and fifty links distance from the *true* corner thereon, as compared with the corresponding boundary on the south, (either of which would indicate an important error in the surveying,) the lines must be *retraced*, even if found necessary to remeasure the meridianal

boundaries of the township, (especially the western boundary,) so as to discover and correct the error; in doing which, the *true corners* must be established and marked, and the *false ones* destroyed and obliterated, to prevent confusion in future; and *all the facts* must be distinctly set forth in the notes. Thence proceed in a similar manner from No. 4 to No. 5, No. 5 to No. 6, No. 6 to No. 7, and so on to No. 10, the south- west corner of T. 4 N.--- R. 1 W. Thence north, still on a true meridian line, establishing the mile and half-mile corners, until reaching the STANDARD PARALLEL or correction line; throwing the *excess* over, or *deficiency* under, *four hundred and eighty chains*, on the *last* half-mile, according to law, and at the intersection establishing the "CLOSING CORNER," the distance of which *from* the standard corner must be measured and noted as required per instructions. But should it ever so happen that some impassable barrier will have prevented or delayed the extension of the standard parallel along and above the field of present survey, then the deputy will plant, in place, the corner for the township, subject to correction thereafter, should such parallel be extended.

NORTH *of the base line, and* EAST *of the principal meridian.*

Commencing at No. 1, being the *southeast* corner of T. 1 N.---R. 1 E., and proceed as with townships situated "north and west," except that the *random* or trial lines will be run and measured *west*, and the *true* lines east, throwing the excess over or deficiency under four hundred and eighty chains on the *west end* of the line, as required by law; wherefore the surveyor will commence his measurement with the length of the deficient or excessive half section boundary on the west of the township, and thus the remaining measurements will all be *even* miles and half- miles.

METHOD OF SUBDIVIDING

1. The first mile, both of the 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 change that may have taken place in the magnetic variation, as it existed at the time of running the township lines, and will also enable you to compare your chaining with that upon the township lines.

2. Any discrepancy, arising either from a change in the magnetic variation or a difference in measurement, is to be carefully noted in the field notes.

3. After adjusting your compass to a variation which you have thus found will retrace the eastern boundary of the township, you will commence at the corner to sections 35 and 36, on the south boundary, and run a line due north, forty chains, to the quarter section corner which you are to establish, between sections 35 and 36; continuing due north forty chains further, 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, *due east*, for the corner of sections 25 and 36, in 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 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, 36, run due north 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, 26. Then run a random *due east* for the corner of sections 24 and 25 in east boundary; setting temporary quarter corner 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 section 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 line of the township, which you will reach in running up a random line between sections 1 and 2. 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 south to the corner from which your random started. Where the closing corner is on a base or standard line, a deviation from the general rule is explained under the head of “Diagram B.”

7. The first tier of sections being thus laid out and surveyed, you will return to the south boundary of the township, and from the corner of sections 34 and 35 commence and survey the second tier of sections in the same manner that you pursued in the survey of the first, closing at the section corners on the first tier.

8. 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 this tier, you are to run random lines to the corresponding corners established upon the range line forming the western boundary of the township; setting, as you proceed, each *temporary* quarter section post at forty chains from the interior section corner, so as to throw the excess or deficiency of measurement on the extreme tier of quarter section contiguous to the township boundary; and, on returning, establish the *true* line, and establish thereon the *permanent* quarter section corner.

QUARTER SECTION CORNERS, both upon the 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.

Every north and south section line, except those terminating in the north boundary of the township, is to be eighty chains in length. The east and west section lines, except those terminating on the west boundary of the township, are to be within one hundred links of eighty chains in length; and the north and south boundaries of any one section, except in the extreme western tier, are to be within one hundred links of equal length. The meanders within each fractional section, or between any two meander posts, or of a pond or island in the interior of a section, must close within one chain and fifty links.

DIAGRAM A illustrates the mode of laying off township exteriors north of the BASE line and EAST and WEST of the principal MERIDIAN, whether between the base and first standard, or between any two standards; and the same general principles will equally apply to townships *south* of the base line and east and west of the meridian, and between any two standards *south*, where the distances between the base and the first standard, and between the standards themselves, are five townships or thirty miles.

DIAGRAM B indicates the mode of laying off a TOWNSHIP into sections and quarter sections, and the accompanying set of field notes (marked B) critically illustrate the mode and order of conducting the survery* under every variety of circumstance shown by the topography on the diagram. In townships lying *south* of and *contiguous* to the base or to any standard parallel, the lines between the northern tier of sections will be run *north*, and be made to close as *true* lines; quarter section corners will be set at forty chains, and section corners established at the intersection of such section lines with the base or standard, (as the case may be,) and the distance is to be measured and entered in the field book to the nearest corner on such standard or base.

DIAGRAM C illustrates the mode of making mounds, stake, or stone corner boundaries for townships, sections, and quarter sections.

The mode and order of surveying the *exterior* boundaries of a township are illustrated by the specimen field notes marked A; and the mode and order of *subdividing* a township into sections and quarter sections are illustrated by the specimen field notes marked B. 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, &c., 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 analogous in practice, *will be regarded as a violation of his contract and oath.*

The subdivisions of fractional sections into forty acre lots, (as near as may be,) are to be so laid down on the official township plat in *red* lines, as to admit of giving to each a specific designation, if possible according to its relative position in the fractional section, as per examples afforded by diagram B, as well as by number, in all cases where the lot cannot 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; No. 1 being (wherever practicable, and as a general rule) either the northeastern or the most easterly fractional lot, and proceeding from east to west and from west to east, alternately, to the end of the series; but such general rule is departed from under circumstances given as examples in fractional section 4, 7, 19 and 30, where No. 1 is the interior lot of the northern and western tiers of the quarter sections to which there is a corresponding No. 2 given to the exterior lot, and the series num-

*survey misspelled in the original document

bers is in continuation of the latter, The lots in the extreme northern and western tiers of quarter sections, containing either more or less than the regular quantity, are always to be numbered as per example, Interior lots in such extreme tiers are to be *twenty* chains wide, and the excess or deficiency of measurement is always to be thrown on the exterior lots; elsewhere, the assumed subdivisional corner will always be a point equidistant from the established corners.

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 B," 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 district office, and the third to be retained as the record in the office of the Surveyor General.

The original 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.

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 characterand* quality of the soil and timber found on and in the vicinity of each surveyed line, and giving a description of each corner boundary.

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. There is shown a series of meander corners on diagram B, viz: from No. 1 No. 22, on the river and islands; 23 to 28 being on Island lake; 29 and 30 on Clear lake; and 31 and 32 on lake in section 26.

There is also a distinct series of numbers, 1 to 7, to designate corners D. Reed's private survey, and to fractional sections, made such thereby; and the same series is continued from 8 to 14 inclusive, to

*"character and" printed as one word in original document.

designate corners to S. Williams's private survey, and to fractional sections made such thereby. These are numberings on a plat merely for the purpose of ready reference to the descriptions of such corners to be furnished to the registers.

The *letters* on "diagram B," at the "corners" on the township boundaries, are referred to in the descriptive notes to be furnished to the district land office, but are not required to be inserted on the official plat to be returned to the General Land Office.

The following chapter, on the subject of the variation of the magnetic needle, is extracted from the revised edition of the work on surveying by CHARLES DAVIES, L. L. D., and 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 modes by which the variation may be ascertained.

VARIATION OF THE NEEDLE.

1. The angle which the magnetic meridian makes with the true meridian, at any place on the surface of the earth, is called the *variation of the needle* at that place, and is east or west, according as the north end of the needle lies on the east or west side of the true meridian.

2. The variation is different at different places, and even at the same place it does not remain constant for any length of time. The variation is ascertained by comparing the magnetic with the true meridian.

3. If we suppose a line to be traced through those points on the surface of the earth, where the needle points directly north, such a line is called the *line of no variation*. At all places lying on the east of this line, the variation of the needle is west; at all places lying on the west of it, the variation is east.

4. The public is much indebted to Professor Loomis for the valuable results of many observations and much scientific research on the dip and variation of the needle, contained in the 39th and 42d volumes of Silliman's Journal.

The variation at each place was ascertained for the year 1840; and by a comparison of previous observations and the application of known formulas, the annual motion, or change in variation, at each place, was also ascertained, and both are contained in the tables which follow.

5. If the annual motion was correctly found, and continues uniform, the variation at any subsequent period can be ascertained by simply multiplying the annual motion by the number of years, and adding the product, in the algebraic sense, to the variation in 1840. It will be observed that all variations west are designated by the plus sign; and all variations east, by the minus sign. The annual motions being all west, have all the plus sign.

6. Our first object will be to mark the line, as it was in 1840, of *no variation*. For this purpose, we shall make a table of places lying near this line.

PLACES NEAR THE LINE OF NO VARIATION.

Place.	Latitude.	Longitude.	Variation.	An. Motion.
A Point	40° 53′	80° 13′	0° 00′	+ 4′.4
Cleveland, Ohio	41 31	81 45	— 0 19	4.4
Detroit, Mich.	42 24	82 58	— 1 56	4
Mackinaw	45 51	84 41	— 2 08	3.9
Marietta, Ohio	39 30	81 28	— 1 24	4.3
Charlottesville, Va.	39 02	78 30	+ 0 19	3.7
Charleston, S. C.	32 42	80 04	— 2 44	1.3

At the point whose latitude is 40° 53', longitude 80° 13', the variation of the needle was nothing in the year 1840, and the direction of the line of no variation, traced north, was N. 24° 35' west. The line of no variation, prolonged, passed a little to the east at Cleveland, in Ohio---the variation there being 19 minutes east. Detroit lay still further to the west of this line, the variation there being 1° 56' east; and Mackinaw still further to the west, as the variation at that place was 2° 08' east.

The course of the line of no variation, prolonged southerly, was S. 24° 35' E. Marietta, Ohio, was west of this line----the variation there being 1° 24' east. Charlottesville, in Virginia, was a little to the east of it----the variation there being 19' west; whilst Charleston, in South Carolina, was on the west---the variation there being 2° 44' east.

From these results, it will be very easy see about where the line of no variation is traced in our own country.

7. We shall give two additional tables:

PLACES WHERE THE VARIATION WAS WEST.

Place.	Latitude.	Longitude.	Variation.	An. Motion.
A Point	40° 53′	80° 13′	0° 00′	+ 4′.4
Cleveland, Ohio	41 31	81 45	— 0 19	4.4
Detroit, Mich.	42 24	82 58	— 1 56	4
Mackinaw	45 51	84 41	— 2 08	3.9
Marietta, Ohio	39 30	81 28	— 1 24	4.3
Charlottesville, Va.	39 02	78 30	+ 0 19	3.7
Charleston, S. C.	32 42	80 04	— 2 44	1.3

PLACES WHERE THE VARIATION WAS EAST.

Places.	Latitude.	Longitude.	Variation.	An. Motion.
Mouth of Columbia River . .	46° 12′	123° 30′	21° 40′	Unknown.
Jacksouville, Ill.	39 43	90 20	8 28	+ 2′.5
St. Louis, Mo.	38 37	90 17	8 37	2.3
Nashville, Tenn.	36 10	86 52	6 42	2
Louisiana, at	29 40	94 00	8 41	1.4
Mobile, Ala.	30 42	88 16	7 05	1.4
Tuscaloosa, Ala.	33 12	87 43	7 26	1.6
Columbus, Geo.	32 28	85 11	5 28	2
Milledgeville, Geo.	33 07	83 24	5 07	2.4
Savannah, Geo.	32 05	81 12	4 13	2.7
Tallahassee, Fla.	30 26	84 27	5 03	1.8
Pensacola, Fla.	30 24	87 23	5 53	1.4
Logansport, Ind.	40 45	86 22	5 24	2.7
Cincinnati, Ohio	39 06	84 27	4 46	3.1

METHODS OF ASCERTAINING THE VARIATION.

8. 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, it per-forms a revolution about the pole in a circle, the polar distance of which is 1° 30': the time of the revolution is 23 h. and 56 min.

To the eye of the observer, this star is continually in motion, and is due north but twice in 23 h. 56 min.; and is then said to be on the meridian. Now, when it departs from the meridian, it apparently moves east or west, for 5 h. and 59 min., 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 greatest *eastern* or *western* elongation.

The following tables show the times of its greatest eastern and western elongations.

EASTERN ELONGATIONS.

Days.	April.	May.	June.	July.	August.	Sept.
	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.
1	18 18	16 26	14 24	12 20	10 16	8 20
7	17 56	16 03	14 00	11 55	9 53	7 58
13	17 34	15 40	13 35	11 31	9 30	7 36
19	17 12	15 17	13 10	11 07	9 08	7 15
25	16 49	14 53	12 45	10 43	8 45	6 53

WESTERN ELONGATIONS.

Days.	Oct.	Nov.	Dec.	Jan.	Feb.	March.
	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.
1	18 18	16 22	14 19	12 02	9 50	8 01
7	17 56	15 59	13 53	11 36	9 26	7 38
13	17 34	15 35	13 27	11 10	9 02	7 16
19	17 12	15 10	13 00	10 44	8 39	6 54
25	16 49	14 45	12 34	10 18	8 16	6 33

The eastern elongations are put down from the first of April to the first of October; and the western, from the first of October to the first of April; the time is computed from 12 at noon. The western elongations in the first case, and the eastern in the second, occurring in the daytime, cannot be used. Some of those put down are also invisible, occurring in the evening, before it is dark, or after daylight in the morning. In such case, if it be necessary to determine the meridian at that particular season of the year, let 5h. and 59 m. be added to, or subtracted from, the time of greatest eastern or western elongation, and the observation be made at night, when the star is on the meridian.

9. The following table exhibits the angle which the meridian plane makes with the vertical plane passing through the pole-star, when at its greatest eastern or western elongation: such angle is called the *azimuth*. The mean angle only is put down, being calculated for the first of July of each year:

AZIMUTH TABLE.

Year.	Lat. 32° Azimuth.	Lat. 34° Azimuth.	Lat. 36° Azimuth.	Lat. 38° Azimuth.	Lat. 40° Azimuth.	Lat. 42° Azimuth.	Lat. 44° Azimuth.
1851	1° 45½′	1° 48′	1° 50½′	1° 53½′	1° 56¾′	2° 00½′	2° 04½′
1852	1° 45′	1° 47½′	1° 50′	1° 53′	1° 56¼′	1° 59¾′	2° 03¾′
1853	1° 44½′	1° 47′	1° 49¾′	1° 52½′	1° 55¾′	1° 59½′	2° 03½′
1854	1° 44¼′	1° 46½′	1° 49¼′	1° 52′	1° 55¼′	1° 59′	2° 02¾′
1855	1° 43¾′	1° 46¼′	1° 48¾′	1° 51¾′	1° 54¾′	1° 58½′	2° 02¼′
1856	1° 43¼′	1° 45¾′	1° 48¼′	1° 51¼′	1° 54½′	1° 58′	2° 01¾′
1857	1° 43′	1° 45¼′	1° 48′	1° 50¾′	1° 54′	1° 57½′	2° 01¼′
1858	1° 42½′	1° 44¾′	1° 47½′	1° 50¼′	1° 53½′	1° 57′	2° 00¾′
1859	1° 42′	1° 44½′	1° 47′	1° 49¾′	1° 53′	1° 56½′	2° 00¼′
1860	1° 41¾′	1° 44′	1° 46½′	1° 49½′	1° 52½′	1° 56′	2° 00′
1861	1° 41¼′	1° 43¾′	1° 46¼′	1° 49′	1° 52¼′	1° 55¾′	1° 59½′

The use of the above tables, in finding the true meridian, will soon appear.

TO FIND THE TRUE MERIDIAN WITH THE THEODOLITE.

10. Take a board, of about one foot square, paste white paper upon it, and perforate it through the centre: the diameter of the hole being somewhat larger than the diameter of the telescope of the theodolite. Let this board be so fixed to a vertical staff as to slide up and down freely; and let a small piece of board, about three inches square, be nailed to the lower edge of it, for the purpose of holding a candle.

About twenty-five minutes before the time of the greatest eastern or western elongation of the pole-star as shown by the tables of elongations, let the theodolite be placed at a convenient point and levelled. Let the board be placed about one foot in front of the theodolite, a lamp or candle placed on the shelf at its lower edge; and let the board be slipped up or down, until the pole-star can be seen through the hole. The light reflected from the paper will show the cross hairs in the telescope of the theodolite.

Then, let the vertical spider's line be brought exactly upon the pole-star, and, if it is an eastern elongation that is to be observed, and the star has not reached the most easterly point, it will move from the line towards the east, and the reverse when the elongation is west.

At the time the star attains its greatest elongation, it will appear to coincide with the vertical spider's line for some time, and then leave it, in the direction contrary to its former motion.

As the star moves towards the point of its greatest elongation, the telescope must be continually directed to it, by means of the tangent-screw of the vernier plate; and when the star has attained its greatest elongation, great care should be taken that the instrument be not afterward moved.

Now, if it be not convenient to leave the instrument in its place until daylight, let a staff, with a candle or small lamp upon its upper extremity, be arranged at thirty or forty yards from the theodolite, and in the same vertical plane with the axis of the telescope. This is easily effected, by revolving the vertical limb about its horizontal axis without moving the vernier plate, and aligning the staff to coincide with the vertical hair. Then mark the point directly under the theodolite; the line passing through this point and the staff, makes an angle with the true meridian equal to the azimuth of the pole-star.

From the table of azimuths, take the azimuth corresponding to the year and nearest latitude. If the observed elongation was east, the true meridian lies on the west of the line which has been found, and makes

with it an angle equal to the azimuth. If the elongation was west, the true meridian lies on the east of the line; and, in either case, laying off the azimuth angle with the theodolite, gives the true meridian.

TO FIND THE TRUE MERIDIAN WITH THE COMPASS.

11. 1. Drive two posts firmly into the ground, in a line nearly east and west; the uppermost ends, after the posts are driven, being about three feet above the surface, and the posts about four feet apart: then lay a plank, or piece of timber three or four inches in width, and smooth on the upper side, upon the posts, and let it be pinned or nailed, to hold it firmly.

2. Prepare a piece of board four or five inches square, and smooth on the under side. Let one of the compass-sights be placed at right angles to the upper surface of the board, and let a nail be driven through the board, so that it can be tacked to the timber resting on the posts.

3. At about twelve feet from the stakes, and in the direction of the pole-star, let a plumb be suspended from the top of an inclined stake or pole. The top of the pole should be of such a height that the pole star will appear about six inches below it; and the plumb should be swung in a vessel of water to prevent it from vibrating.

This being done, about twenty minutes before the time of elongation, place the board, to which the compass sight is fastened, on the horizontal plank, and slide it east or west, until the aperture of the compass-sight, the plumb-line, and the star, are brought into the same range. Then if the star depart from the plumb-line, move the compass-sight east or west along the timber, as the case may be, until the star shall attain its greatest elongation, when it will continue behind the plumb-line for several minutes, and will then recede from it in the direction contrary to its motion before it became stationary. Let the compass-sight be now fastened to the horizontal plank. During this observation it will be necessary to have the plumb-line lighted: this may be done by an assistant holding a candle near it.

Let now a staff, with a candle or lamp upon it, be placed at a distance of thirty or forty yards from the plumb-line, and in the same direction with it and the compass-sight. The line so determined makes, with the true meridian, an angle equal to the azimuth of the pole-star; and from this line the variation of the needle is readily determined, even without tracing the true meridian on the ground.

Place the compass upon this line, turn the sights in the direction of it, and note the angle shown by the needle, Now, if the elongation, at

the time of observation, was west, and the north end of the needle is on the west side of the line, the azimuth, plus the angle shown by the needle, is the true variation. But should the north end of the needle be found on the east side of the line, the elongation being west, the difference between the azimuth and the angle would show the variation, and the reverse when the elongation is east.

1. Elongation west, azimuth - - - -	2° 01’
North end of the needle on the west, angle -	4° 06’
Variation - - -	6° 10’ west
2. Elongation west, azimuth - - - -	1° 59’
North end of the needle on the east, angle -	4° 50’
Variation - - -	2° 51’ east
3. Elongation east, azimuth - - - -	2° 05’
North end of the needle on the west, angle -	8° 30’
Variation - - -	6° 25’ west
4. Elongation west, azimuth - - - -	1° 57’
North end of the needle on the west, angle -	8° 40’
Variation - - -	10° 37’ east

Remark I. The variation at West point, in September, 1835, was 6° 32’ west.

Remark II. The variation of the needle should always be noted on every survey made with the compass, and then if the land be surveyed at a future time, the old lines can always be re-run.

12. It has been found by observation, that heat and cold sensibly affect the magnetic needle, and that the same needle will, at the same place, indicate different lines at different hours of the day.

If the magnetic meridian be observed early in the morning, and again at different hours of the day, it will be found that the needle will continue to recede from the meridian as the day advances, until about the time of the highest temperature, when it will begin to return, and at evening will make the same line as in the morning. This change is called the *diurnal variation*, and varies, during the summer season, from one-fourth to one-fifth of a degree.

13. A very near approximation to a true meridian, and consequently to the variation, may be had, by remembering that the pole-star very nearly reaches the true meridian, when it is in the same vertical plane with the star Alioth in the tail of the Great Bear, which lies nearest the four stars forming the quadrilateral.

The vertical position can be ascertained by means of a plumb-line. To see the spiders lines in the field of the telescope at the same time with the star, a faint light should be placed near the object-glass. When the plumb-line, the star Alioth, and the north star, fall on the vertical spider's line, the horizontal limb is firmly clamped, and the telescope brought down to the horizon; a light, seen through a small aperture in a board, and held at some distance by an assistant, is then moved according to signals, until it is covered by the intersection of the spider's lines. A picket driven into the ground, under the light, serves to mark the meridian line for reference by day, when the angle formed by it and the magnetic meridian may be measured.