TECHNOLOGY QUARTERLY

AND

PROCEEDINGS OF THE SOCIETY OF ARTS.

VOL. XII. DECEMBER, 1899. No. 4.

THE RECTANGULAR SYSTEM OF UNITED STATES PUBLIC LAND SURVEYING.

BY CHARLES L. DU BOIS, C. E., CHIEF OF DIVISION OF PUBLIC SURVEYS, GENERAL LAND OFFICE.

IT is a well known fact that among civil engineers of this country the theory and practice of public land surveying is not thoroughly understood, and the admirable features of the rectangular method have not received the recognition they deserve.

In the bulky volumes of the great trigonometrical survey of India, which work was accomplished many years ago at an expenditure of years of labor and thousands of pounds sterling, we see an accurate record of a magnificent scientific achievement, the result of which has been that that far-off region is faithfully mapped and monumented for future generations, and the configuration of such a vast territory so clearly determined as to have a bearing upon the ascertainment of the exact shape of the globe itself. Such a result is valuable for scientific and strategical purposes, but has not the economic uses of our public land survey system.

In the public domain of our country a plan, which became the law, was devised by a Committee of the Continental Congress, headed by Thomas Jefferson, whereby the unoccupied and unappropriated land could be so divided up as to enable settlers to obtain equitable portions of the land, and so fix and determine the boundaries of the smallest tract that no confusion or conflict would arise. The wisdom

of this plan is made manifest every day. Over the great plains and rich valleys, as well as the rugged sides of the Rockies, there are symmetrical squares of land definitely and accurately described, not by metes and bounds, but by location, which contain forty, eighty, and one hundred and sixty acre tracts, the homes of the millions now domiciled, and the countless numbers yet to come, upon the vast domain which fifty years ago was an unbroken wilderness inhabited by red men and buffaloes. This plan has been modified and improved by various acts of Congress, but the inceptional design has not been changed.

A few years ago our Canadian brethren found themselves confronted by the problem of dividing up their own extensive territory in preparation for the settlement by the constantly increasing squatters in the British Possessions; and it was a high compliment to the rectangular system of United States public land surveys when they adopted practically our methods. To be sure, there were one or two so-called improvements made by them, but they are minor changes, and their utility has been questioned by experts.

The *United States Coast and Geodetic Survey* has charge of the survey of the Atlantic, Gulf, and Pacific coasts of this country, including the coasts of Alaska, the survey of rivers to the head of tide-water or ship navigation; deep-sea soundings, temperature and current observations along the said coasts and throughout the Gulf Stream and Japan Stream flowing off from them; magnetic observations and gravity researches, determinations of heights by geodetic leveling, and of geographical positions by lines of transcontinental triangulation which, with other connecting triangulations and observations for latitude, longitude, and azimuth, furnish points of reference for State surveys and connect the work on the Atlantic coast with that on the Pacific.

The *United States Geological Survey* has charge of the classification of the public lands and examination of the geological structure, mineral resources, and products of the national domain, and of survey of boundaries of forest reserves.

The *Hydrographic Survey* under the Department of the Navy is engaged upon the preparation of maps of foreign coasts and harbors for the use of our navigators.

The *Nautical Almanac* office, under the same department, prepares valuable tables and formulæ showing right ascensions, declinations, occultations of the heavenly bodies, for use of navigators and for gen-

eral scientific use in surveying operations demanding astronomical observations.

Upon the Commissioner of the General Land Office devolves the important duty of carrying forward the public land surveys, and under him the direction of the work is entrusted to the Division of Public Surveys of that office.

The surveying is done principally under contract with experienced engineers who are called deputy surveyors. In each of the surveying districts of the West, viz., Arizona, California, Nevada, Oregon, Washington, Idaho, Utah, New Mexico, Colorado, Montana, Wyoming, North Dakota, South Dakota, Minnesota and Alaska, a Surveyor General is appointed by the President, with authority to make contracts for surveys, subject to the approval of the Commissioner of General Land Office. He has in his office clerks and draftsmen who prepare the finished returns for transmittal to Washington. The sum of $325,000 is annually appropriated by Congress to pay for the surveys, which is exclusive of the amounts set apart by Congress for the salaries and expenses of the Surveyors General and their corps of clerks.

The Rectangular System.

"Existing law requires that in general the public lands of the United States 'shall be divided by north and south lines run according to the true meridian, and by others crossing them at right angles so as to form townships 6 miles square,' and that the corners of the townships thus surveyed 'must be marked with progressive numbers from the beginning.'

"Also, that the townships shall be subdivided into thirty-six sections, each of which shall contain 640 acres, as nearly as may be, by a system of two sets of parallel lines, one governed by true meridians and the other by parallels of latitude, the latter intersecting the former at right angles, at intervals of a mile.

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

"Therefore, to conform the meridional township lines to the true meridians, produces townships of a trapezoidal form which do not contain the precise area of 23,040 acres required by law, and which dis-

crepancy increases with the increase in the convergency of the meridians, as the surveys attain the higher latitudes.

"In view of these facts, and under the provisions of Section 2 of the Act of May 18, 1796, that sections of a mile square shall contain 640 acres *as nearly as may be*, the public lands of the United States are surveyed under the methods of the system of rectangular surveying, which harmonizes the incompatibilities of the requirements of law and practice, as follows:

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

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

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

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

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

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

"Standard parallels are 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 meridians, thus confin-

ing the errors resulting from convergence of meridians and inaccuracies in measurement within comparatively small areas." — *Manual of Surveying Instructions, 1894.*

How Public Land Surveys are Initiated.

In order to obtain a survey of public land, application is made to the Surveyor General of the district where the lands are situated, by settlers, at least three for every tract 6 miles square, whose petition must set forth that they are *bona fide* settlers, and that they have made valuable improvements. The Surveyor General forwards the petition to the General Land Office at Washington and asks for authority to contract for a survey of the land. If the application be properly supported, the Surveyor General is instructed to take the necessary steps to have the survey made.

If there appear to be involved the payment of the minimum or intermediate rates, which are hereinafter explained, the Surveyor General can at once enter into contract with a reputable surveyor to be selected by him, for an amount of work not to exceed $5,000, which is estimated to be the maximum that one surveyor can absorb in a surveying season. No sub-letting of contracts is allowed. This limit can be increased to $8,000, which amount is allowed two surveyors in a *joint* contract.

Should the character of the proposed survey involve the maximum rates, the Surveyor General is required to invite proposals and competitive bids from reliable and experienced surveyors, and advertisements are inserted in local papers, showing the estimated amount and description of the survey. Where the surveyor is unknown to the General Land Office, he is required to file evidence of his qualifications to complete the work.

Where no competitive bids are required, the contracts are prepared and forwarded to the Commissioner of the General Land Office for his approval, but where bids are submitted, they are all sent to the Commissioner by the Surveyor General, with a recommendation as to the lowest bidder.

The Commissioner transmits the bids to the Secretary of the Interior, who alone has authority to allow the increased rates, and after the latter has granted permission to allow the rates and approved the selection of the bidder, the Commissioner instructs the Surveyor General to award the contract. This contract must, however, receive

official sanction by the Commissioner before the work can be entered upon.

Contracts always specify the exact number of miles to be run, and the rates to be allowed for the classes of lines. Of course it is impossible to estimate in advance, how much of the survey will be obstructed and rendered difficult by the lands being heavily timbered, or mountainous, and the complete field notes of the work are necessary to show this.

It will be observed by the practical surveyor that here is an opportunity for impositions to be practiced upon the government, for a line may be returned as exceptionally difficult to survey, when in fact it is unobstructed by any natural obstacles. However, by the system of inspections to be hereafter described, such frauds are detected. Deputies who have been found making false statements as to difficulties encountered or in respect to evidences of surveys are disbarred from future work under the government.

Rates for Contract Surveys.

The payment for surveys made under contract is in accordance with the provisions of annual appropriations by Congress for surveys and resurveys of public lands. The rates are thus fixed by Congressional enactment and do not change from year to year. Surveyors are allowed a compensation by the mile for each mile actually run and marked in the field.

Twenty-five years ago the rates were greater than at present, for obvious reasons. Difficulties attending transportation of supplies and higher prices for provisions and equipment, made the surveyor's profit about equal to the present time.

In fixing the rates, allowance was made for increased difficulties encountered by the surveyor in establishing lines in a mountainous region, and the more important lines requiring greater care to establish were rated higher than subdivisional lines.

There are now nine classes of rates as follows:

Minimum Rates.

For surveys and resurveys of lands offering no obstruction to the surveyor, such as in prairie country.

$5.00 per mile for section lines.
7.00 per mile for township lines.
9.00 per mile for standard and meander lines.

FIG. 1. — U. S. DEPUTY SURVEYOR.
Showing bearing tree and quarter-section post.

Intermediate Rates.

For surveys and resurveys of lands heavily timbered, mountainous, or covered with dense undergrowth.

$7.00 per mile for section lines.
11.00 per mile for township lines.
13.00 per mile for standard, base, and meander lines.

Maximum Rates.

For surveys and resurveys of lands exceptionally difficult to survey where the intermediate rates can not be contracted for.

$12.00 per mile for section lines.
15.00 per mile for township and range lines.
18.00 per mile for standard, base, and meander lines.

Special Maximum Rates.

Allowed only in States and Territories west of and embracing the Rocky Mountains, for the survey and resurvey of lands heavily timbered, mountainous, or covered with dense undergrowth.

$20.00 per mile for section lines.
23.00 per mile for township lines.
25.00 per mile for standard, base, and meander lines.

The above presents a good idea of the grading of the rates paid contractors.

In certain States, such as California, surveys may be contracted for at a *per diem* compensation, the contract fixing the limit of the liability. This is to provide for surveys which cannot be contracted for at the mileage rates, such as small groups of surveys remote from lines of travel. Contracts are made for such work at $25.00 to $40.00 per day, the total cost not to exceed a certain sum.

Corner Monuments.

There are over one hundred varieties of corners prescribed for marking the lines of public land surveys. This seems at first glance to be a rather cumbrous system, but it is the result of an attempt to differentiate the classes of lines and to conform to the conditions found upon the tract surveyed, the desiderata being to plant the most durable monuments without imposing upon the government the cost of transporting materials over great distances.

The great variety is accounted for as follows:

The surveyor is required to establish one of eight kinds of corners, varying according to the character of the ground, and the practicability of securing materials at the points determined, viz.:

First, the *stone corner with pits and mound of earth.* This corner is placed in a cleared space where the earth can be removed.

Second, the *stone corner with mound of stone.* This is placed in open country, in rocky soil where pits are impracticable.

When the point for corner comes in timber, the

Third kind is established: a *stone with bearing trees.*

This corner is considered the best and most durable of all corners. In regions where stone does not abound there is placed the

Fourth kind of corner, which is a *post with pits and mound of earth*, placed in open spaces, but, if corner point come in timber, there is placed the

Fifth kind: a *post with bearing trees.*

If, however, nothing is obtainable with which to make suitable post, and the surveyor is unable to ship to the point proper material, he is allowed to establish the

Sixth kind: a *mound of earth with deposit and stake in pit.*

This corner is considered to be inferior to any other, as its perpetuity is dependent upon its memorials placed under the mound and the small stake in pit. It sometimes happens that a tree is found at the precise point for corner, in which case the

Seventh kind is established. That is, the tree is marked and suitably witnessed by pits and mound of earth, and if the tree is in the midst of others, the

Eighth kind of corner is established, involving the marking of bearing trees.

Differentiation of Corners.

The above described corners comprise those which must be built contingent upon prescribed conditions; they are easily remembered and involve no complications, but the surveyor has something more to learn beside the marking, size, shape, and limits of the above; he must *vary these corners* according to the class of lines he is engaged upon surveying.

There are thirteen classes of corners which govern the kind of monuments. They are:

Standard township corners.
Closing township corners.
Corners common to four townships.
Corners common to two townships.
Corners referring to one township.
Meander corners.

Standard section corners.
Closing section corners.
Corners common to four sections.
Corners common to two sections.
Corners referring to one section.
Quarter section corners.

Reservation corners.

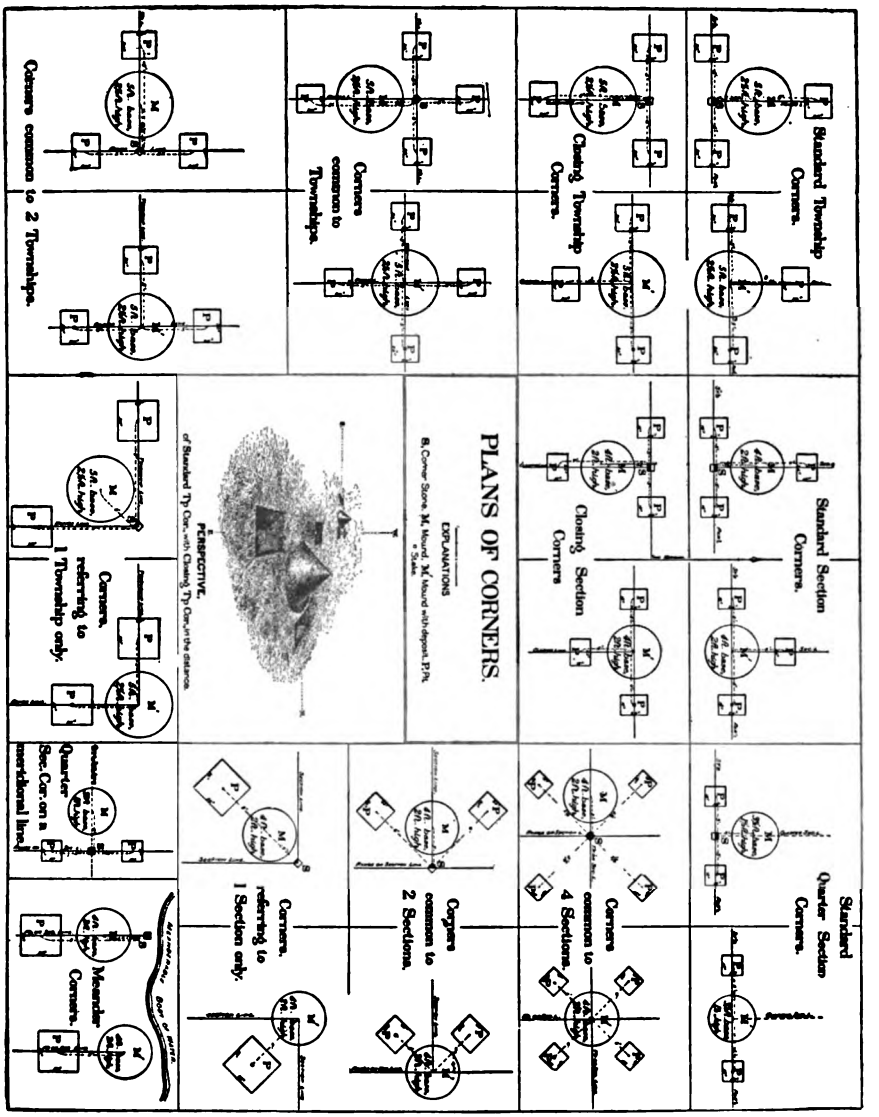

FIG. 2.—GROUND PLANS OF CORNERS OF U. S. PUBLIC LAND SURVEYS.

Now if each monument must have an appropriate size and shape, and the pits be placed differently for each one of the thirteen classes, it follows that the surveyor must be familiar with the construction of 104 kinds of corners in order to be properly equipped for his duties.

In examining candidates for the position of inspector of contract surveys of public lands, it has been found practically impossible to obtain surveyors possessing the necessary qualifications among those who have never been in the field either as deputy surveyors or as chainmen with examiners of surveys.

To young engineers who have in view the undertaking of this kind of surveying I would say, engage as a subordinate in a surveying party for a season and learn thus the conditions peculiar to the work of running lines of public surveys.

Base Lines and Standard Parallels.

It will be at once observed that these lines from which township exteriors are run must be very carefully established, and the instructions and requirements to deputies who attempt such surveys are very full and specific. They must be run as near as possible on a true latitude curve.

If a true meridian be determined at every set up of the solar transit at short intervals, and a right angle be turned, a close approximation to the latitude curve will be attained, but in many cases it is deemed impracticable to pursue this method, and the lines are run by the tangent or secant methods.

Secant Method.

The method of establishing corners on a true latitude curve by offsets from a line situated between and parallel to the chord and tangents was devised to meet the demand for short offsets.

It consists of running out a connected series of straight lines, each 6 miles long, on such courses that any one of the lines will intersect the curve of the parallel of latitude in two points, separated by an interval of 4 miles; and from the lines thus established, measuring north or south, as the case may be, to attain other required points on the latitude curve. The straight lines are called secants.

The direction of the first secant will be determined at its initial point by observation on Polaris, and similar observations are made at

intervals of not exceeding 18 miles, while observations are made when practicable every night to guard against mistakes, detect errors, and check the direction of the line. The correct establishment of a standard parallel of offsets from secant lines depends upon:

1. Accuracy of observations on Polaris.
2. Close measurement of the azimuth angle, to define the initial direction of the secant.
3. Careful prolongation of the secant in a straight line.
4. Correct measurement of the deflection angle.

The secant method adapted to transit instruments exclusively, is recommended for its simplicity and accuracy, and the facility with which the line may be extended over rough mountainous land through dense undergrowth; in deep valleys or canyons where the sun cannot be observed in favorable positions, or anywhere during the continuance of adverse weather conditions and under circumstances where the use of solar apparatus would be, if not impossible, at least inconvenient and unreliable.

Tables showing the azimuths of the tangent to the parallel are furnished the surveyor. They are calculated for latitudes 30° to 50° and for each mile point of 12 miles.

Tangent Method.

This method consists in laying off from a true meridian, established by observations on Polaris, an angle of 90° producing the direction thus determined, a distance of 6 miles in a straight line, and measuring north therefrom, at half mile intervals, distances of correct length, taken from tables furnished to deputies for the latitude, to attain other points on the latitude curve passing through the tangential or initial point.

Instruments.

The requirements of the government in the use of instruments in running lines of public land surveys, provide that a solar transit or solar compass shall be employed, and that it shall be run independently of the magnetic needle.

In former times the kind of instrument was not prescribed, and great attention was paid to the variation of the needle. Much literature was furnished bearing upon the diurnal fluctuations of the mag-

netic needle, the annual changes in the magnetic declination and the shifting of the isogonic lines by the lapse of years. Many of the old surveys were executed with the needle compass and the variation either assumed or erroneously calculated. In consequence, the reliability of the surveys was much impaired by reason of local magnetic attraction, the carelessness of deputies, and the consciousness that no field examination would take place.

To avoid this state of things it was resolved to adopt and require the use of an instrument operating by other means than by the needle. Burt's Solar Compass was at first employed, and for twenty years was the only instrument adaptable to finding a meridian by observation upon the sun, which was practicable for field use, and to-day the principles upon which all solar transits used in public land surveying are constructed and the forms of attachments are identical with those of Burt's invention.

By this ingenious contrivance the surveyor can set his compass or transit over any point, and if the sun be shining, he can in five minutes direct his line of sight to a point precisely north or south or east and west of him. All that is necessary for him to know is the approximate latitude and longitude of the place, and the declination of the sun.

Aside from the original Burt's Solar Compass, which is an open sight apparatus, there are several instruments used in public land surveys made by different manufacturers. Gurley & Company use the Jones patent latitude arc, and their telescope carries the declination arc giving the sun's image as in the original Burt's compass. Young & Sons employ an ordinary railroad transit with Smith's Solar Attachment, which consists of an auxiliary telescope carrying a declination arc, and having a counterpoise. The image in this attachment is considerably increased in size, being several times larger than in the Gurley instrument. Keuffel, Esser & Company, manufacture the Saegmüller Solar Attachment to their solar transits.

There are other devices for solar work made as attachments to engineer's transits, which will not be described. Surveyors are divided in their preferences among these instruments, and it is outside the province of this article to write their advantages and disadvantages. The government, however, permits the use of the ordinary transit without any solar equipment whatever, provided the surveyor takes frequent observations for meridian, and in the use of the ordinary

transit, the deputy must observe for meridian each night, or upon the sun by day where practicable, turning off transit angles from his meridian for his east and west lines, making the necessary corrections

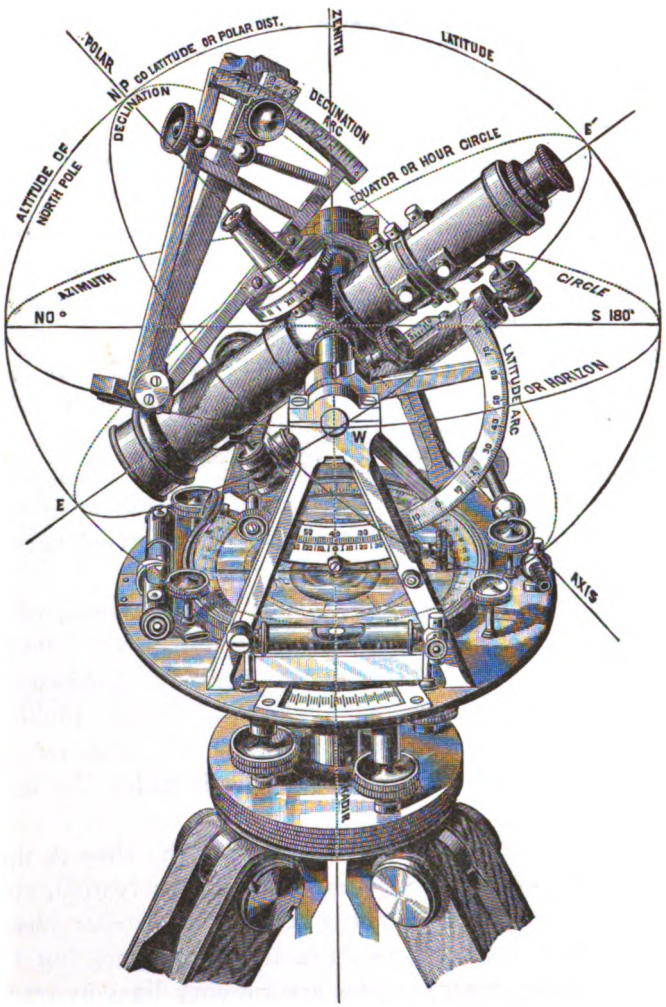

FIG. 4. — A SOLAR TRANSIT.
Showing principles of construction.

and allowances by subsequent observations. Very accurate surveys are made by this method, but the method is not considered by many surveyors to be rapid enough for profitable work.

Meridian Observations.

The work of Government Land Surveys involving true meridian lines makes the ascertainment of the exact direction of a north and south line by the surest and quickest means a great desideratum. The government does not insist upon any one method of finding the stellar meridian, but describes and recommends several methods in the *Manual of Surveying Instructions.*

Among these is the alignment of certain stars when Polaris is in culmination. When the star Zeta of the Great Bear, or the Big Dipper, is in the same vertical plane with the North Star, the latter is on the true meridian. Also when Delta of Cassiopeia and Polaris are in line vertically, a very close approximation to a true meridian is reached. In observing these transits it is necessary to allow a small interval of time to elapse before staking down the meridian.

The well known formula for ascertaining the azimuth of Polaris at elongation is furnished to all deputy surveyors, and they are given tables showing culminations of this star. Employment of this means of securing a meridian involves remaining up often until after midnight, and this to the tired deputy means the loss of much needed sleep.

In order to avoid the inconvenience attending the elongation and culmination method of Polaris observations, a plan was devised by the surveying division of the General Land Office, and tables furnished public land surveyors by which the azimuth of Polaris could be ascertained by direct observation of the star *at any hour when visible.* This was a great boon to the surveyor. It is called the hour angle method.

The hour angle is obtained by subtracting the time of upper culmination from the correct local mean time of observation, and applying the result to a table of azimuths of Polaris. Stellar observations for meridian are almost universally used by surveyors, but there are some deputies (those generally who are running lines by transit without solar attachment) who obtain their meridians by observations upon the sun. This can be accomplished by the following rule:

Add together the polar distance, the latitude, and the true altitude; take the difference between the half sum and the polar distance, and note the remainder. Add together the log. secant of the latitude, the log. secant of the altitude, the log. cosine of the half sum,

FIG. 5. — AN INSPECTION PARTY.
The position of the transit indicates the "falling."

and the log. cosine of the remainder; half the sum of these four logarithms will be the log. cosine of half the true azimuth of the sun.

Determination of the true meridian at intervals is required of deputies for the purpose of testing the accuracy of their solar apparatus, especially after moving camp and subjecting the delicate adjustments of the parts to the inevitable jarring and jolting of travel in rough mountainous regions. Conscientious surveyors will observe for meridian nearly every clear evening in order that observations may check each other. Surveyors are required to note in their records the details of such determinations in order that the General Land Office can ascertain if incorrect methods are employed.

Sometimes government surveyors record the details of an hour angle observation, which show an error of azimuth amounting to several minutes. Such an observation was probably never made, for the reason that, if as they state, their solar is in accord with the meridian as determined by such an amount of azimuth, it could not be in adjustment if the azimuth, as *correctly worked out*, were three or four minutes greater or less.

Inspections.

Prior to the "eighties," public land surveys made under contract were seldom examined in the field before payment, and as a consequence, the temptation to fraud and carelessness was very great. In other branches of the government, supplies for official use furnished by contract are duly inspected by vigilant officers to ascertain if the article be according to specification, but in the matter of surveys, strange to say, surveyors were formerly permitted to make returns to the Surveyors General of their work, their oath and that of their assistants being deemed sufficient guarantees of its correctness. But as the country became settled it was apparent that in many instances gross frauds had been perpetrated by unprincipled deputies and the government had paid for mere "paper" surveys; besides in numerous cases inaccurate lines were established, although the monuments were reasonably well marked.

To remedy this, the Surveyors General were instructed to make such inspections as they thought proper by men selected by them and to allow them full equipment of men and supplies to take the field and examine portions of the contract. These inspectors were generally other deputies, and they were naturally loth to find errors in each

other's work. Their reports were usually favorable, and it was rare to have one of these reports show gross neglect of duty on the part of the deputy.

As the work did not seem to grow more in accordance with the required standard, a new departure was determined upon.

A corps of Examiners of Surveys was appointed to consist of experienced engineers and practical surveyors, operating in conjunction with expert public land surveyors detailed from the surveying division of the General Land Office. These examiners comprise a trained class of men who are directed by the Commissioner, and are independent of any local affiliation or sympathy. They report their findings to the Commissioner, and upon their statements he accepts or rejects the surveys. This method has been in vogue for several years and correct and faithfully executed surveys are the result.

Surveys in Newly Acquired Territory.

It will doubtless be asked if the system will be extended to the outlying territories recently added to the United States.

In the case of Alaska, the last Congress extended the system to that district, but not being contiguous to the "States," the lines can not well be prolonged to embrace the lands desired to be surveyed, and if the survey of tracts of agricultural land be applied for by settlers, independent base and meridian lines will probably be established to govern the surveys, as the mountainous character of the surface of Alaska will preclude the possibility of a connected system over the entire country.

In Hawaii the commission appointed to recommend a form of government has advised the appointment of an officer whose functions shall be similar to those of our Surveyors General, to take charge of government surveys of what is known as "crown lands."

In Cuba, Porto Rico, and the Philippines, should there be found considerable areas of crown lands subject to disposal by the United States, the survey of such lands will unquestionably be proceeded with in the same manner as are lands in the public land States.

Reforms.

It would be natural to expect that in the course of years, modifications and improvements of the system would be suggested by experience. One of the changes which may be recommended to Congress

is the use of tubular iron posts, capped with brass, copper, or steel, upon which are to be stamped the data now placed upon the corner stones or posts. These would be more durable and less likely to be removed or destroyed by fire. They would be flanged at bottom and tamped, securing a rigidity not obtainable by the wooden post now in use.

Another change in the law, which is in the interest of promptness and accuracy, is the adoption of a proviso authorizing the contracting for small fragmentary surveys such as islands, for a lump sum. The law provides now that surveys however insignificant, involving sometimes a fraction of a mile, must be paid for at mileage rates, which results in the failure to find competent surveyors who are willing to go to the expense of traveling, oftentimes many miles, to a remote locality and receive three or four dollars as compensation for their work.

Still another progressive step would be the accomplishment of a topographical, or contour, survey simultaneously with the public land survey, such as has been done by the United States Geological Survey. This may be done by increasing the contract rates to cover the cost of topographical survey equipment.

Other and less important changes in the rules for public land surveying have been considered and adopted from time to time by the General Land Office, in cases where no Congressional authority is required. Their enumeration would materially lengthen this article, which is only intended as a brief exposition of the system.