

Serial No. 204

59181
Com.

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
E. LESTER JONES, Director

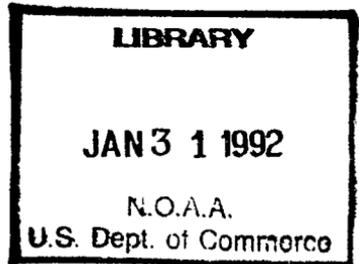
17

PRECISE TRAVERSE
RACINE, WIS., TO VANDALIA, ILL.

BY
CHARLES A. MOURHESS
Mathematician
AND
WALTER D. SUTCLIFFE
Mathematician

QB
275
.435
no. 86
(1922)

Special Publication No. 86



PRICE, 15 CENTS

Sold by the Superintendent of Documents, Government Printing Office
Washington, D. C.

WASHINGTON
GOVERNMENT PRINTING OFFICE
1922

National Oceanic and Atmospheric Administration

ERRATA NOTICE

One or more conditions of the original document may affect the quality of the image, such as:

Discolored pages

Faded or light ink

Binding intrudes into the text

This has been a co-operative project between the NOAA Central Library and the Climate Database Modernization Program, National Climate Data Center (NCDC). To view the original document, please contact the NOAA Central Library in Silver Spring, MD at (301) 713-2607 x124 or www.reference@nodc.noaa.gov.

LASON

Imaging Contractor

12200 Kiln Court

Beltsville, MD 20704-1387

January 1, 2006

CONTENTS.

PART I.

	Page.
Introduction.....	1
General arrangement of the data and subject matter.....	2
The North American datum.....	2
Explanation of positions, lengths, and azimuths, and of the North American datum.....	2
Uses of horizontal control data.....	5
Explanation of tables.....	6
Arrangement of tabulated data.....	6
Explanation of lengths.....	7
Azimuth and back azimuth.....	7
Accuracy of data indicated in tables.....	7
Elevations.....	8
How to find data desired.....	8
Related publications.....	8
Geographic positions.....	10
Description of stations.....	18
Standard notes on the marking of stations.....	19
Conversion tables.....	47
Feet to meters.....	47
Meters to feet.....	51

PART II.

General statement.....	55
Field work.....	55
Rate of progress.....	56
Cost.....	56
Transportation.....	56
Reconnaissance and signal building.....	56
Horizontal angle and azimuth observations.....	57
Difference between astronomic and geodetic azimuths.....	58
Tape measurements.....	58
The track level.....	59
Office computation.....	60
The least-squares adjustment.....	61
Discrepancy in geographic position.....	61
Condition equations.....	62
Tables of corrections.....	64
Table of corrections to the angles.....	64
Table of corrections to the measured lengths.....	66
Sketches.....	68
Index to stations and bench marks.....	79

ILLUSTRATIONS.

Fig. 1. Standard marks of the U. S. Coast and Geodetic Survey.....	18
Fig. 2. Tripod and scaffold for elevating the instrument and observer.....	56
Fig. 3. Tripod with target in place.....	56
Fig. 4. Forward end of the tape.....	57
Fig. 5. Rear end of the tape.....	57
Fig. 6. Tape supports at the beginning of a curve.....	58
Fig. 7. Stakes from station to rail tangent.....	59
Fig. 8. Track level.....	59
Fig. 9. Index map showing areas in the United States covered by published triangulation and traverse which have been rigidly computed on the North American datum.....	68

	Page.
Fig. 10. Index map of Illinois, showing the boundaries of the sketches, Figs. 11 to 20.....	68
Fig. 11. Precise traverse, vicinity of Racine to Beloit, Wis.....	68
Fig. 12. Precise traverse, Beloit, Wis., to Rockford, Ill.....	69
Fig. 13. Precise traverse, Rockford and vicinity.....	70
Fig. 14. Precise traverse, vicinity of Rockford to Rochelle.....	71
Fig. 15. Precise traverse, Rochelle to vicinity of Mendota.....	72
Fig. 16. Precise traverse, vicinity of Mendota to La Salle.....	73
Fig. 17. Precise traverse, La Salle and vicinity.....	74
Fig. 18. Precise traverse, vicinity of La Salle to Bloomington.....	75
Fig. 19. Precise traverse, Bloomington to Macon.....	76
Fig. 20. Precise traverse, Macon to Vandalia.....	77

PRECISE TRAVERSE, RACINE, WIS., TO VANDALIA, ILL.

By CHARLES A. MOURHES and WALTER D. SUTCLIFFE, *Mathematicians, U. S. Coast and Geodetic Survey.*

PART I.

INTRODUCTION.

During the summer of 1920 a precise traverse was measured from a point about 15 miles west of Racine, Wis., to Vandalia, Ill. The resulting data are given here, in Part I, in convenient form for the use of engineers, surveyors, and others interested. In Part II there is a rather limited discussion of the field and office work.

The route of the traverse was almost entirely along the railroad right of way, and by far the greater portion of the measurement was made with the invar tape supported throughout its length on the rail. At curves and other places where the measurement could not be made with the tape thus supported, stakes were used, except in the few places where the line followed improved highways or streets. The traverse at its northern end is connected to a station of the U. S. Lake Survey just west of Racine, and from there it follows the Chicago, Milwaukee & St. Paul Railway to Rockford, Ill., then south on the Chicago, Burlington & Quincy Railroad to Stewart Junction. Here the line returns to the Chicago, Milwaukee & St. Paul Railway, which it follows to Mendota. From Mendota to Vandalia the route is over the Illinois Central Railroad. At Vandalia the traverse connects with a station of the transcontinental precise triangulation.

At La Salle the traverse crosses the Illinois River, and a connection was made here with the triangulation along that river. Two stations of the river triangulation were recovered, and the connection was made to them by means of two triangles, using a line of the traverse as a base.

A precise leveling party followed closely behind the traverse party from Rockton to Vandalia. Consequently, the precise elevations of most of the traverse stations between these points have been determined and are given with the descriptions of the stations. The descriptions and elevations of other bench marks established between these points are also included.

This traverse is precise in character, having the same relative degree of accuracy as is required for precise triangulation. These requirements are that the closing error in the geographic position shall not exceed 1 part in 25 000 of the distance run, and that astronomical azimuths for the control of the geodetic azimuths of the traverse are to be measured at every 10 to 15 main angle stations and are to have an accuracy represented by a probable error of about $\pm 0''.5$.

GENERAL ARRANGEMENT OF THE DATA AND SUBJECT MATTER.

This report has been divided for the convenience of those who may use it into two parts. Part I contains all the data which an engineer or surveyor may use for the control of local surveys. The geographic positions of the stations are given in tabular form, showing the azimuths, back azimuths, distances between stations in both feet and meters, and the logarithms of the distances in meters. Arranged in the same order as the geographic positions are the descriptions of the stations, and at the end of each description there is given the precise elevation of the station mark in both feet and meters, if it has been determined. There is also given the description and elevations of some additional bench marks which are not traverse stations.

Part II is devoted to a brief discussion of the field work, costs, methods of making observations, and a discussion of the office computation and the final rigid least-squares adjustment. Tabulations are given which show the condition equations used in the adjustment and the corrections which were applied to the angles and lengths.

THE NORTH AMERICAN DATUM.

Concerning the actual use of the table of geographic positions, it is necessary to explain the "North American datum," which serves as the basis for all the geodetic values in this report.

Early in the year 1913 the Superintendent of the U. S. Coast and Geodetic Survey was notified by the director of the Commission Geodésica Mexicana and by the chief astronomer of the Dominion of Canada Astronomical Observatory that the so-called United States standard datum had been adopted as the datum for the triangulation of those organizations. They also reported that the Clarke spheroid of 1866, now used in the United States, would be used by them. Owing to the international character of the datum adopted by the three countries, the Superintendent of the U. S. Coast and Geodetic Survey changed its designation from the "United States standard datum" to the "North American datum."

EXPLANATION OF POSITIONS, LENGTHS, AND AZIMUTHS, AND OF THE NORTH AMERICAN DATUM.

All of the positions and azimuths have been computed upon the Clarke spheroid of 1866, as expressed in meters, which has been in use in the U. S. Coast and Geodetic Survey for many years.

After a spheroid has been adopted and all the angles and lengths in a triangulation have been fully fixed it is still necessary, before the computation of latitudes, longitudes, and azimuths can be made, to adopt a standard latitude and longitude for a specified station and a standard azimuth of a line from that station. For convenience the adopted standard position (latitude and longitude) of a given station, together with the adopted standard azimuth of a line from that station, is called the geodetic datum.

The triangulation in the United States was commenced at various points and existed at first as a number of detached portions in each of which the geodetic datum was necessarily dependent only upon the astronomic stations connected with that particular portion. As examples of such detached portions of triangulation there may be

mentioned the early triangulation in New England and along the Atlantic coast, a detached portion of the transcontinental triangulation centering on St. Louis and another portion of the same triangulation in the Rocky Mountain region, and three separate portions of triangulation in California, in the latitude of San Francisco, in the vicinity of Santa Barbara Channel, and in the vicinity of San Diego. With the lapse of time these separate pieces expanded until they touched.

The transcontinental triangulation, the office computation of which was completed in 1899, joined all the detached portions mentioned and made them one continuous triangulation. As soon as this took place the logical necessity existed of discarding the old geodetic data used in these various pieces and substituting one for the whole country, or at least for as much of the country as is covered by continuous triangulation. To do this was a very tedious piece of work and involved much preliminary study to determine the best datum to be adopted. On March 13, 1901, the Superintendent adopted what was known from that time until 1913 as the United States standard datum, but is now known as the North American datum, and it was decided to reduce the positions to that datum as rapidly as possible. The datum adopted was that formerly in use in New England, and therefore its adoption did not affect the positions which had been used for geographic purposes in New England and along the Atlantic coast to North Carolina, nor those in the States of New York, Pennsylvania, New Jersey, and Delaware. The adopted datum does not agree, however, with that used in the Transcontinental Triangulation and in the Eastern Oblique Arc of the United States, publications which deal primarily with the purely scientific problem of the determination of the figure of the earth and which were prepared for publication before the adoption of the new datum. As the adoption of such a standard datum was a matter of considerable importance it is in order here to explain the desirability of this step more fully.

The main objects to be attained by the geodetic operations of the U. S. Coast and Geodetic Survey are, first, the control of the charts published by the survey; second, the furnishing of the geographic positions (latitudes and longitudes), accurately determined elevations, distances, and azimuths to officers connected with the Survey and to other organizations; third, the determination of the figure of the earth. For the first and second objects it is not necessary that the reference spheroid should be accurately that which most closely fits the geoid within the area covered, nor that the adopted geodetic datum should be absolutely the best that can be derived from the astronomic observations at hand. It is simply desirable that the reference spheroid and the geodetic datum adopted shall be, if possible, such a close approximation to the truth that any correction which may hereafter be derived from the observations which are now, or may become, available shall not greatly exceed the probable errors of such corrections. It is, however, very desirable that one spheroid and one geodetic datum be used for the whole country. In fact, this is absolutely necessary if a geodetic survey is to perform fully the function of accurately coordinating all surveys within the area which it covers. This is the most important function of a geodetic survey. To perform this function, it is also highly desirable that

when a certain spheroid and geodetic datum have been adopted for a country they be rigidly adhered to without change for all time unless shown to be largely in error.

In striving to attain the third object, the determination of the figure of the earth, the conditions are decidedly different. This problem concerns itself, primarily, with astronomic observations of latitude, longitude, and azimuth and with the geodetic positions of the points at which the astronomic observations were made, but is not concerned with the geodetic positions of other points fixed by the triangulations. The geodetic positions (latitudes and longitudes) of comparatively few points are therefore concerned in this problem. However, in marked contrast to the statements made in preceding paragraphs, it is desirable in dealing with this problem that with each new important accession of data a new spheroid fitting the geoid with the greatest possible accuracy and new values of the geodetic latitudes, longitudes, and azimuths of the highest degree of accuracy should be derived.

The North American datum was adopted with reference to positions furnished for geographic purposes but has no reference to the problem of the determination of the figure of the earth. It was adopted with reference to the engineer's problem of furnishing standard positions and does not affect the scientist's problem of the determination of the figure of the earth.

The principles which guided in the selection of the datum to be adopted were: First, that the adopted datum should not differ widely from the ideal datum for which the sum of the station errors in latitude, longitude, and azimuth should each be zero; second, it was desirable that the adopted datum should produce minimum changes in the publications of the U. S. Coast and Geodetic Survey, including its charts; and, third, it was desirable, other things being equal, to adopt that datum which allowed the maximum number of positions already in the office files to remain unchanged, and therefore necessitated a minimum amount of new computation. These considerations led to the adoption, as the standard, of that datum which had been in use for many years in the northeastern group of States and along the Atlantic coast as far south as North Carolina.

An examination of the station errors of the astronomical stations so far reduced, scattered widely over the United States from Maine to Louisiana and to California, indicated that this datum approaches closely the ideal for which the algebraic sum of the station errors of each class would be zero.

The North American datum, upon which the positions and azimuths given in this publication depend, may be defined in terms of the position of the station Meades Ranch, Kans., as follows:

	°	'	"
$\phi=39$	13	26.086	
$\lambda=98$	32	30.506	
α to Waldo=75	28	14.52	

Points are then said to be upon the North American datum when they are connected with the station Meades Ranch by a continuous triangulation, through which the corresponding latitudes, longitudes, and azimuths have been computed on the Clarke spheroid of 1866, as expressed in meters, starting from the above data.

USES OF HORIZONTAL CONTROL DATA.

The plan or map for any extensive engineering project, whether or not map construction is the primary object, should have all of its parts properly correlated and should be on the same datum as adjacent surveys. Federal and State mapping organizations have long been aware of the necessity for having all surveys based upon a common datum, but the local engineers and surveyors in this country have too often in the past been content, and in many cases compelled, to use a local datum for their surveys. The future economic disadvantage of such a system is now becoming recognized, with the result that city and county surveys are being more generally placed upon a permanent basis by connecting them to stations on the North American datum.

One other factor must be taken into consideration by the engineer of to-day. As the States develop industrially they will undoubtedly follow the lead of one of the Eastern States, Massachusetts, which with splendid foresight has extended its triangulation control over the entire State for the purpose of defining property boundaries in terms of latitude and longitude. The advantage of such a system is well stated in the following extracts from the Report on the Maryland Oyster Survey:

The difficulties of accurately locating and permanently defining the boundaries of a farmer's plantation on land, even with the aid of monuments, public roads, streams of water, and other points of reference, are often great, judging from the disputes frequently arising in connection with boundaries. * * *

There is only one point on the earth's surface at the intersection of any one parallel of latitude and any one meridian of longitude, and therefore there can be no dispute as to the meaning of such a geographic definition of the location of a point, even though all the original triangulation station marks used in its determination, together with the chart on which its position was originally plotted, have been totally destroyed.

In the case of the destruction of an original triangulation station mark, or any other point defined by a geographic position, a competent geodetic engineer can reestablish its exact location by means of a new system of triangulation connecting with other distant triangulation marks which have not been destroyed.

In a section of the country covered by adequate geodetic control the data are available to the engineer for any of the following operations, in addition to its possible future use as a basis for cadastral surveys:

(1) **Extensive mapping.**—The topographer needs as initial data for beginning a topographic survey the distance and direction between two points and the geographic position of one of them, in latitude and longitude, on the North American datum. His local triangulation or traverse, based on this control, will prevent the accumulation of excessive errors as he carries on his mapping operations. In the event that the available precise triangulation in that region has lines of too great length to join to conveniently, he can measure a base and azimuth at some place visible from a precise or a primary triangulation or traverse station and connect his base to the station by triangulation or traverse, thus obtaining proper geographic positions for his local surveys.

Instructions for secondary (formerly called tertiary) triangulation, suitable for the control of local surveys, may be found in U. S. Coast and Geodetic Survey Special Publication No. 26. Instructions for precise and secondary traverse are given in Special Publication No. 58. Either of these publications can be had at a nominal cost from the Superintendent of Documents, Government Printing Office, Washington, D. C.

(2) **Boundary lines.**—If it is desired to locate or to delimit accurately and permanently the boundaries of political subdivisions, such as States, counties, or cities, the methods indicated in the preceding paragraph may be followed. Whenever possible, a line of the adjusted triangulation or traverse should be used as a basis for local surveys rather than a point, since a line gives the three essentials of position, length, and direction.

(3) **Local intensive surveys.**—The necessity for such surveys arises most frequently in connection with extensive improvements over a considerable area or as a basis for city planning, where the needs of a city are being anticipated for a number of years. Here the requirements are somewhat different from those in the two preceding operations, for it is often necessary to extend precise or primary control in considerable detail over the entire area affected, secondary triangulation or traverse then being used to furnish additional points for the survey. Such a control survey should invariably be started from a line of adjusted triangulation or traverse on the North American datum.

While it may be noted in the preceding paragraphs that the azimuth and length of one line and the geographic position of one end of that line constitute the essential data for the complete utilization of old work as a basis for new work, there is always grave danger in depending upon this minimum of data. There may be failure to identify the true station mark, or the mark, though genuine, may have been tampered with or otherwise disturbed in position. This will, of course, introduce an error into the new work based on these stations. It is the present practice in this survey, unless unusual conditions render it unnecessary, to establish the integrity of the recovered points by using at least three old stations as a basis for new work, the third station serving as a check for the two stations on which the new work may actually depend.

In local surveys where the area is of limited extent it is usually desirable to use a system of plane coordinates, the origin being connected to some point of the precise or primary triangulation or traverse scheme. Tables for computing plane coordinates from geographic positions are found in U. S. Coast and Geodetic Survey Special Publication No. 71. The U. S. Coast and Geodetic Survey will be glad to give advice on any problem arising out of the use of its control points or on any proposed extension of triangulation or traverse from them.

EXPLANATION OF TABLES.

ARRANGEMENT OF TABULATED DATA.

In the tables of positions the latitude and longitude of each point are given on the North American datum (see p. 2); also the length and azimuth of each line observed over, whether in one way or both ways, to other points of the triangulation or traverse. **NO LENGTHS OR AZIMUTHS ARE REPEATED, AND FOR A GIVEN LINE THE LENGTH AND AZIMUTH WILL BE FOUND OPPOSITE THE POSITION OF ONE OR THE OTHER OF THE TWO STATIONS INVOLVED.**

The distances between stations are given in both meters and feet. To facilitate further the use of the tables, a column is given of the logarithms of the lengths in meters. It must be remembered that it is the logarithm of the length in meters which is derived first in the

computation, the lengths in meters given in this table being derived from the corresponding logarithm and the lengths in feet in turn derived from the lengths in meters by the aid of the conversion tables on pages 47-54. Where further work of considerable extent is contemplated, an accumulation of error in the last two operations can be avoided by using the logarithm.

EXPLANATION OF LENGTHS.

The lengths, for the most part, were actually measured, but as given in the tables are all reduced to sea level. If the actual length of a line simply reduced to the horizontal is desired—that is, its length in its actual elevation on the surface of the earth—it may be obtained by adding to the sea-level length as given in meters a correction = (length of line as given in meters) times

$$\left[\frac{\text{mean elevation of the two ends of the line in meters}}{6\,370\,000} \right].$$

The maximum value of this correction does not exceed $\frac{1}{20000}$ of the length of any line of the triangulation or traverse here published. The error introduced by the use of the above approximate formula does not exceed $\frac{1}{7000000}$ of the length of any portion of this triangulation or traverse.

AZIMUTH AND BACK AZIMUTH.

All azimuths are reckoned continuously from true south around by west to 360° , south being 0° , west 90° , north 180° , and east 270° . Because of the convergence of the meridians the azimuth and back azimuth of a line do not differ by exactly 180° , the amount of the divergence varying with the latitude and the difference of longitude of the two points. To illustrate from the tables, page 10, the azimuth from Vilas to Kansas is $262^\circ 47' 21''.7$, while the back azimuth, or the azimuth from Kansas to Vilas, is $82^\circ 52' 01''.0$.

The azimuths of the triangulation lines offer a very convenient and accurate means of testing the error of the magnetic needle on a surveyor's transit, and even the azimuth over such short distances as those between a station mark and its reference mark may be used for this purpose with fair accuracy, provided the distance is greater than 100 feet.

ACCURACY OF DATA INDICATED IN TABLES.

The rule followed in recent publications of this office has been to give latitudes and longitudes to thousandths of a second for all points the positions of which have been fixed by fully adjusted triangulation or traverse. Points, the positions of which are given to hundredths of a second only, are marked by footnotes as being without check.

In the columns giving azimuths, distances, and logarithms of distances the accuracy is indicated to a certain extent by the number of decimal places given, it being understood that in each case two doubtful places are given. In some cases there is very little doubt of the correctness of the second figure from the right, while in a few cases some doubt may be cast on the third figure from the right.

ELEVATIONS.

The elevations of the bench marks and traverse stations given in the descriptions are based on mean sea level and depend on the 1912 adjustment of the precise level net. They were determined by precise leveling, which was done in connection with the traverse work. The level line, of which the bench marks and stations form a part, started near Rockton, Ill., followed the route of the traverse to Vandalia, and then continued along the Illinois Central Railroad to Centralia, Ill., where a connection was made with previously established bench marks.

HOW TO FIND THE DATA DESIRED.

Following the text at the back of this publication are 12 maps. The first is an index map showing all the areas in the United States covered by published triangulation or traverse rigidly computed on the North American datum. Following this is an index map showing the route of this traverse and the principal towns through which it passes. The others are detailed maps showing the traverse stations contained in this publication. The names of the stations in any locality can readily be obtained from these maps. Then, by using the index at the end of the publication the tables containing the desired data may be consulted. Included in this publication are certain bench marks that are not traverse stations. These bench marks are not shown on the maps, but are given in the index under the designation of the bench mark. No table of elevations is given, but the elevations of bench marks and traverse stations where determined are given at the end of the description of the bench mark or station.

In the appropriately headed columns of the index, opposite the name of each traverse station, are given the pages on which may be found its geographic position, description (including elevation above mean sea level, if determined), and the number of the detailed map on which the station is plotted. For each bench mark the page on which the description and elevation are given is shown.

RELATED PUBLICATIONS.

Engineers and others using the data given in this report for the control of maps and surveys will find it of help to have Special Publications Nos. 5, 8, and 71 of the U. S. Coast and Geodetic Survey. They may be obtained at a nominal cost from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Special Publication No. 5 is entitled "Tables for a polyconic projection of maps based on Clarke's reference spheroid of 1866." This publication contains the necessary explanation of the method employed in constructing a polyconic projection, and also gives the values in meters of the degrees, minutes, and seconds of latitude and longitude for all latitudes.

Special Publication No. 8 is entitled "Formulæ and tables for the computation of geodetic positions." As the title of this publication implies, the data contained in it will enable one to compute the spherical coordinates for triangulation where the distances and angles are known.

Special Publication No. 71 is entitled "Relation between plane rectangular coordinates and geographic positions." This book contains tables which will facilitate the use by engineers of plane coordinates for local surveys.

The principal lists of geographic positions published on the North American datum throughout the United States, together with descriptions of stations, are contained in the following publications of the U. S. Coast and Geodetic Survey and of other organizations:

- Appendix 8 of the Report for 1888, positions in Connecticut.
- Appendix 8 of the Report for 1893, positions in Pennsylvania, Delaware, and Maryland.
- Appendix 6 of the Report for 1901, positions and descriptions in Kansas and Nebraska.
- Appendix 9 of the Report for 1904, positions and descriptions in California.
- Appendix 3 of the Report for 1907, positions and descriptions in California.
- Appendix 5 of the Report for 1910, positions and descriptions in California.
- Appendix 4 of the Report for 1911, positions and descriptions in Nebraska, Minnesota, North Dakota, and South Dakota.
- Appendix 6 of the Report for 1911, positions and descriptions in Florida.
- Special Publication No. 11, positions and descriptions in Texas, New Mexico, Arizona, and California.
- Special Publication No. 13, positions and descriptions in California, Oregon, and Washington.
- Special Publication No. 16, positions and descriptions in Florida.
- Special Publication No. 17, positions and descriptions in Texas.
- Special Publication No. 19, positions and descriptions in Colorado, Utah, Nevada, Wyoming, Montana, South Dakota, and North Dakota.
- Special Publication No. 24, positions and descriptions in Alabama and Mississippi.
- Special Publication No. 30, positions and descriptions in West Virginia, Ohio, Kentucky, Indiana, Illinois, and Missouri.
- Special Publication No. 31, positions and descriptions in Oregon, Washington, and California.
- Special Publication No. 43, positions in Georgia.
- Special Publication No. 45, descriptions in Georgia.
- Special Publication No. 46, positions and descriptions in Maine.
- Special Publication No. 54, positions and descriptions in Texas.
- Special Publication No. 62, positions and descriptions in Rhode Island.
- Special Publication No. 70, positions and descriptions in Kansas.
- Special Publication No. 74, positions and descriptions in Idaho, Oregon, and Washington.
- Special Publication No. 76, positions and descriptions in Massachusetts.
- Special Publication No. 78, positions and descriptions in Texas.
- Special Publication No. 79, positions and descriptions in Indiana.
- Special Publication No. 84, positions and descriptions in California and Oregon.
- Special Publication No. 86, positions and descriptions in Illinois and Wisconsin.
- Special Publication No. 88, positions and descriptions in Oklahoma and Texas.
- Report on triangulation of Greater New York.
- Report on a plan of sewerage for the city of Cincinnati.
- Appendix EEE, pages 2905-3031, Annual Report of the Chief of Engineers, U. S. Army, 1902, positions of points on and near the Great Lakes.
- Professional Paper No. 24, Corps of Engineers, U. S. Army, descriptions of points on and near the Great Lakes.
- Publications of the Massachusetts Commission on Waterways and Public Lands.
- Various bulletins of the United States Geological Survey.

GEOGRAPHIC POSITIONS.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
<i>Principal points.</i>	<i>° ' "</i>	<i>° ' "</i>	<i>° ' "</i>				
Dover, 1873.....	42 40 25.379 88 05 02.930						
Midway, 1920.....	42 40 32.752 88 04 50.632	50 54 33.9	230 54 25.6	Dover.....	2.5572688	360.80	1183.72
Kansas, 1920.....	42 41 05.215 88 05 08.021	337 45 35.6	157 45 47.8	Midway.....	3.0343058	1082.20	3550.52
Vilas, 1920.....	42 40 26.957 88 12 00.685	262 47 21.7	82 52 01.0	Kansas.....	3.9757066	9455.98	31023.49
Wilmont, 1920....	42 40 04.953 88 16 00.504	262 53 24.8	82 56 07.3	Vilas.....	3.7400038	5503.05	18054.59
Oneida, 1920.....	42 40 05.440 88 16 20.078	271 19 17.1	91 19 36.5	Wilmont.....	2.8134994	650.88	2135.43
Burlington, 1920..	42 40 05.511 88 16 53.239	270 13 34.4	90 13 50.8	Oneida.....	2.7399005	549.53	1802.92
Oconto, 1920.....	42 39 46.731 88 17 37.009	239 50 28.9	50 50 58.6	Burlington....	3.0620471	1153.58	3784.70
Lang, 1920.....	42 39 35.124 88 18 17.456	248 44 50.8	68 45 27.2	Oconto.....	2.9049140	988.30	3242.64
Kenosha, 1920....	42 38 43.209 88 23 58.732	258 20 36.6	78 24 27.8	Lang.....	3.8996237	7936.40	26038.01
BunEAU, 1920.....	42 38 15.424 88 26 33.874	256 18 29.1	76 20 14.2	Kenosha.....	3.5608175	3637.62	11934.42
Whistle, 1920....	42 38 14.211 88 26 52.132	264 51 24.8	84 51 37.2	BunEAU.....	2.6208207	417.67	1370.31
Bank, 1920.....	42 38 16.348 88 27 11.252	286 19 51.0	106 20 04.0	Whistle.....	2.0569974	453.94	1480.30
Iron, 1920.....	42 38 31.286 88 27 29.423	313 57 30.2	133 57 42.5	Bank.....	2.7597471	575.10	1896.81
Iowa, 1920.....	42 39 21.088 88 30 25.594	290 56 12.7	110 58 12.1	Iron.....	3.6331908	4297.25	14098.56
Elkhorn, 1920....	42 39 58.092 88 32 33.797	201 20 47.0	111 22 13.9	Iowa.....	3.4962572	3135.14	10285.87
Forest, 1920.....	42 39 42.875 88 33 28.038	249 23 26.1	69 24 03.3	Elkhorn.....	3.1252541	1334.30	4377.02
Fond, 1920.....	42 39 20.360 88 35 07.181	252 47 28.9	72 48 35.7	Forest.....	3.3709705	2349.47	7708.22
Elorence, 1920....	42 38 25.394 88 36 56.277	235 40 37.7	55 41 51.6	Fond.....	3.4783018	3008.79	9871.34
Delavan, 1920....	42 38 07.214 88 37 31.807	235 16 27.0	55 16 51.1	Elorence.....	2.9033844	984.88	3231.23
Dunn, 1920.....	42 36 21.579 88 41 54.144	241 22 33.6	61 25 31.2	Delavan.....	3.8331094	6809.41	22340.54
Darlen, 1920.....	42 36 06.592 88 42 29.857	240 23 53.3	60 24 17.5	Dunn.....	2.9714048	936.28	3071.78
Door, 1920.....	42 34 58.813 88 45 43.545	244 38 23.2	64 40 34.3	Darlen.....	3.6880807	4886.31	16031.17
Dodge, 1920.....	42 34 51.453 88 46 21.370	255 14 43.5	75 15 09.1	Door.....	2.9503416	891.95	2920.34
Dane, 1920.....	42 34 39.500 88 47 33.179	257 22 06.1	77 22 54.7	Dodge.....	3.2248376	1678.18	5505.83

GEOGRAPHIC POSITIONS—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
<i>Principal points—Continued.</i>							
Calumet, 1920.....	42 34 26. 755 88 48 09. 812	244 40 27. 1	64 40 51. 9	Dane.....	2. 9657954	924. 20	3032. 34
Burnett, 1920.....	42 33 25. 991 88 50 59. 415	244 07 35. 3	64 00 30. 0	Calumet.....	3. 6333677	4299. 00	14104. 30
Clinton, 1920.....	42 33 01. 862 88 52 05. 101	243 36 18. 5	63 37 03. 0	Burnett.....	3. 2240568	1675. 16	5495. 02
Buffalo, 1920.....	42 32 26. 687 88 53 50. 708	245 43 24. 9	65 44 36. 3	Clinton.....	3. 4217588	2640. 94	8604. 48
Bayfield, 1920.....	42 32 18. 533 88 54 30. 843	254 38 04. 9	74 38 32. 0	Buffalo.....	2. 9776199	949. 77	3116. 04
Barron, 1920.....	42 32 04. 233 88 55 35. 704	253 24 32. 4	73 25 10. 3	Bayfield.....	3. 1891652	1545. 84	5071. 04
Ashland, 1920.....	42 32 13. 739 88 50 08. 090	291 40 52. 4	111 41 14. 3	Barron.....	2. 8097518	703. 87	2904. 56
Cut, 1920.....	42 32 16. 016 88 50 24. 715	280 29 25. 7	100 29 36. 9	Ashland.....	2. 5864053	385. 84	1265. 88
Cave, 1920.....	42 32 13. 672 88 50 32. 775	248 31 53. 7	68 31 59. 1	Cut.....	2. 2958840	197. 64	648. 42
Morgan, 1920.....	42 30 54. 859 88 59 05. 623	235 06 20. 8	55 08 04. 1	Cave.....	3. 6286535	4252. 59	13952. 04
Long, 1920.....	42 30 02. 241 89 00 47. 178	234 59 19. 4	55 00 28. 0	Morgan.....	3. 4518677	2830. 53	9286. 50
Slim, 1920.....	42 29 54. 777 89 01 11. 730	247 40 05. 6	67 40 22. 2	Long.....	2. 7826200	606. 21	1988. 87
Short, 1920.....	42 29 51. 203 89 01 41. 716	260 59 48. 4	81 00 08. 7	Slim.....	2. 8408062	693. 12	2274. 01
Beloit, 1920.....	42 29 50. 416 89 02 07. 609	267 28 31. 1	87 28 48. 7	Short.....	2. 7737021	593. 88	1948. 42
State Line, 1920...	42 29 46. 631 89 02 16. 544	239 57 37. 3	59 57 43. 3	Beloit.....	2. 3679198	233. 30	765. 42
Flat, 1920.....	42 28 58. 367 89 02 58. 123	212 31 12. 3	32 31 40. 4	State Line....	3. 2470458	1766. 22	5794. 67
Limit, 1920.....	42 28 38. 701 89 03 20. 307	210 51 28. 0	39 51 43. 6	Flat.....	2. 8079183	790. 53	2593. 60
Shaw, 1920.....	42 28 25. 502 89 03 38. 249	225 10 43. 9	45 10 50. 0	Limit.....	2. 7617641	577. 78	1895. 60
Rockton, 1920.....	42 27 40. 937 89 04 11. 875	209 11 12. 0	29 11 35. 6	Shaw.....	3. 1973099	1575. 11	5167. 67
Bond, 1920.....	42 26 51. 742 89 04 00. 638	170 24 00. 8	350 23 53. 2	Rockton.....	3. 1873798	1539. 50	5050. 84
Alexander, 1920...	42 26 28. 019 89 03 37. 718	144 24 55. 0	324 24 39. 5	Bond.....	2. 9542972	900. 11	2953. 11
Adams, 1920.....	42 26 02. 770 89 03 27. 086	164 03 44. 2	344 03 37. 6	Alexander.....	2. 9085028	810. 03	2657. 57
Roscoe, 1920.....	42 25 32. 227 89 03 03. 213	149 00 24. 9	329 00 08. 2	Adams.....	3. 0412402	1099. 64	3607. 74
Boon, 1920.....	42 24 15. 214 89 02 37. 822	166 16 23. 0	346 16 05. 9	Roscoe.....	3. 3884842	2446. 16	8025. 44
Brown, 1920.....	42 23 49. 400 89 02 40. 070	193 19 35. 1	13 10 40. 7	Boon.....	2. 9129351	818. 34	2684. 84

GEOGRAPHIC POSITIONS—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
<i>Principal points— Continued.</i>							
Bureau, 1920.....	42 23 29.264 89 02 48.445	184 50 41.1	4 59 42.7	Brown.....	2.7950900	623.86	2046.78
Calhoun, 1920.....	42 23 23.691 89 02 62.677	209 22 37.1	29 22 40.0	Bureau.....	2.2951732	197.32	647.37
Carroll, 1920.....	42 23 04.834 89 03 13.380	219 08 27.8	39 08 41.8	Calhoun.....	2.8751909	750.22	2461.35
Latham, 1920.....	42 22 10.826 89 03 33.354	195 19 59.1	15 20 12.6	Carroll.....	3.2375285	1727.94	5699.08
Cass, 1920.....	42 21 56.117 89 03 33.748	181 08 15.3	1 08 15.6	Latham.....	2.6509874	453.93	1469.27
Champaign, 1920..	42 21 40.463 89 03 38.740	193 18 21.5	13 18 24.9	Cass.....	2.6057065	496.33	1628.38
Christian, 1920....	42 21 33.071 89 03 42.813	203 58 38.5	23 58 41.2	Champaign...	2.3605008	220.36	752.49
Clark, 1920.....	42 21 04.559 89 04 13.406	217 55 58.4	37 56 19.0	Christian.....	3.0504842	1138.90	3736.54
Clay, 1920.....	42 20 58.461 89 04 20.728	238 19 12.3	58 19 21.3	Clark.....	2.5542387	368.29	1175.49
Clinton, 1920.....	42 20 52.482 89 04 32.142	213 53 23.7	33 53 27.3	Clay.....	2.3468083	222.23	729.10
Genet, 1920.....	42 20 43.723 89 04 35.959	197 54 53.1	17 54 55.7	Clinton.....	2.4533444	294.02	931.82
Coles, 1920.....	42 20 21.636 89 04 30.073	168 40 00.6	348 48 56.6	Genet.....	2.8417908	694.09	2270.16
Jones, 1920.....	42 19 24.782 89 04 14.305	168 22 23.0	348 22 12.4	Coles.....	3.2530942	1790.99	5875.94
Cook, 1920.....	42 19 07.741 89 04 14.485	190 20 52.5	0 20 52.6	Jones.....	2.7208300	525.82	1725.13
Ruby, 1920.....	42 18 58.158 89 04 12.731	172 15 51.8	352 15 50.6	Cook.....	2.4747788	298.39	978.07
Crawford, 1920....	42 18 39.672 89 04 17.582	191 01 13.4	11 01 16.7	Ruby.....	2.7042627	581.12	1906.50
Cumberland, 1920.	42 18 35.352 89 04 20.721	208 20 24.3	28 20 26.4	Crawford.....	2.1802628	151.45	496.88
Dekob, 1920.....	42 18 22.354 89 04 37.310	223 26 57.1	43 27 08.3	Cumberland..	2.7422994	552.46	1812.53
Forest, 1920.....	42 17 44.977 89 04 36.991	179 17 44.1	359 17 43.7	Dekob.....	3.0619659	1153.36	3783.98
Burton, 1920.....	42 17 33.637 89 04 41.722	198 13 50.0	18 13 53.4	Forest.....	2.5602917	368.38	1208.59
Guard, 1920.....	42 17 02.551 89 04 55.711	108 28 30.7	18 28 40.1	Burton.....	3.0048790	1011.30	3317.91
John, 1920.....	42 16 55.629 89 05 01.914	213 15 35.5	33 15 39.7	Guard.....	2.4135110	259.13	850.16
Church, 1920.....	42 16 57.699 89 05 06.234	304 02 24.4	124 02 27.3	John.....	2.0771831	119.45	391.90
Park, 1920.....	42 16 35.843 89 05 31.142	220 14 40.2	40 14 57.0	Church.....	2.0461475	883.38	2898.22
Peach, 1920.....	42 16 25.161 89 05 39.611	210 27 57.2	30 28 02.9	Park.....	2.5829254	382.76	1255.77

GEOGRAPHIC POSITIONS—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
<i>Principal points—Continued.</i>							
Western, 1920.....	42 16 03.114 89 05 55.406	208 01 39.8	28 01 50.4	Peach.....	2.8866580	770.30	2527.23
First, 1920.....	42 15 52.463 89 05 29.819	119 16 12.3	299 15 55.1	Western.....	2.8275139	672.22	2205.44
Fourth, 1920.....	42 15 45.309 89 05 11.432	117 26 55.0	297 26 42.6	First.....	2.6705735	474.87	1557.07
Gregory, 1920.....	42 15 29.990 89 05 11.784	180 58 28.4	0 58 28.6	Fourth.....	2.6761382	474.39	1558.39
Eighteenth, 1920..	42 14 50.598 89 05 11.667	179 52 25.0	359 52 24.9	Gregory.....	3.0847925	1215.61	3988.21
Douglas, 1920.....	42 14 07.860 89 05 12.148	180 28 39.0	0 28 39.3	Eighteenth...	3.1200622	1318.45	4325.61
Dewitt, 1920.....	42 13 53.221 89 04 57.833	144 00 53.7	324 00 44.1	Douglas.....	2.7470569	558.54	1832.48
DuPage, 1920.....	42 13 46.942 89 04 55.232	162 53 09.0	342 53 07.3	Dewitt.....	2.3068841	202.71	665.06
Edgar, 1920.....	42 12 46.758 89 04 51.020	179 34 00.9	359 34 00.5	DuPage.....	3.2688118	1857.00	6092.51
Grant, 1920.....	42 11 57.924 89 04 54.272	179 41 47.2	359 41 47.0	Edgar.....	3.1780409	1506.76	4943.40
Edwards, 1920.....	42 11 30.643 89 05 10.451	203 47 45.4	23 47 56.3	Grant.....	2.9637613	919.94	3018.17
Effingham, 1920..	42 10 35.218 89 05 09.579	179 19 46.9	359 19 46.3	Edwards.....	3.2330630	1710.26	5611.08
Fayette, 1920.....	42 10 02.191 89 05 14.658	186 31 32.9	6 31 36.3	Effingham....	3.0109739	1025.60	3364.82
Ford, 1920.....	42 08 56.147 89 05 31.797	190 55 39.0	10 55 50.5	Fayette.....	3.8170935	2075.88	6808.98
Franklin, 1920....	42 06 49.760 89 05 27.342	178 29 50.3	358 29 47.3	Ford.....	3.6911639	3900.89	12798.17
Fulton, 1920.....	42 06 25.678 89 05 28.337	181 45 48.8	1 45 44.5	Franklin.....	2.8712160	743.39	2438.94
Davis, 1920.....	42 04 42.815 89 05 42.855	185 59 59.7	6 00 09.4	Fulton.....	3.5039511	3191.20	10469.80
Hocomb, 1920.....	42 03 33.001 89 05 41.241	179 00 48.7	359 00 47.6	Davis.....	3.3332917	2154.24	7067.70
Gallatin, 1920....	42 02 44.019 89 05 42.781	181 20 45.7	1 20 46.7	Hocomb.....	3.1792227	1510.85	4955.85
Green, 1920.....	42 02 08.144 89 05 41.891	178 56 16.4	358 56 15.8	Gallatin.....	3.0446317	1107.98	3635.10
Grundy, 1920.....	42 01 14.796 89 06 16.918	206 04 40.8	26 05 03.7	Green.....	3.2630687	1832.56	6012.82
Hamilton, 1920....	42 00 84.584 89 06 16.126	179 09 49.9	359 09 49.4	Grundy.....	3.0937079	1240.82	4070.62
Kings, 1920.....	42 00 03.224 89 06 32.686	201 29 46.3	21 29 57.4	Hamilton.....	3.0166938	1039.92	3411.80
Hancock, 1920....	41 59 00.993 89 06 40.527	185 22 09.5	5 22 14.7	Kings.....	3.2852193	1928.50	6327.09
Center, 1920.....	41 58 24.392 89 07 05.040	180 39 42.0	6 39 58.4	Hancock.....	3.6870376	4864.49	15829.58

GEOGRAPHIC POSITIONS—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
<i>Principal points—Continued.</i>							
Hardin, 1920.....	41 55 13.000 89 04 34.354	122 23 06.5	302 21 25.8	Center.....	3.6139034	4110.58	13486.13
Henderson, 1920..	41 53 52.006 89 03 14.920	131 34 53.9	311 22 20.2	Center.....	3.8504600	7086.96	23251.13
Iroquois, 1920....	41 53 52.673 89 02 32.596	88 47 42.0	268 47 13.7	Henderson....	2.9893775	975.84	3201.57
Henry, 1920.....	41 54 22.484 89 02 46.095	341 18 27.4 35 14 47.3	161 18 36.5 215 14 28.1	Iroquois..... Henderson....	2.9871934 3.0612125	970.94 1151.36	3185.49 3777.42
Steward, 1920....	41 51 04.514 89 01 28.432	164 05 17.5	344 04 34.7	Iroquois.....	3.7319907	5394.99	17700.06
Scarboro, 1920...	41 46 42.536 89 02 01.499	185 23 28.7	5 28 50.7	Steward.....	3.9094794	8118.57	26635.67
Fred, 1920.....	41 45 54.131 89 01 52.996	172 30 33.7	352 30 28.0	Scarboro.....	3.1779002	1506.26	4941.79
Jackson, 1920....	41 44 22.984 89 01 19.147	164 27 42.4	344 27 19.9	Fred.....	3.4652008	2918.78	9576.03
Jasper, 1920.....	41 43 04.534 89 01 41.359	191 58 24.7	11 58 39.5	Jackson.....	3.3934263	2474.15	8117.27
Roxbury, 1920....	41 42 02.633 89 02 23.766	207 10 14.1	27 10 42.3	Jasper.....	3.3317729	2146.71	7043.00
Jefferson, 1920...	41 41 03.786 89 03 04.907	207 35 42.7	27 36 10.0	Roxbury.....	3.3114627	2048.63	6721.21
Jersey, 1920.....	41 39 20.900 89 03 41.060	194 47 47.5	14 48 11.6	Jefferson.....	3.5162855	3283.11	10771.34
Daviess, 1920....	41 38 29.094 89 03 42.676	181 20 24.8	1 20 25.9	Jersey.....	3.2037738	1598.73	5245.17
Johnson, 1920....	41 38 11.858 89 03 52.336	202 48 07.4	22 48 13.8	Daviess.....	2.7610589	576.84	1892.62
Kane, 1920.....	41 36 16.020 89 05 20.950	209 50 59.5	29 51 58.4	Johnson.....	3.6149737	4120.78	13519.43
Kankakee, 1920..	41 35 06.027 89 06 17.184	211 05 26.8	31 06 04.1	Kane.....	3.4016964	2521.72	8273.34
Kendall, 1920....	41 34 17.192 89 06 38.498	198 08 36.2	18 08 50.3	Kankakee....	3.2001507	1585.44	5201.56
Mendota, 1920...	41 33 38.014 89 06 47.940	190 15 30.0	10 15 36.3	Kendall.....	3.0898134	1228.83	4029.95
Knox, 1920.....	41 33 19.716 89 06 47.436	178 48 54.3	358 48 54.0	Mendota.....	2.7517558	564.62	1852.42
Simpson, 1920...	41 33 11.131 89 07 04.993	236 56 12.8	56 56 24.4	Knox.....	2.6861788	485.49	1592.81
Lake, 1920.....	41 32 25.800 89 07 03.783	178 51 05.8	358 51 05.0	Simpson.....	3.1457499	1398.78	4589.16
Culton, 1920.....	41 29 03.175 89 07 02.137	179 39 00.8	359 38 59.7	Lake.....	3.7959654	6251.23	20509.24
Lawrence, 1920...	41 24 39.600 89 06 58.512	179 24 26.6	359 24 24.2	Culton.....	3.9101867	8131.80	26979.08
Lee, 1920.....	41 22 38.985 89 06 57.355	179 35 10.6	359 35 09.8	Lawrence....	3.5706644	3721.04	12208.11
Livingston, 1920..	41 22 08.470 89 06 37.846	157 31 17.5	337 31 04.6	Lee.....	3.0739854	1185.78	3890.18

GEOGRAPHIC POSITIONS—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
<i>Principal points—Continued.</i>							
Logan, 1920.....	41 21 29.439 89 05 46.510	131 20 52.8	311 20 18.9	Livingston....	3.2012091	1589.81	5214.26
Vinson, 1920.....	41 21 02.739 89 05 46.572	180 05 59.4	0 05 59.4	Logan.....	2.9157605	823.68	2702.36
Bowie, 1920.....	41 20 41.489 89 05 45.935	178 42 21.5	358 42 21.1	Vinson.....	2.8107712	655.80	2151.57
Joy, 1920.....	41 20 19.098 89 05 45.973	180 04 29.8	0 04 29.8	Bowie.....	2.6274587	672.14	2205.18
Gooding, 1920.....	41 20 19.864 89 05 54.097	271 32 57.1	91 33 02.5	Joy.....	2.2768970	188.97	619.98
Earl, 1920.....	41 19 59.489 89 05 50.431	173 15 27.5	353 15 25.1	Gooding.....	2.8610103	726.12	2382.28
La Salle, 1920.....	41 19 40.660 89 05 47.902	173 07 53.6	358 07 51.9	Earl.....	2.6918233	491.84	1613.65
McDonough, 1920.	41 19 44.369 89 05 08.160	82 56 45.8	262 56 19.6	La Salle.....	2.9690712	931.26	3055.31
Vermilion River (Illinois River Survey), 1903.	41 18 35.241 89 05 39.219	174 17 09.9 198 42 37.0	354 17 04.2 18 42 57.5	La Salle..... McDonough....	3.807114 3.362488	2028.2 2251.6	6654.2 7387.1
Little Rock Ferry (Illinois River Survey), 1903.	41 19 06.755 89 02 42.105	76 44 17.5 108 52 26.8	250 42 20.0 238 50 50.4	Vermilion River. McDonough....	3.626633 3.555033	4252.9 3589.5	13887.4 11776.6
Cinder, 1920.....	41 17 48.003 89 03 04.642	141 20 21.3	321 18 59.7	McDonough....	3.6625687	4598.00	15085.27
Oglesby, 1920.....	41 17 30.652 89 03 03.820	177 57 16.8	357 57 15.8	Cinder.....	2.7288362	535.59	1767.18
Macoupin, 1920...	41 17 15.791 89 03 25.232	227 22 43.1	47 22 57.2	Oglesby.....	2.8306293	677.06	2221.32
McHenry, 1920...	41 16 58.688 89 03 42.599	214 26 24.1	34 26 35.6	Macoupin.....	2.8540430	714.57	2344.39
Macon, 1920.....	41 16 51.511 89 03 46.214	207 46 36.7	27 46 39.1	McHenry.....	2.2564986	189.51	592.22
McLean, 1920.....	41 15 07.906 89 04 13.714	191 19 21.9	11 19 40.0	Macon.....	3.5131637	3259.60	10694.20
Tonica, 1920.....	41 13 43.729 89 04 05.333	175 43 42.5	355 43 37.0	McLean.....	3.4156431	2604.01	8543.32
Madison, 1920.....	41 09 46.662 89 03 39.706	175 19 30.7	355 19 13.8	Tonica.....	3.8655590	7837.68	24073.70
Marion, 1920.....	41 07 24.147 89 03 25.353	175 38 50.8	355 38 41.4	Madison.....	3.6443497	4409.10	14465.52
Santa Fee, 1920...	41 00 45.616 89 02 41.806	175 17 10.0	355 16 41.4	Marion.....	4.0911659	12335.76	40471.57
Rut, 1920.....	40 56 32.420 89 02 15.607	175 30 10.8	355 29 53.6	Santa Fee.....	3.8940198	7834.65	25704.18
Menok, 1920.....	40 53 36.178 89 01 55.018	175 10 52.3	355 10 39.5	Rut.....	3.7368791	5456.06	17900.42
Woodford, 1920...	40 51 11.412 89 01 40.942	175 28 57.8	355 28 47.9	Menok.....	3.6512167	4479.37	14696.07
Panola, 1920.....	40 47 01.407 89 01 13.817	175 17 20.7	355 17 03.0	Woodford.....	3.8885260	7736.15	25331.02
El Paso, 1920.....	40 44 19.125 89 00 53.755	175 25 56.7	355 25 45.6	Panola.....	3.7010153	5023.60	16481.59

GEOGRAPHIC POSITIONS—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
<i>Principal points—Continued.</i>							
Kappa, 1920.....	40 40 43.358 89 00 29.182	174 26 38.3	354 26 20.3	El Paso.....	3.8252357	6687.07	21930.16
Marshal, 1920.....	40 38 36.116 88 59 43.798	164 48 50.6	344 48 21.0	Kappa.....	3.6092723	4066.98	13343.08
Kerrick, 1920.....	40 32 27.740 88 59 13.024	176 21 31.5	356 21 11.5	Marshal.....	4.0533435	11385.80	37354.01
Bloomington, 1920	40 26 42.468 88 58 43.482	176 15 84.6	356 15 35.4	Kerrick.....	4.0282714	10672.63	35015.12
Curve, 1920.....	40 25 28.876 88 58 38.010	176 44 54.9	356 44 51.3	Bloomington..	3.3567080	2273.57	7450.20
Stines, 1920.....	40 23 07.998 88 58 47.312	182 53 19.8	2 53 25.8	Curve.....	3.6385760	4350.80	14274.45
Harlan, 1920.....	40 21 02.251 88 58 52.831	181 55 20.8	1 55 24.4	Stines.....	3.5889181	3880.77	12732.16
Heyworth, 1920....	40 18 12.381 88 58 28.346	173 42 24.0	353 42 08.1	Harlan.....	3.7219163	5271.28	17204.19
Wapella, 1920.....	40 13 14.422 88 57 44.440	173 38 46.6	363 33 18.2	Heyworth.....	3.9060735	9248.55	30342.95
Harras, 1920.....	40 10 45.712 88 57 23.620	173 52 26.8	353 52 13.4	Wapella.....	3.6639915	4613.09	15134.78
Clinton, 1920.....	40 09 23.254 88 57 22.098	179 11 20.6	359 11 19.6	Harras.....	3.4054361	2543.53	8344.90
Weld, 1920.....	40 07 34.804 88 57 19.039	179 00 12.0	359 00 10.4	Clinton.....	3.5244550	3345.45	10975.86
Ospur, 1920.....	40 05 17.396 88 57 17.758	179 23 50.5	359 23 49.3	Weld.....	3.6271911	4238.29	13905.12
Maroa, 1920.....	40 02 10.885 88 57 10.176	178 12 44.3	358 12 39.4	Ospur.....	3.7601163	5755.93	18884.25
Emery, 1920.....	39 58 03.318 88 57 00.085	178 12 18.7	358 12 12.2	Maroa.....	3.8830188	7638.69	25061.27
Forsyth, 1920.....	39 55 53.363 88 56 54.326	178 02 48.7	358 02 45.0	Emery.....	3.6031880	4010.41	13157.49
Hickory, 1920.....	39 52 10.991 88 56 45.301	178 12 36.8	358 12 31.0	Forsyth.....	3.6864325	6861.71	22512.13
Pit, 1920.....	39 50 55.282 88 56 42.185	178 11 21.2	358 11 19.2	Hickory.....	3.8685019	2336.16	7664.55
Decatur, 1920.....	39 50 42.341 88 56 46.859	195 31 30.1	15 31 33.1	Pit.....	2.6172553	414.24	1350.05
Cliker, 1920.....	39 48 24.251 88 55 20.949	207 42 31.1	27 43 31.4	Decatur.....	3.6822269	4810.91	15783.79
Elvin, 1920.....	39 47 30.792 88 55 33.544	192 19 31.0	12 19 30.1	Cliker.....	3.1472185	1403.52	4604.72
Mason, 1920.....	39 45 59.168 88 55 59.994	191 27 56.4	11 28 13.3	Elvin.....	3.6004825	8165.79	10386.43
Short, 1920.....	39 44 10.928 88 59 29.410	191 49 54.1	11 50 12.9	Mason.....	3.5338688	3414.73	11203.16
Macon, 1920.....	39 42 34.188 88 59 54.909	191 33 02.4	11 33 18.7	Short.....	3.4831657	3042.05	9980.46
Moweaqua, 1920..	39 37 33.499 89 01 15.069	191 37 23.6	11 38 14.7	Macon.....	3.9762637	9468.12	31063.32
Ray, 1920.....	39 34 01.110 89 02 11.894	191 41 25.4	11 42 01.6	Moweaqua....	3.8233395	6688.67	21944.41

GEOGRAPHIC POSITIONS.—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
<i>Principal points—Continued.</i>							
Assumption, 1920.	39 31 12.704 89 02 53.065	191 28 23.7	11 28 51.8	Ray.....	3.7242434	5299.60	17387.10
Dunkel, 1920.....	39 25 53.840 89 04 30.238	191 33 23.5	11 34 17.0	Assumption...	4.0016186	10037.34	32930.84
Pana, 1920.....	39 23 07.010 89 05 05.661	191 55 25.1	11 55 53.9	Dunkel.....	3.7208332	5253.15	17251.11
Watson, 1920.....	39 18 05.512 89 06 24.466	191 27 57.0	11 28 47.0	Pana.....	3.9771611	9487.70	31127.56
Oconee, 1920.....	39 17 11.354 80 06 34.679	188 20 09.6	8 20 16.1	Watson.....	3.2273635	1637.98	5337.08
Warren, 1920.....	39 14 47.108 89 06 34.820	180 02 46.0	0 02 46.7	Oconee.....	3.6481961	4448.32	14594.20
Leach, 1920.....	39 11 37.088 89 06 33.579	179 42 25.4	369 42 24.6	Warren.....	3.7679924	5860.93	19225.45
Ramsey, 1920.....	39 09 18.078 89 06 33.104	179 50 51.0	369 50 50.7	Leach.....	3.6321337	4280.80	14064.28
Moore, 1920.....	39 05 37.916 89 06 32.477	179 52 22.8	369 42 22.4	Ramsay.....	3.8318240	6789.28	22274.50
Lost, 1920.....	39 03 04.295 80 06 45.024	183 38 30.8	3 38 38.7	Moore.....	3.6764049	4746.84	15573.59
Vera, 1920.....	39 02 07.072 89 06 46.750	181 20 49.6	1 20 50.7	Lost.....	3.2467678	1765.09	5790.97
Jim, 1920.....	39 01 14.979 89 06 36.847	171 33 56.2	351 33 50.0	Vera.....	3.2105712	1623.94	5327.88
Clem, 1920.....	38 59 55.986 89 06 22.573	171 58 33.4	351 58 24.4	Jim.....	3.3909345	2460.00	8070.85
Garner, 1920.....	38 59 00.577 89 06 24.343	181 25 40.8	1 25 41.9	Clem.....	3.2327837	1709.16	5607.47
Dow, 1920.....	38 58 24.841 89 06 20.075	174 40 28.0	354 40 25.3	Garner.....	3.0440557	1106.77	3631.13
Cocagne, 1920.....	38 58 35.184 89 07 09.380	234 08 32.3 285 02 36.8	54 09 00.6 105 03 07.8	Garner..... Dow.....	3.1260934 3.0893756	1336.88 1228.50	4386.08 4030.50
Sturgess, 1883.....	38 56 57.121 89 06 02.602	152 00 52.9 171 09 41.1 172 10 24.6	332 00 10.9 351 09 30.1 352 10 10.9	Cocagne..... Dow..... Garner.....	3.5340049 3.4573590 3.5846455	3424.56 2737.52 3342.81	11235.41 8981.35 12697.62
<i>Supplementary points.</i>							
Clinton Junction, Bowman Dairy Co., center of brick stack, 1920. ¹	42 33 07.34 88 51 57.04	47 45 07 64 12 06	227 45 01 244 10 49	Clinton..... Buffalo.....	2.399991 8.459526	251.2 2890.9	824.1 9451.8
Beloit, First Congregational Church, spire, 1920.	42 30 05.073 89 01 39.550	275 03 18.4 297 53 34.5 40 50 05.7	95 03 53.8 117 53 53.3 220 40 13.0	Long..... Slim..... Flat.....	3.079300 2.859481 3.438480	1200.5 718.6 2744.6	3938.6 2357.6 9004.6
Roscoe siding, in- tersection of main track and east-west road (U. S. G. B.). ¹	42 24 44.55 89 02 42.44	162 00 44	342 00 80	Roscoe.....	8.1391232	1545.7	5071.2
Rockford, Ingersoll's Milling Machine Co., stack, 1920. ¹	42 17 50.61 80 04 14.19	173 48 50 177 03 38	353 48 46 357 03 30	Cumberland.. Crawford.....	3.142539 3.180608	1388.5 1615.7	4555.4 4972.8

¹ No check on this position.

GEOGRAPHIC POSITIONS—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
<i>Supplementary points—Contd.</i>							
Rookford, Catholic Church, spire, 1920. ¹	42 15 00.37 89 04 57.00	358 58 28 0 31 41	178 58 29 180 31 40	Dupage..... Dewitt.....	3.355270 3.816398	2266.1 2072.0	7434.7 6797.9
Mironk, Catholic Church, spire, 1920. ¹	40 54 15.50 89 01 45.88	11 03 45 170 39 05	191 03 38 350 39 45	Menok..... Rut.....	3.092042 3.631499	1236.1 4280.5	4055.4 14043.6
Vandalla, Ford Roofing Products Co., water tank, final, 1920.	38 57 49.137 89 06 18.943	139 28 56.6 178 34 56.6 346 12 56.3	319 28 24.9 358 34 55.9 166 13 06.6	Cocagne..... Dow..... Sturgess.....	3.271375 3.041925 3.217892	1868.0 1101.3 1651.6	6128.6 3613.2 5418.6
Vandalla, railroad water tank, final, 1920. ¹	38 58 17.41 89 06 18.78	114 14 00 172 13 44	294 13 28 352 13 43	Cocagne..... Dow.....	3.125568 2.363876	1335.3 231.1	4380.9 758.2

¹ No check on this position.

DESCRIPTIONS OF STATIONS.

This list of descriptions of stations may be conveniently consulted by reference to the illustrations at the end of this publication or to the index. All azimuths given in the descriptions are reckoned continuously from true south around by west to 360°, south being 0°, west 90°, north 180°, and east 270°. Where magnetic azimuths are given they are indicated as such. The distance between the station and reference mark is the horizontal distance unless otherwise noted.

In general, except where the contrary is specifically stated, the surface and underground mark are not in contact, so that a disturbance of the surface mark will not necessarily affect the underground mark. The underground mark should be resorted to only in cases where there is evidence that the surface mark has been disturbed.

The name and dates given in each description immediately after the county refer to the chief of party by whom the station was established, the date of the establishment of the station, and the date when the station was last recovered.

Any person who finds that one of the stations herein described has been disturbed or that the description no longer fits the facts is requested to send such information to the Director, U. S. Coast and Geodetic Survey, Washington, D. C.

The standard station and reference marks (see Fig. 1) referred to in the following descriptions and notes consist of a disk and shank of bronze cast in one piece. The disk of the station mark is 90 millimeters in diameter, with a hole at the center surrounded by a 20-millimeter equilateral triangle, and has the following inscribed legend: "U. S. Coast and Geodetic Survey Triangulation Station. For information write to the Superintendent, Washington, D. C. \$250 fine or imprisonment for disturbing this mark." The shank is 25 millimeters in diameter and 80 millimeters long, with several grooves cut around it to give a secure anchorage in concrete. The name of the station and the year in which it was established are stamped on the station mark.

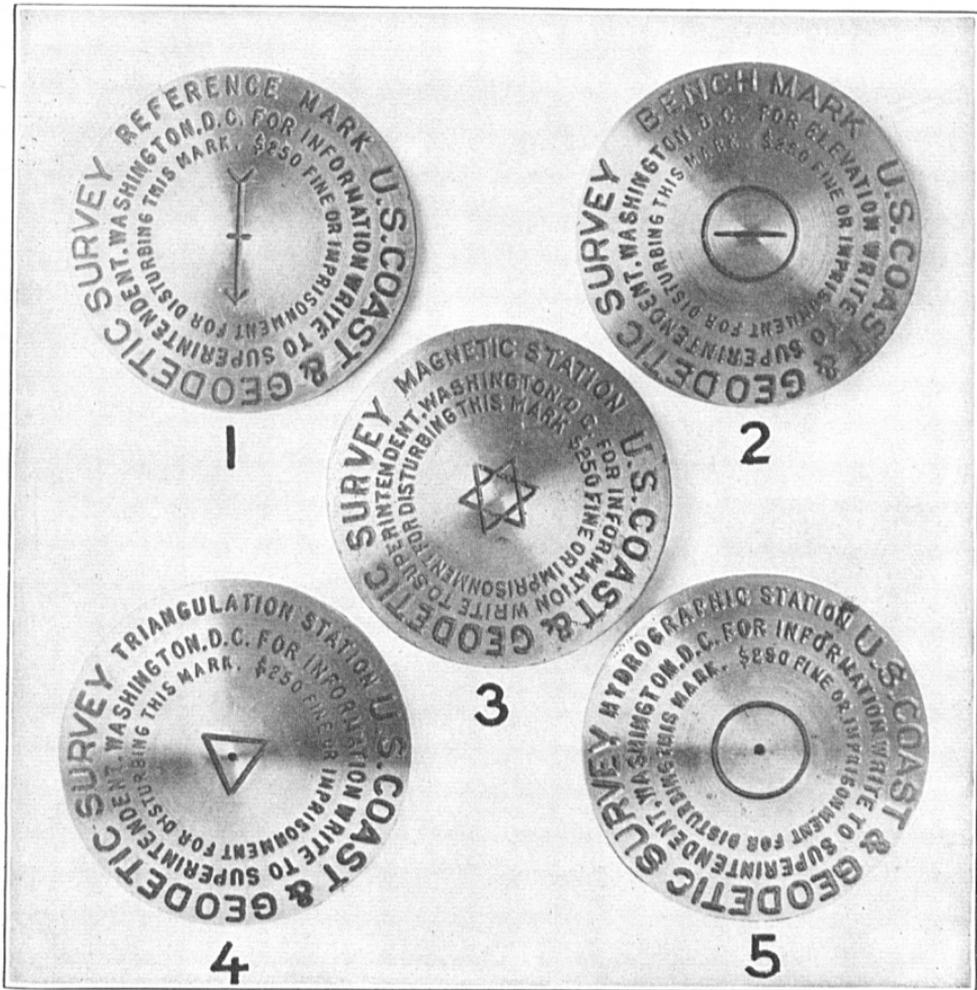


FIG. 1.—STANDARD MARKS OF THE U. S. COAST AND GEODETIC SURVEY.

1. Reference mark.
2. Bench mark.
3. Magnetic station mark.
4. Triangulation station mark.
5. Hydrographic station mark.

The standard reference mark, shown in Figure 1, is the same size and shape as the station mark, with an arrow on the top in place of the triangle, which, when properly set, points to the station. The legend is the same, except the words "reference mark" take the place of the words "triangulation station."

STANDARD NOTES ON THE MARKING OF STATIONS.

Surface marks.

Note 1.—A standard bronze tablet set in the top of (a) a square block or post of concrete, (b) a concrete cylinder, (c) an irregular mass of concrete.

Note 2.—A standard bronze tablet wedged in a drill hole in outcropping bedrock, (a) and surrounded by a triangle chiseled in the rock, (b) and surrounded by a circle chiseled in the rock, (c) at the intersection of two lines chiseled in the rock.

Note 3.—A standard bronze tablet set in concrete in a depression in outcropping bedrock.

Note 4.—A standard bronze tablet wedged in a drill hole in a bowlder.

Note 5.—A standard bronze tablet set in concrete in a depression in a bowlder.

Note 6.—A standard bronze tablet set in concrete at the center of the top of a tile (a) which is embedded in the ground, (b) which is surrounded by a mass of concrete, (c) which is fastened by means of concrete to the upper end of a long wooden pile driven into the marsh, (d) which is set in a block of concrete and projects from 12 to 20 inches above the block.

Underground marks.

Note 7.—A block of concrete 3 feet below the ground containing at the center of its upper surface (a) a standard bronze tablet, (b) a copper bolt projecting slightly above the concrete, (c) an iron nail with the point projecting above the concrete, (d) a glass bottle with the neck projecting a little above the concrete, (e) an earthenware jug with the mouth projecting a little above the concrete.

Note 8.—In bedrock, (a) a standard bronze tablet wedged in a drill hole, (b) a standard bronze tablet set in concrete in a depression, (c) a copper bolt set in cement in a drill hole or depression, (d) an iron spike set point up in cement in a drill hole or depression.

Note 9.—In a bowlder 3 feet below the ground, (a) a standard bronze tablet wedged in a drill hole, (b) a standard bronze tablet set in concrete in a depression, (c) a copper bolt set with cement in a drill hole or depression, (d) an iron spike set with cement in a drill hole or depression.

Note 10.—Embedded in earth 3 feet below the surface of the ground, (a) a bottle in an upright position, (b) an earthenware jug in an upright position, (c) a brick in horizontal position with a drill hole in its upper surface.

Reference marks.

Note 11.—A standard bronze tablet, with the arrow pointing toward the station, set at the center of the top of (a) a square block or post of concrete, (b) a concrete cylinder, (c) an irregular mass of concrete.

Note 12.—A standard bronze tablet, with the arrow pointing toward the station, (a) wedged in a drill hole in outcropping bedrock, (b) set in concrete in a depression in outcropping bedrock, (c) wedged in a drill hole in a bowlder, (d) set in concrete in a depression in a bowlder.

Note 13.—A standard bronze tablet, with the arrow pointing toward the station, set in concrete at the center of the top of a tile, (a) which is embedded in the ground, (b) which is surrounded by a mass of concrete, (c) which is fastened by means of concrete to the upper end of a long wooden pile driven into the marsh, (d) which is set in a block of concrete and projects from 12 to 20 inches above the block.

Witness marks.

Note 14.—A conical mound of earth surrounded by a circular trench.

Note 15.—A tree marked with (a) a triangular blaze with a nail at the center and each apex of the triangle, (b) a square blaze with a nail at the center and each corner of the square, (c) a blaze with a standard disk reference mark set at its center into the tree.

PRINCIPAL POINTS.

Dover (U. S. L. S.) (Racine County, Wis., U. S. Lake Survey, 1873; 1920).—About $1\frac{1}{2}$ miles east of Kansasville, in the southwest quarter of section 6, Dover Township, on a small knoll, 275 yards northeast of the J. W. Payne homestead. The station mark is a bronze tablet set in concrete as described in note 1a, and the underground mark is a stone set so that its upper end is 27 inches below the surface of the ground. Two reference stones are set in the road south of the station. One bears S. $14^{\circ} 13' E.$, distant 318.58 meters (1,045.21 feet) from the station, and the second bears S. $35^{\circ} 08' W.$, distant 190.42 meters (624.74 feet) from the station. The elevation of the ground at the station is 860 feet.

Midway (Racine County, Wis., J. S. Bilby, 1920).—About $1\frac{1}{2}$ miles east of Kansasville, in Dover Township, on the east side of the first road turning south after crossing the Chicago, Milwaukee & St. Paul Railway in following the Burlington-Racine highway from Burlington, $\frac{3}{4}$ mile south of the tracks, 1 yard west of the east fence line of the north and south half-section road of section 6, 100 yards south of the center of the section, and $\frac{1}{2}$ mile north of the Dover township line. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the road, 13.78 meters (45.21 feet) from the station, in azimuth $92^{\circ} 50'$.

Kansas (Racine County, Wis., J. S. Bilby, 1920).—About 1 mile east of Kansasville, on the north side of the Chicago, Milwaukee & St. Paul Railway track, 200 yards east of the Burlington-Racine highway crossing, 100 yards northeast of G. A. Beacher's residence, and 4.33 meters (14.21 feet) north of the north and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, near the fence line, 20.04 meters (65.75 feet) from the station, in azimuth $337^{\circ} 12'$.

Vilas (Racine County, Wis., J. S. Bilby, 1920).—About $3\frac{1}{4}$ miles east of Burlington, on the south side of the Chicago, Milwaukee & St. Paul Railway track, $1\frac{1}{4}$ miles west of Rosewood, on the summit of what is known as the Dover Hill grade, 40 yards east of the wagon road crossing leading across the track from the P. J. Cunningham farm, and 5.93 meters (19.46 feet) south of the south and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 18.48 meters (60.63 feet) from the station, in azimuth $287^{\circ} 51'$.

Wilmont (Racine County, Wis., J. S. Bilby, 1920).—About 1 mile east of the Chicago, Milwaukee & St. Paul Railway station at Burlington, on the south side of the track, 80 yards west of a tower at the intersection of the Chicago, Milwaukee & St. Paul Railway and the Minneapolis, St. Paul & Sault Ste. Marie Railway, 10 yards west of a highway crossing, and 4.41 meters (14.47 feet) south of the south and nearest rail. The station and underground marks are bronze tablets set in concrete as described in notes 1a and 7a. The reference mark is on the same side of the track and is a bronze tablet set in the concrete base of the block signal mechanism, 8.20 meters (26.90 feet) from the station, in azimuth $105^{\circ} 56'$.

Oneida (Racine County, Wis., J. S. Bilby, 1920).—About $\frac{3}{4}$ mile east of the Chicago, Milwaukee & St. Paul Railway station at Burlington, on the north side of the track, 20 yards northwest of the switch signal for the east end of the Burlington yards, 220 yards east of the extension of Kane Street, on the north bank of the first cut west of the signal tower at the crossing of the Chicago, Milwaukee & St. Paul and the Minneapolis, St. Paul & Sault Ste. Marie Railways and 8.60 meters (28.22 feet) north of the north and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 10.22 meters (33.53 feet) from the station, in azimuth $119^{\circ} 38'$.

Burlington (Racine County, Wis., J. S. Bilby, 1920).—At Burlington, about 385 yards east of the Chicago, Milwaukee & St. Paul Railway station, on the north side of the track, 330 yards east of the intersection of Market and McHenry Streets, on the north edge of Market Street, 55 yards north of semaphore signal No. 26/6, and 27.18 meters (89.17 feet) north of the north and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 9.68 meters (31.76 feet) from the station, in azimuth $97^{\circ} 55'$.

Oconto (Racine County, Wis., J. S. Bilby, 1920).—About $\frac{1}{2}$ mile west of the railroad station at Burlington, on the south side of the Chicago, Milwaukee & St. Paul

Railway track, 330 yards east of the Burlington gravel and sand pit, 100 yards east of the switch signal for the gravel pit siding, and 5.42 meters (17.78 feet) south of the south and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 13.79 meters (45.24 feet) from the station, in azimuth 262° 35'.

Lang (Racine County, Wis., J. S. Bilby, 1920).—About 1 mile west of the railroad station at Burlington, on the south side of the Chicago, Milwaukee & St. Paul Railway track, 220 yards east of a highway crossing, 135 yards west of the Racine County gravel and sand pit, on the highest ground of the cuts between the gravel pit and the highway crossing, and 16.16 meters (53.02 feet) south of the south and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the corner of a field, 38.29 meters (125.62 feet) from the station, in azimuth 60° 16'.

Kenosha (Walworth County, Wis., J. S. Bilby, 1920).—About 1 mile east of Springfield, on the north side of the Chicago, Milwaukee & St. Paul Railway track, $\frac{3}{8}$ mile east of a wagon road crossing, 65 yards west of the east switch signal for the passing track at Springfield, 220 yards east of the west end of the first cut east of Springfield, and 15.36 meters (50.39 feet) north of the north and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 16.50 meters (54.13 feet) from the station, in azimuth 260° 56'.

Bureau (Walworth County, Wis., J. S. Bilby, 1920).—About $4\frac{3}{4}$ miles east of Elkhorn, on the north side of the Chicago, Milwaukee & St. Paul Railway track, 220 yards north of a district schoolhouse, near the west fence line of the first road crossing east of Elkhorn, which has an electric dangersignal, and 5.95 meters (19.52 feet) north of the north and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, but on the opposite side of the road, 22.55 meters (73.98 feet) from the station, in azimuth 232° 03'.

Whistle (Walworth County, Wis., J. S. Bilby, 1920).—About $4\frac{1}{2}$ miles east of Elkhorn, on the south side of the Chicago, Milwaukee & St. Paul Railway track, 330 yards east of an old north and south grade for a railroad track, on the south bank of the second deep cut west of a road crossing, 13 yards from the edge of the bank, and 24.35 meters (79.89 feet) from the south and nearest rail. The station mark is a stake 2 by 4 inches in size, with a nail in the top, and the reference mark is a stake 2 by 4 inches in size, with a cross sawed in the top. The reference mark is on the same side of the track, near the fence line, 14.22 meters (46.65 feet) from the station, in azimuth 279° 44'.

Bank (Walworth County, Wis., J. S. Bilby, 1920).—About $4\frac{1}{4}$ miles east of Elkhorn, on the south side of the Chicago, Milwaukee & St. Paul Railway track, 275 yards east of a post marked "Section 5," 9 yards from the edge of the bank and 11.28 meters (37.01 feet) south of the south and nearest rail. The station mark is a stake 2 by 4 inches in size, with a nail in the top, and the reference mark is a stake 2 by 4 inches in size, with a cross sawed in the top. The reference mark is on the same side of the track, near the fence line, 7.61 meters (24.97 feet) from the station, in azimuth 142° 01'.

Iron (Walworth County, Wis., J. S. Bilby, 1920).—About 4 miles east of Elkhorn, on the north side of the Chicago, Milwaukee & St. Paul Railway track, 165 yards west of culvert No. 151, near the second curve east of Elkhorn, on the north bank of a deep cut, and 14.85 meters (48.72 feet) north of the north and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 14.83 meters (48.65 feet) from the station, in azimuth 184° 58'.

Iowa (Walworth County, Wis., J. S. Bilby, 1920).—About 2 miles east of Elkhorn, on the south side of the Chicago, Milwaukee & St. Paul Railway track, on the peak of the first rise east of Elkhorn, directly north of the residence of G. T. Wilkerson, and 3.62 meters (11.88 feet) south of the south and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 12.56 meters (41.21 feet) from the station, in azimuth 314° 48'.

Elkhorn (Walworth County, Wis., J. S. Bilby, 1920).—At Elkhorn, about 125 yards east of the Chicago, Milwaukee & St. Paul Railway station, on the north side of the track, 30 yards northwest of the freight station, 45 yards north of South Wisconsin Street, 60 yards southwest of the Elkhorn Lumber Co. office, 21.93 meters

(71.95 feet) north of the north and nearest rail of the main line, and 4.33 meters (14.21 feet) south of the south and nearest rail of the Eagle Division. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the Eagle Division tracks, 18.33 meters (60.14 feet) from the station, in azimuth $108^{\circ} 57'$.

Forest (Walworth County, Wis., J. S. Bilby, 1920).—About $\frac{3}{4}$ mile west of Elkhorn, on the south side of the Chicago, Milwaukee, & St. Paul Railway track, 135 yards west of the west switch signal for the siding at Elkhorn, $\frac{1}{4}$ mile west of Dallas E. Davis's Holstein dairy farm and 2.05 meters (6.73 feet) south of the south and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, near the fence line, 16.84 meters (55.25 feet) from the station, in azimuth $265^{\circ} 54'$.

Fond (Walworth County, Wis., J. S. Bilby, 1920).—About 2 miles west of Elkhorn, on the north side of the Chicago, Milwaukee & St. Paul Railway track, in the southwest corner of the second field $\frac{1}{4}$ mile east of a road which runs north and south past Delavan Prairie District No. 7 school, and 18.60 meters (61.02 feet) north of the north and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence corner, 15.22 meters (49.93 feet) from the station, in azimuth $25^{\circ} 44'$.

Elorence (Walworth County, Wis., J. S. Bilby, 1920).—About $1\frac{1}{2}$ miles east of Delavan, on the north side of the Chicago, Milwaukee & St. Paul Railway track, 35 yards east of the second road crossing east of the city limits of Delavan, and 3.07 meters (10.07 feet) north of the north and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, near the fence line, 13.38 meters (43.90 feet) from the station, in azimuth $204^{\circ} 19'$.

Delavan (Walworth County, Wis., J. S. Bilby, 1920).—About $\frac{3}{4}$ mile east of the railroad station at Delavan, on the south side of the Chicago, Milwaukee & St. Paul Railway track, 100 yards east of the first road crossing east of the city limits of Delavan, and 2.34 meters (7.68 feet) south of the south and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, near the fence line, 12.33 meters (40.45 feet) from the station, in azimuth $160^{\circ} 03'$.

Dunn (Walworth County, Wis., J. S. Bilby, 1920).—About $\frac{1}{2}$ mile east of Darien, on the north side of the Chicago, Milwaukee & St. Paul Railway track, 150 yards west of a wagon-road crossing, on the northwest bank of the third cut east of Darien, and 6.11 meters (20.05 feet) north of the north and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 15.68 meters (51.44 feet) from the station, in azimuth $218^{\circ} 33'$.

Darien (Walworth County, Wis., J. S. Bilby, 1920).—At Darien, on the south side of the Chicago, Milwaukee & St. Paul Railway track, 125 yards west of the railroad station, 4 yards north of the west side of the shed of the Burker Coal Co., between the side track for the coal shed and the passing track, and 7.24 meters (23.75 feet) south of the south and nearest rail of the main line. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, near the fence line, 21.94 meters (71.98 feet) from the station, in azimuth $158^{\circ} 42'$.

Door (Walworth County, Wis., J. S. Bilby, 1920).—About 2 miles west of Darien, on the south side of the Chicago, Milwaukee & St. Paul Railway track, 80 yards west of the road leading north from Allen Grove, 125 yards west of the railroad bridge, and 8.74 meters (28.67 feet) south of the south and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 17.46 meters (57.28 feet) from the station, in azimuth $56^{\circ} 07'$.

Dodge (Walworth County, Wis., J. S. Bilby, 1920).—About $\frac{1}{2}$ mile east of Allen Grove railroad station, on the south side of the Chicago, Milwaukee & St. Paul Railway track, 150 yards northeast of Theodore Langkoltz's residence, on the south bank of a deep cut, and 10.59 meters (34.74 feet) south of the south and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 22.14 meters (72.64 feet) from the station, in azimuth $70^{\circ} 01'$.

Dane (Rock County, Wis., J. S. Bilby, 1920).—About $3\frac{1}{4}$ miles east of Clinton, on the north side of the Chicago, Milwaukee & St. Paul Railway track, near the center of the first curve west of Allen Grove, and 10.55 meters (34.62 feet) north of the north and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 19.25 meters (63.16 feet) from the station, in azimuth $240^{\circ} 05'$.

Calumet (Rock County, Wis., J. S. Bilby, 1920).—About $2\frac{3}{4}$ miles east of Clinton, on the north side of the Chicago, Milwaukee & St. Paul Railway track, 200 yards west of a wagon-road crossing, 100 yards east of the Allen Grove sign marked "Station 1 mile," on the edge of the north bank of a cut, and 8.74 meters (28.68 feet) north of the north and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 15.43 meters (50.62 feet) from the station, in azimuth $226^{\circ} 13'$.

Burnett (Rock County, Wis., J. S. Bilby, 1920).—About $\frac{3}{4}$ mile east of Clinton, on the north side of the Chicago, Milwaukee & St. Paul Railway track, 55 yards east of the first road crossing east of Clinton, 80 yards east of the semaphore signal controlling the east end of the yards at Clinton, and 8.75 meters (28.71 feet) north of the north and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 12.02 meters (39.44 feet) from the station, in azimuth $225^{\circ} 44'$.

Clinton (Rock County, Wis., J. S. Bilby, 1920).—About $\frac{3}{8}$ mile west of the railroad station at Clinton, on the south side of the Chicago, Milwaukee & St. Paul Railway track, 250 yards west of the crossing of a road which runs north and south in front of the Bowman Dairy Co., about 220 yards west of the Bowman Dairy Co., near the west end of the first cut west of Clinton, and 5.25 meters (17.22 feet) south of the south and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track near the fence line, 9.92 meters (32.55 feet) from the station, in azimuth $305^{\circ} 21'$.

Buffalo (Rock County, Wis., J. S. Bilby, 1920).—About $1\frac{3}{4}$ miles west of Clinton, on the north side of the Chicago, Milwaukee & St. Paul Railway track, $\frac{1}{2}$ mile west of the first section line road crossing west of Clinton, in an orchard, and 17.02 meters (55.84 feet) north of the north and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the north side of the railroad property line fence, 20.48 meters (67.19 feet) from the station, in azimuth $264^{\circ} 09'$.

Bayfield (Rock County, Wis., J. S. Bilby, 1920).—About $2\frac{1}{4}$ miles west of Clinton, on the south side of the Chicago, Milwaukee & St. Paul Railway track, $\frac{1}{4}$ mile east of a road crossing, 150 yards west of railroad bridge No. E 85, on the south bank of a cut, and 8.65 meters (28.38 feet) south of the south and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 17.39 meters (57.05 feet) from the station, in azimuth $277^{\circ} 17'$.

Barron (Rock County, Wis., J. S. Bilby, 1920).—About 7 miles east of Beloit, on the south side of the Chicago, Milwaukee & St. Paul Railway track, $\frac{1}{2}$ mile east of a road crossing, 100 yards northwest of railroad bridge No. E 180 and 13.32 meters (43.71 feet) south of the south and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 14.41 meters (47.28 feet) from the station, in azimuth $267^{\circ} 15'$.

Ashland (Rock County, Wis., J. S. Bilby, 1920).—About 6 miles east of Beloit, on the south side of the Chicago, Milwaukee & St. Paul Railway track, 150 yards west of a road crossing, 330 yards east of railroad bridge No. E 184, 110 yards east of the Porter sign marked "Station 1 mile," and 1.96 meters (6.43 feet) south of the south and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 11.65 meters (38.22 feet) from the station, in azimuth $22^{\circ} 27'$.

Cut (Rock County, Wis., J. S. Bilby, 1920).—About $5\frac{5}{8}$ miles east of Beloit, on the north side of the Chicago, Milwaukee & St. Paul Railway track, $\frac{2}{3}$ mile east of the railroad station at Porter, on the north edge of a rocky cut, 90 yards west of railroad

bridge No. E 184 and 6.17 meters (20.24 feet) north of the north rail. The station and reference marks are pine stakes 2 by 4 inches in size. The reference mark is on the same side of the track, near the fence line, 15.50 meters (50.85 feet) from the station, in azimuth $82^{\circ} 55'$.

Cave (Rock County, Wis., J. S. Bilby, 1920).—About $5\frac{1}{2}$ miles east of Beloit, on the north side of the Chicago, Milwaukee & St. Paul Railway track, $\frac{3}{4}$ mile east of the railroad station at Porter, 150 yards east of the east end of the first deep cut east of Porter, on the north bank of a deep fill, and 1.78 meters (5.84 feet) north of the north and nearest rail. The station and reference marks are pine stakes 2 by 4 inches in size. The reference mark is on the same side of the track, along the edge of the fill, 19.00 meters (62.34 feet) from the station, in azimuth $58^{\circ} 46'$.

Morgan (Rock County, Wis., J. S. Bilby, 1920).—About 3 miles east of Beloit, on the north side of the Chicago, Milwaukee & St. Paul Railway track, 2 yards east of the wagon road crossing leading south across the track from Morgan's farm, 1 mile east of the Beloit Junction sign, $\frac{1}{2}$ mile west of Morgan's spur track, and 2.18 meters (7.15 feet) north of the north and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, near the fence line, 24.38 meters (79.99 feet) from the station, in azimuth $8^{\circ} 33'$.

Long (Rock County, Wis., J. S. Bilby, 1920).—About $1\frac{1}{2}$ miles east of Beloit, on the south side of the Chicago, Milwaukee & St. Paul Railway track, 80 yards west of the point of tangency at the east end of the second curve east of Beloit, 330 yards west of Beloit Junction, and 1.78 meters (5.84 feet) south of the south and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, near the fence line, 17.71 meters (58.10 feet) from the station, in azimuth $148^{\circ} 13'$.

Slim (Rock County, Wis., J. S. Bilby, 1920).—About 1 mile east of the railroad station at Beloit, on the south side of the Chicago, Milwaukee & St. Paul Railway track, 165 yards east of the East Grand Avenue crossing over the track, 100 yards east of the point of tangency of the second curve east of Beloit, and 1.56 meters (5.12 feet) south of the south and nearest rail. The station mark is a pine stake 2 by 4 inches in size, with a nail in the top, and the reference mark is a similar stake with a cross sawed on the top. The reference mark is on the opposite side of the track, near the fence line, 16.22 meters (53.22 feet) from the station, in azimuth $157^{\circ} 23'$.

Short (Rock County, Wis., J. S. Bilby, 1920).—At Beloit, on the south side of the Chicago, Milwaukee & St. Paul Railway track, $\frac{1}{2}$ mile east of the railroad station, 25 yards west of the post marked "Beloit Junction 1 mile," 65 yards southeast of the intersection of Short Street and St. Paul Avenue, 85 yards west of the crossing of St. Paul Avenue and the Chicago, Milwaukee & St. Paul Railway track, and 2.65 meters (8.69 feet) south of the south and nearest rail. The station and underground marks are bronze tablets set in concrete as described in notes 1a and 7a. The reference mark is a bronze tablet set in the north curb of St. Paul Avenue, 21.14 meters (69.36 feet) from the station, in azimuth $191^{\circ} 27'$.

Beloit (Rock County, Wis., J. S. Bilby, 1920).—At Beloit, on the railroad station platform, on the north side of the Chicago, Milwaukee & St. Paul Railway track, 0.605 meter (1.98 feet) east of the edge of a brick walk leading south from the west side of the railroad station, and 4.87 meters (15.98 feet) north of the north and nearest rail. The station mark is a bronze tablet set in the brick-paved platform of the railroad station. The southwest corner of the railroad station is 12.49 meters (40.98 feet) from the station, in azimuth $210^{\circ} 04'$. The southwest corner of the southwest post of the covered railroad station platform is 11.55 meters (37.89 feet) from the station, in azimuth $163^{\circ} 04'$.

State Line (Rock County, Wis., J. S. Bilby, 1920).—At Beloit, on the west side of the Chicago, Milwaukee & St. Paul Railway track, 330 yards south of the railroad station, 20 yards northwest of a State line post, 55 yards south of the intersection of Shirland Avenue and the railroad track, and 2.90 meters (9.51 feet) west of the west and nearest rail. This station does not mark the State boundary. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the corner of a long shed, 22.11 meters (72.54 feet) from the station, in azimuth $228^{\circ} 11'$.

Flat (Winnebago County, Ill., J. S. Bilby, 1920).—About $1\frac{1}{2}$ miles south of Beloit, Wis., on the east side of the Chicago, Milwaukee & St. Paul Railway track, 100 yards south of a signpost marked "Railroad crossing 1 mile," 190 yards north of the south switch signal for the yards at Beloit, and 2.62 meters (8.60 feet) east of the east and

nearest rail of the main track. The station and reference marks are pine stakes 2 by 4 inches in size. The station mark has a nail with a cross on it and the reference mark has a cross sawed in the top. The reference mark is on the same side of the track, near the fence line, 11.13 meters (36.52 feet) from the station, in azimuth $300^{\circ} 37'$.

Limit (Winnebago County, Ill., J. S. Bilby, 1920).—About $1\frac{3}{4}$ miles south of Beloit, Wis., on the east side of the Chicago, Milwaukee & St. Paul Railway track, $\frac{1}{4}$ mile north of the signpost marked "Station 1 mile," 30 yards northeast of the signpost marked "Yard Limit," on the edge of the bank of a railroad cut, and 19.33 meters (63.42 feet) east of the east and nearest rail. The station and reference marks are pine stakes 2 by 4 inches in size. The station mark has a nail with a cross on it, and the reference mark has a cross sawed in the top. The reference mark is on the same side of the track, near the fence line, 21.82 meters (71.59 feet) from the station, in azimuth $34^{\circ} 14'$.

Shaw (Winnebago County, Ill., J. S. Bilby, 1920).—About 1 mile north of Rockton, on the west side of the Chicago, Milwaukee & St. Paul Railway track, 80 yards south of the signpost marked "Station 1 mile," 100 yards south of bridge E 224, 270 yards west of the residence of G. Shaw, 3 yards south of a farm road crossing where the road leading west from Shaw's barnyard crosses the track, and 2.67 meters (8.76 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 9.57 meters (31.40 feet) from the station, in azimuth $128^{\circ} 28'$. The elevation of the station mark is 229.844 meters (754.080 feet) and of the reference mark 229.688 meters (753.568 feet).

Rockton (Winnebago County, Ill., J. S. Bilby, 1920).—At Rockton, about 15 yards east of the Chicago, Milwaukee & St. Paul Railway station, 40 yards north of a siding switch signal which is southeast of the railway station, 140 yards south of a coal tipple, and 6.81 meters (22.34 feet) west of the west and nearest rail. The station and underground marks are bronze tablets set in concrete as described in notes 1a and 7a. The reference mark is a bronze tablet set in the edge of the concrete sidewalk. The reference mark is on the same side of the track, 2.69 meters (8.83 feet) from the station, in azimuth $235^{\circ} 23'$. The elevation of the station mark is 227.647 meters (746.872 feet) and of the reference mark 227.486 meters (746.344 feet).

Bond (Winnebago County, Ill., J. S. Bilby, 1920).—About 1 mile south of Rockton, on the west side of the Chicago, Milwaukee, & St. Paul Railway track, 80 yards south of the south end of the railroad bridge over Rock River, 100 yards north of a tipple for loading molding sand, 30 yards east of Johnson brothers' barn, and 7.01 meters (23 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 9.99 meters (32.78 feet) from the station, in azimuth $121^{\circ} 28'$. The elevation of the station mark is 222.867 meters (731.180 feet).

Alexander (Winnebago County, Ill., J. S. Bilby, 1920).—About $1\frac{1}{2}$ miles south of Rockton, on the east side of the Chicago, Milwaukee & St. Paul Railway track, 220 yards north of the railroad bridge E 550, 160 yards north of the north end of a large gravel pit, 40 yards south of the south yard limit sign for Rockton, and 6.95 meters (22.80 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, near the fence line, 22.48 meters (73.75 feet) from the station, in azimuth $71^{\circ} 41'$. The elevation of the station mark is 225.726 meters (740.569 feet).

Adams (Winnebago County, Ill., J. S. Bilby, 1920).—About 2 miles south of Rockton, on the west side of the Chicago, Milwaukee & St. Paul Railway track, on extension of the east rail of the tangent to the south, 30 yards west of the south end of a large gravel pit, 375 yards northeast of Charlie Kuntzman's residence, and 5.34 meters (17.52 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, 15.53 meters (50.95 feet) from the station in azimuth $246^{\circ} 25'$. The elevation of the station mark is 230.498 meters (756.226 feet) and of the reference mark 229.979 meters (754.523 feet).

Roscoe (Winnebago County, Ill., J. S. Bilby, 1920).—About $2\frac{3}{4}$ miles south of Rockton, on the east side of the Chicago, Milwaukee & St. Paul Railway track, at the intersection of the east rail tangents, 325 yards north of a road crossing, 50 yards north of a post marked "Station 1 mile," 270 yards northeast of Philip Black's residence, and 5.78 meters (18.96 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in

notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 7.21 meters (23.65 feet) from the station, in azimuth $254^{\circ} 19'$. The elevation of the station mark is 231.256 meters (758.712 feet) and of the reference mark 231.519 meters (759.575 feet).

Boon (Winnebago County, Ill., J. S. Bilby, 1920).—About 4 miles south of Rockton, on the west side of the track, $\frac{3}{8}$ mile north of bridge 558 over a wagon road crossing, 140 yards southwest of the northeast corner of Oscar A. Funk's farm and 107.05 meters (351.21 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, directly north of the station and near the fence line, 114.98 meters (377.23 feet) from the station, in azimuth $175^{\circ} 51'$.

Brown (Winnebago County, Ill., J. S. Bilby, 1920).—About $4\frac{3}{4}$ miles south of Rockton, on the west side of the Chicago, Milwaukee & St. Paul Railway track, 80 yards south of bridge 558 E over a wagon road crossing, 325 yards south of Oscar A. Funk's residence, and 8.63 meters (28.31 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 5.07 meters (16.63 feet) from the station, in azimuth $106^{\circ} 16'$. The elevation of the station mark is 222.750 meters (730.806 feet) and of the reference mark 222.318 meters (729.388 feet).

Bureau (Winnebago County, Ill., J. S. Bilby, 1920).—About 5 miles south of Rockton, on the east side of the Chicago, Milwaukee & St. Paul Railway track, 160 yards south of railroad bridge E 560, on the east bank of a deep cut between the railroad and the river, 100 yards north of the north end of the picnic and camping grounds on J. S. Johnson's farm, 300 yards northeast by east from J. S. Johnson's residence, and 4.40 meters (14.44 feet) east of the east and nearest rail. The station and reference marks are elm stakes, each with a nail in the top, and a cross filed on the nail. The reference mark is on the same side of the track, 3.85 meters (12.63 feet) from the station, in azimuth $30^{\circ} 00'$.

Calhoun (Winnebago County, Ill., J. S. Bilby, 1920).—About $5\frac{1}{8}$ miles south of Rockton, on the east side of the Chicago, Milwaukee & St. Paul Railway track, 100 yards north of railroad bridge E 564, 100 yards east of J. L. Johnson's barn, west of the picnic and camping ground, and 1.69 meters (5.54 feet) east of the east and nearest rail. The station and reference marks are green stakes, each with a nail in the top and a cross filed on the nail. The reference mark is on the opposite side of the track, 12.50 meters (41.01 feet) from the station, in azimuth $122^{\circ} 42'$.

Carroll (Winnebago County, Ill., J. S. Bilby, 1920).—About 1 mile north of Latham Park, on the west side of the Chicago, Milwaukee & St. Paul Railway track, 80 yards south of railroad bridge E 566, 130 yards north of the "Station 1 mile" sign, and 5.85 meters (19.20 feet) west of the west and nearest rail. The station mark is a stake 2 by 4 inches in size, with a nail with a cross filed on the head, and the reference mark is a stake of the same size with an arrow sawed in the top. The reference mark is on the same side of the track, 4.11 meters (13.48 feet) from the station, in azimuth $126^{\circ} 50'$. The elevation of the station mark is 225.421 meters (739.569 feet).

Latham (Winnebago County, Ill., J. S. Bilby, 1920).—At Latham Park, 4 yards north of the north end of the railroad station, on the east side of the Chicago, Milwaukee & St. Paul Railway track, 25 yards northwest of the northwest corner of a large ice house, 80 yards north of the section tool house, and 2.07 meters (6.79 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, just north of the northwest corner of the railroad station platform, 13.86 meters (45.47 feet) from the station, in azimuth $309^{\circ} 13'$. The elevation of the station mark is 220.974 meters (724.979 feet) and of the reference mark 220.701 meters (724.083 feet).

Cass (Winnebago County, Ill., J. S. Bilby, 1920).—About $\frac{1}{4}$ mile south of Latham Park railroad station, on the east side of the Chicago, Milwaukee & St. Paul Railway track, 160 yards south of railroad bridge E 574, 10 yards north of a wagon road crossing, 200 yards southeast of Mrs. L. P. Crowell's barn, and 3.88 meters (12.73 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 9.92 meters (32.55 feet) from the station, in azimuth $107^{\circ} 54'$. The elevation of the station mark is 221.434 meters (726.488 feet).

Champaign (Winnebago County, Ill., J. S. Bilby, 1920).—About $\frac{3}{4}$ mile south of Latham Park railroad station, on the east side of the Chicago, Milwaukee & St. Paul

Railway track, 200 yards south of railroad bridge E 576, and 1.91 meters (6.27 feet) east of the east and nearest rail. The station and reference marks are stakes 2 by 4 inches in size, each with a nail in the top and a cross filed on the nail. The reference mark is on the opposite side of the track, near the fence line, 16.67 meters (54.69 feet) from the station, in azimuth $107^{\circ} 53'$.

Christian (Winnebago County, Ill., J. S. Bilby, 1920).—About $\frac{7}{8}$ mile south of Latham Park, on the east side of the Chicago, Milwaukee & St. Paul Railway track, 1 yard south of a wagon road crossing, 160 yards north of the "Station 1 mile" sign, and 3.30 meters (10.83 feet) east of the east and nearest rail. The station and reference marks are stakes 2 by 4 inches in size, each with a nail in the top and a cross filed on the nail. The reference mark is on the opposite side of the track near the fence line, 19.47 meters (63.88 feet) from the station, in azimuth $102^{\circ} 48'$.

Clark (Winnebago County, Ill., J. S. Bilby, 1920).—About $1\frac{1}{2}$ miles south of Latham Park, on the east side of the Chicago, Milwaukee & St. Paul Railway track, 200 yards south of a road crossing, on the east bank of the deep cut south of the road crossing, and 6.72 meters (22.05 feet) east of the east and nearest rail. The station and reference marks are stakes 2 by 4 inches in size, each with a nail in the top and a cross filed on the nail. The reference mark is on the same side of the track, near the fence line, 7.48 meters (24.54 feet) from the station, in azimuth $349^{\circ} 30'$.

Clay (Winnebago County, Ill., J. S. Bilby, 1920).—About $1\frac{3}{4}$ miles south of Latham Park, on the west side of the Chicago, Milwaukee & St. Paul Railway track, at the south end of a deep cut, and 5.10 meters (16.73 feet) west of the west and nearest rail. The station and reference marks are stakes 2 by 4 inches in size, each with a nail in the top and a cross filed on the nail. The reference mark is on the same side of the track, 7.81 meters (25.62 feet) from the station, in azimuth $214^{\circ} 55'$.

Clinton (Winnebago County, Ill., J. S. Bilby, 1920).—About 2 miles south of Latham Park, on the west side of the Chicago, Milwaukee & St. Paul Railway track, 5 yards north of railroad bridge E 580, and 2.11 meters (6.92 feet) west of the west and nearest rail. The station is marked by a green sapling stake with a nail in the top and a cross filed on the nail. The reference mark, on the same side of the track, is a bolt head in the north end of the bridge, with an arrow and wording stamped on it, 6.73 meters (22.08 feet) from the station, in azimuth $12^{\circ} 03'$.

Genet (Winnebago County, Ill., J. S. Bilby, 1920).—About $2\frac{1}{4}$ miles south of Latham Park, on the west side of the Chicago, Milwaukee & St. Paul Railway track, 30 yards south of a private driveway, 40 yards east of Sam Black's residence, and 7.96 meters (26.12 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, near the fence line, 23.76 meters (77.95 feet) from the station, in azimuth $270^{\circ} 05'$. The elevation of the station mark is 222.931 meters (731.399 feet).

Coles (Winnebago County, Ill., J. S. Bilby, 1920).—About 5 miles north of Rockford, on the west side of the Chicago, Milwaukee & St. Paul Railway track, 2 yards south of George Brown's private lane, 270 yards east of his residence, and 2.54 meters (8.33 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 11.80 meters (38.71 feet) from the station, in azimuth $65^{\circ} 30'$. The elevation of the station mark is 224.995 meters (738.171 feet).

Jones (Winnebago County, Ill., J. S. Bilby, 1920).—About $4\frac{1}{4}$ miles north of Rockford, on the east side of the Chicago, Milwaukee & St. Paul Railway track, 12 yards south of the railroad bridge E 590, 325 yards east of Winnebago County Farm Home, and 1.97 meters (6.46 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, 21.05 meters (69.06 feet) from the station, in azimuth $134^{\circ} 23'$. The elevation of the station mark is 217.181 meters (712.535 feet).

Cook (Winnebago County, Ill., J. S. Bilby, 1920).—About $3\frac{3}{4}$ miles north of Rockford, on the west side of the Chicago, Milwaukee & St. Paul Railway track, 30 yards north of railroad bridge E 592, 190 yards north of an old lime kiln and 2.06 meters (6.76 feet) west of the west and nearest rail. The station and reference marks are stakes 2 by 4 inches in size. The station mark stake has a nail, with a cross filed on its head, in the top. The reference stake has an arrow sawed on top and is on the same side of the track, 2.77 meters (9.09 feet) from the station, in azimuth $90^{\circ} 07'$.

Ruby (Winnebago County, Ill., J. S. Bilby, 1920).—About $3\frac{1}{2}$ miles north of Rockford, on the east side of the Chicago, Milwaukee & St. Paul Railway track, 80 yards south of an old lime kiln, and 6.51 meters (21.36 feet) east of the east and nearest rail. The station and reference marks are stakes 2 by 4 inches in size, each with a

nail in the top and a cross filed on the nail. The reference mark is on the same side of the track, 13.64 meters (44.75 feet) from the station, in azimuth $15^{\circ} 57'$.

Crawford (Winnebago County, Ill., J. S. Bilby, 1920).—About 3 miles north of Rockford, on the east side of the Chicago, Milwaukee & St. Paul Railway track, 40 yards north of the Rockford Country Club golf links, and 6.51 meters (21.36 feet) east of the east and nearest rail. The station mark is a stake 2 by 4 inches in size, with a nail, with a cross filed on its head, in the top, and the reference mark is a stake of the same size with an arrow sawed in the top. The reference mark is on the same side of the track, 9.09 meters (29.82 feet) from the station, in azimuth $14^{\circ} 57'$. The elevation of the station mark is 221.738 meters (727.485 feet) and of the reference mark 222.390 meters (729.625 feet).

Cumberland (Winnebago County, Ill., J. S. Bilby, 1920).—About $2\frac{1}{2}$ miles north of Rockford, on the east side of the Chicago, Milwaukee & St. Paul Railway track, 10 yards west of the Rockford Country Club golf links, 435 yards north of a road crossing, this road being an extension of North Main Street, Rockford, on the east bank of the first cut north of the above road crossing, and 5.36 meters (17.59 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 7.96 meters (26.12 feet) from the station, in azimuth $295^{\circ} 00'$. The elevation of the station mark is 224.435 meters (736.334 feet) and of the reference mark 223.648 meters (733.752 feet).

Dekob (Winnebago County, Ill., J. S. Bilby, 1920).—About 2 miles north of Rockford, on the west side of the Chicago, Milwaukee & St. Paul Railway track, at the North Main Street extension crossing, west of the golf links, 4 yards west of the center of the highway, and 4.23 meters (13.88 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, near the fence line, 15.80 meters (51.84 feet) from the station, in azimuth $274^{\circ} 04'$. The elevation of the station mark is 224.614 meters (736.921 feet) and of the reference mark is 224.520 meters (736.613 feet).

Forest (Winnebago County, Ill., J. S. Bilby, 1920).—About $1\frac{1}{2}$ miles north of the center of Rockford, on the east side of North Main Street at its intersection with Brown Avenue, 50 yards northwest of Forest View Abbey, 20 yards east of Ben Carey's store, and 1.66 meters (5.45 feet) east of the east and nearest rail of the street-car track. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the street, 17.03 meters (55.87 feet) from the station, in azimuth $130^{\circ} 54'$. The elevation of the station mark is 227.093 meters (745.054 feet).

Burton (Winnebago County, Ill., J. S. Bilby, 1920).—About $1\frac{1}{4}$ miles north of the center of Rockford, on the east side of North Main Street, 20 yards northeast of the intersection of North Main Street and Burton Avenue, east of North Rockford W. C. T. U. Hall, northwest of the cemetery tool house, and 1.20 meters (3.94 feet) east of the east and nearest rail of the street-car track. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the street, near the fence line, 4.56 meters (14.96 feet) from the station, in azimuth $293^{\circ} 09'$. The elevation of the station mark is 227.709 meters (747.075 feet).

Guard (Winnebago County, Ill., J. S. Bilby, 1920).—At Rockford, about 32 yards south of the intersection of Guard and North Main Streets, on the east side of North Main Street between the curb and the sidewalk, 75 yards north of the intersection of Salem and North Main Streets, 25 yards northwest of Kennedy's residence, 4.76 meters (15.62 feet) east of the east and nearest rail of the street-car track and 0.94 meter (3.08 feet) east of the east and nearest curb of North Main Street. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the street, in the curb lawn, 14.56 meters (47.77 feet) from the station, in azimuth $123^{\circ} 23'$. The elevation of the station mark is 222.681 meters (730.579 feet).

John (Winnebago County, Ill., J. S. Bilby, 1920).—At Rockford, at the northwest corner of the intersection of North Main Street and John Street, near the curb, in North Main Street sidewalk, 35 yards northwest of the public watering trough, 0.74 meter (2.43 feet) north of the north and nearest curb of John Street and 4.09 meters (13.42 feet) north of the north and nearest rail of the street-car track. The station mark is a bronze tablet set in the concrete sidewalk. There is no reference mark. The elevation of the station mark is 221.365 meters (726.262 feet).

Church (Winnebago County, Ill., J. S. Bilby, 1920).—At Rockford, at the southwest corner of the intersection of John and North Church Streets, in the concrete walk just north of the south side of John Street sidewalk, 0.76 meter (2.49 feet) from the curb, and 4.72 meters (15.48 feet) west of the west and nearest rail of the street-car track. The station mark is a bronze tablet set in the concrete sidewalk. There is no reference mark. The elevation of the station mark is 221.657 meters (727.220 feet).

Park (Winnebago County, Ill., J. S. Bilby, 1920).—At Rockford, on the rim of a large sewer manhole on the east side of Church Street, just north of Park Street at the curve in Church Street, 2.14 meters (7.02 feet) west of the east and nearest curb, and 1.61 meters (5.28 feet) east of the east and nearest rail of the street-car track. The station is marked by a cross cut on the north edge of the iron rim of the manhole, and the name "Park" is also stamped on the rim. There is no reference mark. The elevation of the station mark is 222.028 meters (731.390 feet).

Peach (Winnebago County, Ill., J. S. Bilby, 1920).—At Rockford, at the intersection of Peach and North Church Streets, in the concrete sidewalk of Peach Street, near the west curb of North Church Street, 20 yards northeast of Doctor Tuite's residence, 0.46 meter (1.51 feet) west of the west and nearest curb of North Church Street, and 5.77 meters (18.93 feet) west of the west and nearest rail of the street-car track. The station mark is a bronze tablet set in the concrete sidewalk. There is no reference mark. The elevation of the station mark is 222.761 meters (730.842 feet).

Western (Winnebago County, Ill., J. S. Bilby, 1920).—At Rockford, on the extension of South Church Street, on the south side of the Chicago & North Western Railway main westbound track, 30 yards west of the railroad station, 60 yards south of the freight station, and 1.38 meters (4.53 feet) south of the south and nearest rail of the main westbound track. The station mark is a stake, with a nail having a cross filed on the head, in its top. There is no reference mark.

Bench mark I 6.—At Rockford, Winnebago County, Ill., in the south face of the Chicago & North Western Railway station, in the center of the west wing (used for baggage and express), 3 feet above the ground. A brass disk. Elevation, 224.482 meters (736.488 feet).

Bench mark H 6.—At Rockford, Winnebago County, Ill., in the east face of the post office, about 12 feet south of the center of the entrance and 2.5 feet above the ground, placed by mistake 1 foot north of U. S. Geological Survey bench mark "720." A brass disk. Elevation, 219.488 meters (720.104 feet).

Bench mark G. S. 720 (U. S. G. S.).—At Rockford, Winnebago County, Ill., in the east (front) face of the post office, about 11 feet south of the center of the entrance. An aluminum disk stamped "720." Elevation, 219.485 meters (720.094 feet).

First (Winnebago County, Ill., J. S. Bilby, 1920).—At Rockford, on the south side of the Chicago & North Western Railway track, $\frac{1}{4}$ mile east of the railroad station, 8 yards east of overhead bridge 463 which is over the tracks at South First Street, 5 yards east of the first switch signal east of First Street, and 1.70 meters (5.57 feet) south of the south and nearest rail. The station mark is a stake 2 by 4 inches in size, with a nail with a cross filed on the head, in its top. The reference marks are the nearest (southeast and northeast) corners of the east stone abutment (north and south) on which the central supporting timbers rest. They are (S) 11.37 meters (37.30 feet) from the station in azimuth $117^{\circ} 07'$ and (N) 12.13 meters (39.80 feet) from the station, in azimuth $144^{\circ} 27'$. The elevation of the southeast corner of the east stone abutment is 224.044 meters (735.051 feet).

Fourth (Winnebago County, Ill., J. S. Bilby, 1920).—At Rockford, at the intersection of Kishwaukee and Fourth Streets, in the brick pavement of Kishwaukee Street, 0.51 meter (1.67 feet) from the edge of the bridge planking over the Chicago & North Western Railway tracks, 7.00 meters (22.97 feet) southwest of the southwest and nearest rail of the street-car tracks, and 11.45 meters (37.57 feet) east of the west outside edge of the bridge. The station mark is a bronze tablet set in concrete in the brick pavement. There is no reference mark. The elevation of the station mark is 229.952 meters (754.434 feet).

Bench mark C7 (city bench mark).—At Rockford, Winnebago County, Ill., at the corner of South First and Walnut Streets, on the southwest corner of the Rockford City Hall, about 6 inches above the sidewalk. A cross with the letters "B. M." stamped in the stone foundation. Elevation, 227.300 meters (745.733 feet).

Gregory (Winnebago County, Ill., J. S. Bilby, 1920).—At Rockford, at the southwest corner of Gregory and Kishwaukee Streets, in the edge of the brick pavement, 0.76 meter (2.49 feet) from the curb where Gregory Street sidewalk ends at the west

For notes in regard to marking of stations see p. 19.

curb of Kishwaukee Street, 3.96 meters (12.99 feet) west of the west and nearest rail of the street-car track, and 80 yards south of the Kishwaukee Garage. The station mark is a bronze tablet set in concrete in the edge of the brick pavement. There is no reference mark. The elevation of the station mark is 226.873 meters (744.333 feet).

Eighteenth (Winnebago County, Ill., J. S. Bilby, 1920).—At Rockford, on the east side of Kishwaukee Street, 50 yards south of its intersection with Eighteenth Avenue, directly opposite Anderson Bros. Manufacturing Co., in a curb lawn, 3.59 meters (11.78 feet) east of the east and nearest edge of the brick pavement, and 0.97 meter (3.18 feet) west of the west and nearest edge of the concrete sidewalk. The station and underground marks are bronze tablets set in concrete as described in notes 1a and 7a. There is no reference mark. The elevation of the station mark is 225.663 meters (740.363 feet).

Douglas (Winnebago County, Ill., J. S. Bilby, 1920).—About $2\frac{1}{2}$ miles south of Rockford, on the east side of Kishwaukee Street, just north of where the Chicago, Burlington & Quincy Railroad track crosses, in the east edge of the concrete pavement, 10 yards northeast of the watchman's shelter, 80 yards northeast of Rock River School, 0.155 meter (0.51 foot) west of the east and nearest edge of the concrete pavement, and 3.36 meters (11.02 feet) east of the east and nearest rail. The station mark is a bronze tablet set in the concrete pavement. The reference mark is on the same side of the track, near the fence line, 16.51 meters (54.17 feet) from the station, in azimuth $284^{\circ} 24'$. The elevation of the station mark is 219.352 meters (719.657 feet) and of the reference mark 218.818 meters (717.905 feet).

Dewitt (Winnebago County, Ill., J. S. Bilby, 1920).—About $2\frac{3}{4}$ miles south of Rockford, on the east side of the Chicago, Burlington & Quincy Railroad track, 80 yards north of a wagon-road crossing, 100 yards north of a semaphore signal, and 6.82 meters (22.38 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 7.27 meters (23.85 feet) from the station, in azimuth $242^{\circ} 56'$. The elevation of the station mark is 223.259 meters (732.476 feet).

Dupage (Winnebago County, Ill., J. S. Bilby, 1920).—About $2\frac{7}{8}$ miles south of Rockford, on the east side of the Chicago, Burlington & Quincy Railroad track, 75 yards south of a wagon-road crossing, 50 yards north of a signal tower, 35 yards south of a semaphore signal, and 4.94 meters (16.21 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 9.80 meters (32.15 feet) from the station, in azimuth $284^{\circ} 51'$. The elevation of the station mark is 221.402 meters (726.383 feet).

Edgar (Winnebago County, Ill., J. S. Bilby, 1920).—About 4 miles south of Rockford, on the east side of the Chicago, Burlington & Quincy Railroad track, $\frac{1}{2}$ mile north of Camp Grant passenger station, 60 yards northeast of an open-air transformer station, and 1.89 meters (6.20 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, 8.97 meters (29.43 feet) from the station, in azimuth $69^{\circ} 44'$. The elevation of the station mark is 225.192 meters (738.817 feet).

Grant (Winnebago County, Ill., J. S. Bilby, 1920).—About 5 miles south of Rockford, on the east side of the Chicago, Burlington & Quincy Railroad track, $\frac{1}{2}$ mile south of Camp Grant railroad station, 165 yards directly east of Camp Grant water tower, 20 yards north of a battery box which is just south of the point of tangency of the first curve south of Camp Grant railroad station, and 1.62 meters (5.32 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, 6.27 meters (20.57 feet) from the station, in azimuth $94^{\circ} 55'$. The elevation of the station mark is 224.227 meters (735.651 feet) and of the reference mark 223.796 meters (734.237 feet).

Edwards (Winnebago County, Ill., J. S. Bilby, 1920).—About $5\frac{1}{2}$ miles south of Rockford, on the west side of the Chicago, Burlington & Quincy Railroad track, on the south edge of Camp Grant, 60 yards south of railroad bridge 18-12, 100 yards north of an overhead bridge, and 4.76 meters (15.62 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 6.21 meters (20.37 feet) from the station, in azimuth $34^{\circ} 58'$. The elevation of the station mark is 221.577 meters (726.957 feet).

Effingham (Winnebago County, Ill., J. S. Bilby, 1920).—About $6\frac{1}{2}$ miles south of Rockford, on the east side of the Chicago, Burlington & Quincy Railroad track,

$\frac{3}{4}$ mile south of New Milford railroad station, 100 yards south of a road crossing, 50 yards north of the south end of the first cut south of New Milford railroad station, and 7.69 meters (25.23 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 6.16 meters (20.21 feet) from the station, in azimuth $279^{\circ} 14'$. The elevation of the station mark is 216.667 meters (710.848 feet) and of the reference mark 216.716 meters (711.009 feet).

Fayette (Winnebago County, Ill., J. S. Bilby, 1920).—About $7\frac{1}{4}$ miles south of Rockford, on the east side of the Chicago, Burlington & Quincy Railroad track, on the east bank of a deep cut 140 yards south of a road crossing, 220 yards directly west of John Gair's residence, and 7.82 meters (25.66 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 5.80 meters (19.03 feet) from the station, in azimuth $301^{\circ} 10'$.

Ford (Ogle County, Ill., J. S. Bilby, 1920).—About $8\frac{1}{4}$ miles south of Rockford, on the west side of the Chicago, Burlington & Quincy Railroad track, 200 yards south of a road crossing, 125 yards southwest of C. A. Smith's silo, and 9.64 meters (31.63 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 4.92 meters (16.14 feet) from the station, in azimuth $111^{\circ} 44'$. The elevation of the station mark is 218.938 meters (718.299 feet) and of the reference mark 218.895 meters (718.158 feet).

Franklin (Ogle County, Ill., J. S. Bilby, 1920).—About $\frac{3}{8}$ mile north of Davis Junction, on the east side of the Chicago, Burlington & Quincy Railroad track, on the bank of the first cut north of Davis Junction, 75 yards south of a wagon road crossing, 50 yards south of a signboard marked "Davis Junction 1 mile," 130 yards north of the north switch signal for Davis Junction yards, nearly due east of Elmer Johnson's residence, and 8.23 meters (27.00 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, near the fence line, 24.25 meters (79.56 feet) from the station, in azimuth $85^{\circ} 47'$. The elevation of the station mark is 244.749 meters (802.981 feet) and of the reference mark 243.959 meters (800.389 feet).

Fulton (Ogle County, Ill., J. S. Bilby, 1920).—About $\frac{3}{8}$ mile north of Davis Junction, on the east side of the main track of the Chicago, Burlington & Quincy Railroad, 7 yards north of a wagon road crossing, 325 yards southeast of C. J. Richardson's brick silo, and 1.36 meters (4.46 feet) east of the east and nearest rail of the main track. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 24.73 meters (81.14 feet) from the station, in azimuth $301^{\circ} 33'$. The elevation of the station mark is 240.933 meters (790.461 feet) and of the reference mark 240.699 meters (789.693 feet).

Bench mark G. S. 789 (U. S. G. S.).—At Davis Junction, Ogle County, Ill., in the cement wall at the southeast corner of the Hotel de Rice. An aluminum disk stamped "789." Elevation, 240.500 meters (789.040 feet).

Bench mark Permanent.—About 2 miles east of Davis Junction, Ogle County, Ill., on the Chicago, Milwaukee & St. Paul Railway, at the northeast end of bridge Z 284 over Killbuck Creek. A chiseled square on the northwest corner of the east abutment. Elevation, 233.595 meters (766.386 feet).

Bench mark P. B. M. 78.—At Monroe Center, Ogle County, Ill., 24 meters (79 feet) west of the Chicago, Milwaukee & St. Paul Railway station, in the east face of the stone foundation wall of the elevator building owned by D. A. Capperly, 1.5 feet north of the southeast corner and 3.5 feet above the ground. The center point of a copper bolt, leaded horizontally into the masonry. Elevation, 256.942 meters (842.984 feet).

Davis (Ogle County, Ill., J. S. Bilby, 1920).—About 1 mile north of Holcomb, on the west side of the Chicago, Burlington & Quincy Railroad track, 80 yards south and 40 yards north of road crossings, and 3.34 meters (10.96 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 10.49 meters (34.42 feet) from the station, in azimuth $91^{\circ} 14'$. The elevation of the station mark is 244.769 meters (803.046 feet) and of the reference mark 244.739 meters (802.948 feet).

Hocomb (Ogle County, Ill., J. S. Bilby, 1920).—About $\frac{3}{4}$ mile south of Holcomb, on the east side of the Chicago, Burlington & Quincy Railroad track, on the north end of the first cut south of Holcomb, 50 yards south of a switch signal, and 8.16 meters

(26.77 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 5.96 meters (19.55 feet) from the station, in azimuth $279^{\circ} 44'$. The elevation of the station mark is 262.019 meters (859.641 feet) and of the reference mark 260.792 meters (855.615 feet).

Gallatin (Ogle County, Ill., J. S. Bilby, 1920).—About $1\frac{1}{2}$ miles south of Holcomb, on the west side of the Chicago, Burlington & Quincy Railroad track, 75 yards north of a road crossing, $\frac{3}{8}$ mile south of the sign marked "Holcomb station 1 mile," on the bank of a cut near the fence line, and 4.59 meters (15.06 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 14.83 meters (48.66 feet) from the station, in azimuth $264^{\circ} 54'$. The elevation of the station mark is 270.177 meters (886.406 feet) and of the reference mark 269.574 meters (884.427 feet).

Green (Ogle County, Ill., J. S. Bilby, 1920).—About 2 miles south of Holcomb, on the east side of the Chicago, Burlington & Quincy Railroad track, on a high knoll 15 yards north of the second east-and-west section road crossing south of Holcomb, and 9.40 meters (30.84 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, near the fence line, 23.45 meters (76.94 feet) from the station, in azimuth $85^{\circ} 13'$. The elevation of the station mark is 274.212 meters (899.644 feet) and of the reference mark 272.443 meters (893.840 feet).

Grundy (Ogle County, Ill., J. S. Bilby, 1920).—About 3 miles south of Holcomb, on the west side of the Chicago, Burlington & Quincy Railroad track, 6 yards south of a road crossing, 160 yards southwest of R. G. Miller's residence, and 4.10 meters (13.45 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 13.85 meters (45.44 feet) from the station, in azimuth $81^{\circ} 57'$. The elevation of the station mark is 268.122 meters (879.664 feet) and of the reference mark 267.750 meters (878.443 feet).

Hamilton (Ogle County, Ill., J. S. Bilby, 1920).—About $\frac{1}{4}$ mile north of Kings, on the east side of the Chicago, Burlington & Quincy Railroad track, at the first curve north of Kings, and 9.36 meters (30.71 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, near the fence line, 21.87 meters (71.75 feet) from the station, in azimuth $99^{\circ} 38'$. The elevation of the station mark is 272.020 meters (892.452 feet).

Kings (Ogle County, Ill., J. S. Bilby, 1920).—At Kings, about 220 yards south of the railroad station, on the west side of the Chicago, Burlington & Quincy Railroad track, 25 yards north of the south end of a triangular lot, and 16.55 meters (54.30 feet) west of the west and nearest rail of the main line. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, near the fence line, 33.48 meters (109.84 feet) from the station, in azimuth $303^{\circ} 03'$. The elevation of the station mark is 269.402 meters (883.863 feet).

Hancock (Ogle County, Ill., J. S. Bilby, 1920).—About $1\frac{1}{4}$ miles south of Kings, on the west side of the Chicago, Burlington & Quincy Railroad track, 100 yards east of Judge Lockwood Bailey's residence, and 4.23 meters (13.88 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, near the fence line, 19.80 meters (64.96 feet) from the station, in azimuth $304^{\circ} 37'$. The elevation of the station mark is 264.924 meters (869.171 feet), and of the reference mark 263.912 meters (865.851 feet).

Center (Ogle County, Ill., J. S. Bilby, 1920).—At Flag Center, about 50 yards west of the railroad station, on the south side of the Chicago, Burlington & Quincy Railroad track, 10 yards east of a road crossing, 150 yards east of the Flag Center elevator, 25 yards west of a tool house, and 2.55 meters (8.37 feet) south of the south and nearest rail of the south track. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 12.98 meters (42.59 feet) from the station, in azimuth $62^{\circ} 40'$. The elevation of the station mark is 252.328 meters (827.846 feet) and of the reference mark 252.140 meters (827.229 feet).

Hardin (Ogle County, Ill., J. S. Bilby, 1920).—Near the western outskirts of Rochelle, on the edge of a fill on the right of way of the Chicago, Burlington & Quincy

Railroad, about 200 yards north of the Chicago & North Western Railway crossing, between the track and a private road which runs alongside a large cannery, and about 2 yards north of a semaphore signal. The station is marked by a bronze tablet set in concrete as described in note 1a. There is no underground mark or reference mark. The elevation of the station mark is 241.677 meters (792.902 feet).

Bench mark D 7.—At Rochelle, Ogle County, Ill., in the township library, in the steps just west of the main entrance on Fourth Avenue. A brass disk. Elevation, 250.898 meters (823.155 feet).

Bench mark E 7.—At Rochelle, Ogle County, Ill., on Eighth Street, in the southeast corner of the public high school, 3.6 feet above the sidewalk. A brass disk. Elevation, 251.671 meters (825.691 feet).

Henderson (Ogle County, Ill., J. S. Bilby, 1920).—About 2 miles south of Rochelle, on the south side of the highway, 50 yards north of the point where the Rochelle-Steward Road turns directly east, and 45 yards south of Vale School No. 132. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the road near the school fence line, 18.31 meters (60.07 feet) from the station, in azimuth $192^{\circ} 30'$.

Iroquois (Ogle County, Ill., J. S. Bilby, 1920).—About $2\frac{1}{2}$ miles south of Rochelle, on the east side of the Chicago, Burlington & Quincy Railroad track, 10 yards southeast of the center of a road crossing, 20 yards north of a semaphore signal, and 4.52 meters (14.83 feet) east of the east and nearest rail of the east track. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 12.40 meters (40.68 feet) from the station, in azimuth $55^{\circ} 44'$. The elevation of the station mark is 243.133 meters (797.679 feet) and of the reference mark 242.709 meters (796.288 feet).

Henry (Ogle County, Ill., J. S. Bilby, 1920).—About $1\frac{1}{2}$ miles south of Rochelle on the east side of the Chicago, Burlington & Quincy Railroad track, $\frac{1}{2}$ mile south of a coaling station, 200 yards north of a semaphore signal, and 4.27 meters (14.01 feet) east of the east and nearest rail of the east track. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 10.46 meters (34.32 feet) from the station, in azimuth $234^{\circ} 20'$. The elevation of the station mark is 242.703 meters (796.268 feet) and of the reference mark 242.435 meters (795.389 feet).

Steward (Lee County, Ill., J. S. Bilby, 1920).—At Steward Junction, about 20 yards north by northeast of the railroad station, on the west side of the Chicago, Burlington & Quincy Railroad track and the east side of the Chicago, Milwaukee & St. Paul Railway track, 130 yards south of a signal tower, 75 yards south of the junction point of the two railroads, and 3.70 meters (12.14 feet) west of the west and nearest rail of the Chicago, Burlington & Quincy Railroad track. The station and underground marks are bronze tablets set in concrete as described in notes 1a and 7a. The reference mark is on the same side of the Chicago, Milwaukee & St. Paul Railway track and is a bronze tablet set in the concrete base of a semaphore signal post, 3.10 meters (10.17 feet) from the station, in azimuth $121^{\circ} 11'$. The elevation of the station mark is 249.824 meters (819.631 feet) and of the reference mark 249.818 meters (819.611 feet).

Scarboro (Lee County, Ill., J. S. Bilby, 1920).—At Scarboro, about 160 yards south of the railroad station, on the west side of the Chicago, Milwaukee & St. Paul Railway track, 65 yards south of the Standard Oil Co.'s tanks, 75 yards east of Scarboro public school, 30 yards northeast of J. H. Soltman's residence, and 12.63 meters (41.44 feet) west of the west and nearest rail of the main track. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 17.34 meters (56.89 feet) from the station, in azimuth $22^{\circ} 16'$. The elevation of the station mark is 248.632 meters (815.720 feet) and of the reference mark 248.522 meters (815.359 feet).

Fred (Lee County, Ill., J. S. Bilby, 1920).—About 1 mile south of Scarboro, on the west side of the Chicago, Milwaukee & St. Paul Railway track, 30 yards south of a sign marked "Station 1 mile," 100 yards east of R. J. Horman's barn, and just north of where a lane from a wood lot back of the barn crosses the track. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, near the fence line, 9.84 meters (32.28 feet) from the station, in azimuth $264^{\circ} 39'$. The elevation of the station mark is 249.344 meters (818.056 feet).

Jackson (Lee County, Ill., J. S. Bilby, 1920).—About 3 miles south of Scarboro, on the east side of the Chicago, Milwaukee & St. Paul Railway track, 130 yards north-east of the point where the second road south of Scarboro turns east from the Roxbury-Scarboro road and crosses the railroad track, and 50.90 meters (167.00 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 36.77 meters (120.64 feet) from the station, in azimuth $77^{\circ} 59'$. The elevation of the station mark is 260.597 meters (854.975 feet) and of the reference mark 259.671 meters (851.937 feet).

Jasper (Lee County, Ill., J. S. Bilby, 1920).—About $1\frac{1}{4}$ miles north of Roxbury, on the east side of the Chicago, Milwaukee & St. Paul Railway track, 120 yards north of a road crossing, near the center of the first curve north of Roxbury, on the bank of a cut and 11.98 meters (39.30 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 9.84 meters (32.28 feet) from the station, in azimuth $8^{\circ} 24'$. The elevation of the station mark is 265.947 meters (872.528 feet) and of the reference mark 266.021 meters (872.771 feet).

Roxbury (Lee County, Ill., J. S. Bilby, 1920).—At Roxbury, about 20 yards southeast of the southeast corner of the railroad station, on the east side of the Chicago, Milwaukee & St. Paul Railway track, 100 yards north of a road crossing, 75 yards north of a grain elevator, and 6.17 meters (20.24 feet) east of the east and nearest rail. The station and underground marks are bronze tablets set in concrete as described in notes 1a and 7a. The reference mark, on the opposite side of the track, is a bronze tablet set in the railroad station concrete platform, 13.29 meters (43.60 feet) from the station, in azimuth $145^{\circ} 33'$. The elevation of the station mark is 273.916 meters (898.673 feet) and of the reference mark 274.099 meters (899.273 feet).

Jefferson (Lee County, Ill., J. S. Bilby, 1920).—About 1 mile south of Roxbury, on the east side of the Chicago, Milwaukee & St. Paul Railway track, 25 yards south of the first section line road crossing south of Roxbury, 30 yards south of the sign marked "Station 1 mile," and 3.51 meters (11.52 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 10.36 meters (33.99 feet) from the station, in azimuth $283^{\circ} 03'$. The elevation of the station mark is 279.976 meters (918.555 feet).

Jersey (Lee County, Ill., J. S. Bilby, 1920).—About 3 miles south of Roxbury, on the east side of the Chicago, Milwaukee & St. Paul Railway track, 100 yards southeast of the residence of Conrad Zimmerman, and 17 yards south of the third section line road crossing south of Roxbury. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is in the same side of the track, near the fence line, 5.23 meters (17.16 feet) from the station, in azimuth $284^{\circ} 12'$. The elevation of the station mark is 284.080 meters (932.019 feet).

Daviess (Lee County, Ill., J. S. Bilby, 1920).—About 4 miles south of Roxbury, $1\frac{1}{4}$ miles north of Welland, on the east side of the Chicago, Milwaukee & St. Paul Railway track, 5 yards east of the east end of an overhead road bridge, on the north side of the fourth section road crossing south of Roxbury, 100 yards southeast of residence of L. Politsch, and 5.16 meters (16.93 feet) east of the east and nearest edge of bridge V 30. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track just north of the east end of the bridge, near the fence line, 11.55 meters (37.89 feet) from the station, in azimuth $148^{\circ} 10'$. The elevation of the reference mark is 281.797 meters (924.529 feet).

Johnson (Lee County, Ill., J. S. Bilby, 1920).—About 1 mile north of Welland, on the west side of the Chicago, Milwaukee & St. Paul Railway track, near the center of the first cut north of Welland, 100 yards south of railroad bridge V 69, and 8.72 meters (28.61 feet) west of the west and nearest rail. The station and reference marks are stakes 1 by 4 inches in size, each with a nail in the top and a cross filed on the nail. The reference mark is on the same side of the track, near the fence line, 6.09 meters (19.98 feet) from the station, in azimuth $186^{\circ} 11'$.

Kane (La Salle County, Ill., J. S. Bilby, 1920).—About $1\frac{3}{4}$ miles south of Welland, on the east side of the Chicago, Milwaukee & St. Paul Railway track, 100 yards north of the second road crossing south of Welland, 160 yards south of railroad bridge V 36, 140 yards north of the point of tangency of the first curve south of Welland, on the bank of a cut, and 7.35 meters (24.12 feet) east of the east and nearest rail. The sta-

tion, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 6.11 meters (20.05 feet) from the station, in azimuth $301^{\circ} 12'$. The elevation of the station mark is 258.263 meters (847.318 feet) and of the reference mark 258.196 meters (847.098 feet).

Kankakee (La Salle County, Ill., J. S. Bilby, 1920).—About $2\frac{1}{2}$ miles north of Mendota, on the west side of the Chicago, Milwaukee & St. Paul Railway track, near the fence line, 80 yards north of a road crossing, and 13.27 meters (43.54 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 13.91 meters (45.64 feet) from the station, in azimuth $202^{\circ} 55'$. The elevation of the station mark is 245.582 meters (805.714 feet) and of the reference mark 245.532 meters (805.550 feet).

Kendall (La Salle County, Ill., J. S. Bilby, 1920).—About 1 mile north of Mendota, on the west side of the Chicago, Milwaukee & St. Paul Railway track, near the center of the first cut north of Mendota, and 10.70 meters (35.11 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 10.71 meters (35.14 feet) from the station, in azimuth $169^{\circ} 53'$. The elevation of the station mark is 237.576 meters (779.447 feet).

Mendota (La Salle County, Ill., J. S. Bilby, 1920).—In the northern part of Mendota, 80 yards north of the Mendota High School and in the school grounds, about 6 yards west of the intersection of Lincoln Avenue and High Street. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of Lincoln Avenue, at the edge of the high school running track, 6.23 meters (20.44 feet) from the station, in azimuth $85^{\circ} 38'$. The elevation of the station mark is 231.920 meters (760.891 feet).

Knox (La Salle County, Ill., J. S. Bilby, 1920).—About $\frac{3}{4}$ mile north of the railroad station at Mendota, on the west side of the Chicago, Milwaukee & St. Paul Railway track, 25 yards east of overhead bridge V 48 $\frac{1}{2}$, and 6.26 meters (20.54 feet) west of the west and nearest rail. The station and underground marks are bronze tablets set in concrete as described in notes 1a and 7a. The reference mark is on the same side of the track and is a bronze tablet set in the concrete abutment of the overhead bridge, 22.03 meters (72.28 feet) from the station, in azimuth $40^{\circ} 24'$. The elevation of the station mark is 225.731 meters (740.586 feet) and of the reference mark 225.992 meters (741.442 feet).

Simpson (La Salle County, Ill., J. S. Bilby, 1920).—About $\frac{1}{4}$ mile north of the railroad station at Mendota, on the east side of the Illinois Central Railroad track, 90 yards north of James A. Simpson's Lumber Co. office, and 30.91 meters (101.41 feet) east of the east and nearest rail of the main-line track. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 8.40 meters (27.56 feet) from the station, in azimuth $359^{\circ} 00'$. The elevation of the station mark is 229.358 meters (752.485 feet).

Bench mark G 7.—At Mendota, La Salle County, Ill., in the east wall of the Union Station, 2.3 feet above the brick platform and about 7 meters (23 feet) west of the Chicago, Burlington & Quincy Railroad track. A brass disk. Elevation, 228.312 meters (749.054 feet).

Bench mark F 7.—At Mendota, La Salle County, Ill., at the corner of Indiana Avenue and Washington Street, in the south corner of the sixth step of the main entrance to the public library. A brass disk. Elevation, 227.580 meters (746.652 feet).

Lake (La Salle County, Ill., J. S. Bilby, 1920).—About $\frac{1}{2}$ mile south of the railroad station at Mendota, on the east side of the Illinois Central Railroad track, 30 yards southwest of the intersection of Seventh Avenue and First Street, 2 yards south of the first cattle guard south of the railroad station, and 1.55 meters (5.08 feet) east of the east and nearest rail. The station and reference marks are pine stakes 2 by 4 inches in size, each with a nail in the top and a cross filed on the nail. The reference mark is on the same side of the track, near the fence line, 8.82 meters (28.94 feet) from the station, in azimuth $292^{\circ} 40'$.

Culton (La Salle County, Ill., J. S. Bilby, 1920).—About 5 miles south of Mendota, on the west side of the Illinois Central Railroad track, 75 yards south of Culton railroad station, 100 yards south of a grain elevator which is just opposite the railroad station, 30 yards north of a road crossing, directly west of the south switch signal for the elevator siding, and 7.27 meters (23.85 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as

described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 9.81 meters (32.18 feet) from the station, in azimuth $41^{\circ} 27'$. The elevation of the station mark is 213.288 meters (699.762 feet) and of the reference mark 212.434 meters (696.961 feet).

Lawrence (La Salle County, Ill., J. S. Bilby, 1920).—About 6 miles north of La Salle, on the east side of the Illinois Central Railroad track, 30 yards south of a road crossing, on the edge of the east bank of a cut, and 6.13 meters (20.11 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, 9.94 meters (32.61 feet) from the station, in azimuth $230^{\circ} 26'$. The elevation of the station mark is 204.231 meters (670.048 feet).

Lee (La Salle County, Ill., J. S. Bilby, 1920).—About 4 miles north of La Salle, on the west side of the Illinois Central Railroad track, 25 yards south of a section tool house, 200 yards south of a signpost marked "Section 470," and 5.03 meters (16.50 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 15.38 meters (50.46 feet) from the station, in azimuth $141^{\circ} 19'$. The elevation of the station mark is 198.430 meters (651.016 feet).

Livingston (La Salle County, Ill., J. S. Bilby, 1920).—About 3 miles north of La Salle, on the west side of the La Salle & Bureau County Railroad track, 30 yards southwest of a grain elevator at Midway, and 8.25 meters (27.07 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 30.18 meters (99.02 feet) from the station, in azimuth $313^{\circ} 12'$. The elevation of the station mark is 194.940 meters (639.566 feet).

Logan (La Salle County, Ill., J. S. Bilby, 1920).—About 2 miles north of La Salle, on the east side of the La Salle & Bureau County Railroad track, on the east edge of the extension of St. Vincents Avenue, 60 yards south of a bridge over the Illinois Central Railroad track, and 4.38 meters (14.37 feet) east of the east and nearest rail. The station is marked by a railroad spike set in concrete and having a cross on it. The reference mark is a bronze tablet set in concrete as described in note 11a and is on the opposite side of the track, near the right of way fence line, 22.38 meters (73.43 feet) from the station, in azimuth $55^{\circ} 46'$. The elevation of the reference mark is 190.753 meters (625.829 feet).

Vinson (La Salle County, Ill., J. S. Bilby, 1920).—About $1\frac{1}{2}$ miles north of La Salle, 15 yards northwest of the intersection of St. Vincents Avenue and Edwards Street, and 6.30 meters (20.67 feet) west of the center of St. Vincents Avenue. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the street, 14.39 meters (47.21 feet) from the station, in azimuth $262^{\circ} 16'$. The elevation of the station mark is 192.928 meters (632.965 feet) and of the reference mark 193.038 meters (633.326 feet).

Bowie (La Salle County, Ill., J. S. Bilby, 1920).—In the northern part of La Salle, on the east side of St. Vincents Avenue, 10 yards south of the intersection of Sixteenth Street and St. Vincents Avenue, 0.69 meter (2.26 feet) west of the east and nearest curb, and 4.07 meters (13.35 feet) east of the east and nearest rail of the street-car track. The station mark is a bronze tablet set in the edge of the brick pavement. The reference mark, a bronze tablet, is on the opposite side of the street, set in the concrete sidewalk, 11.52 meters (37.80 feet) from the station, in azimuth $93^{\circ} 42'$. The elevation of the station mark is 189.688 meters (622.335 feet).

Joy (La Salle County, Ill., J. S. Bilby, 1920).—In the city of La Salle, at the south edge of Eleventh Street, in the center line of St. Vincents Avenue at its junction with Eleventh Street, 40 yards northwest of Juliet Street, 0.76 meter (2.49 feet) north of the south and nearest curb, 8.43 meters (27.66 feet) southwest of the southwest and nearest rail of the street-car track, and 10.74 meters (35.24 feet) southwest of a sewer manhole. The station mark is a bronze tablet set in the brick pavement. There is no reference mark. The elevation of the station mark is 182.016 meters (597.164 feet).

Gooding (La Salle County, Ill., J. S. Bilby, 1920).—About $\frac{3}{4}$ mile north of the center of La Salle, in the sidewalk on the north side of Eleventh Street, 10 yards north of the intersection of the center lines of Eleventh and Gooding Streets, and 0.77 meter (2.53 feet) north of the north and nearest curb. The station mark is a bronze tablet set in the concrete sidewalk. There is no reference mark. The elevation of the station mark is 183.748 meters (602.847 feet).

Earl (La Salle County, Ill., J. S. Bilby, 1920).—About $\frac{3}{8}$ mile north of the center of La Salle, in the center of Gooding Street, in line with the south curb of Fifth Street, 25 yards northeast of the Methodist Episcopal Church, 4.88 meters (16.01 feet) west of the east curb of Gooding Street, 4.58 meters (15.03 feet) east of the west curb of Gooding Street, and 4.75 meters (15.58 feet) south of the intersection of the center lines of Fifth and Gooding Streets. The station mark is a bronze tablet set in the brick pavement. There is no reference mark. The elevation of the station mark is 172.831 meters (567.030 feet).

La Salle (La Salle County, Ill., J. S. Bilby, 1920).—At La Salle, near the south edge of First Street, on the center line of Gooding Street, 20 yards northwest of the Chicago, Ottawa & Peoria Electric Railway ticket office, 1.74 meters (5.71 feet) south of the south and nearest rail of the street-car track, and 6.15 meters (20.18 feet) north of the south curb of First Street. The station mark is a bronze tablet set in the brick pavement. There is no reference mark. The elevation of the station mark is 135.247 meters (509.340 feet).

McDonough (La Salle County, Ill., J. S. Bilby, 1920).—At La Salle, at the east end of First Street, 40 yards south of the Illinois Central Railroad station, 4.16 meters (13.65 feet) south of the south curb of the railroad station platform, 70 yards north of a coal tipple, and 8.11 meters (26.61 feet) west of the west and nearest rail of the main-line track. The station mark is a bronze tablet set in the brick pavement. There is no reference mark. The elevation of the station mark is 156.181 meters (512.404 feet).

Bench mark T. B. M. 340.—At La Salle, La Salle County, Ill., in the eastern part of the city, a few hundred feet to the east of the Illinois Central Railroad bridge, near the center of the southeast one of the five coping stones on the north end of the second pier from the east end of the aqueduct bridge carrying the Illinois and Michigan Canal over Little Vermilion Creek. The highest point of a square cut between the letters "U" and "S." Elevation, 140.589 meters (461.249 feet).

Bench mark Sanitary B. M.—At La Salle, La Salle County, Ill., on top of the southeast corner of the coping stone at the rounded south end of the east stone abutment of the aqueduct bridge carrying the Illinois and Michigan Canal over Little Vermilion Creek. The highest point in a square, lettered "S. D. B. M." Elevation, 140.082 meters (461.554 feet).

Vermilion River (I. R. S.) (La Salle County, Ill., Illinois River survey, 1903; 1920).—About $1\frac{1}{2}$ miles south of La Salle, in La Salle Township, on the top of a bluff on the south side of the Illinois River, 170 yards south of the La Salle highway bridge across the Illinois River, at the northwest fence corner of the extra right of way secured by La Salle Township for grading and improving the highway extending south from the above bridge, and in the NW. $\frac{1}{4}$ of NE. $\frac{1}{4}$ sec. 27, T. 33 N., R. 1 E. The station mark is a bronze cap on top of a 3-inch wrought-iron pipe. The underground mark is a $\frac{3}{8}$ -inch copper bolt, leaded vertically into a stone block 18 inches square and from 5 to 6 inches thick, about 4 feet below the surface of the ground.

Little Rock Ferry (I. R. S.) (La Salle County, Ill., Illinois River survey, 1903; 1920).—About $2\frac{1}{2}$ miles southeast of La Salle, in Deer Park Township, on the south bank of the Illinois River, about 1 mile east of the mouth of the Vermilion River, 50 yards south of the extreme point of the first sandstone ledge immediately above the old "Little Rock" ferry, and in W. $\frac{1}{2}$ sec. 19, T. 33 N., R. 2 E. The station mark is a bronze cap on top of a 3-inch wrought-iron pipe. The underground mark is a $\frac{3}{8}$ -inch copper bolt, leaded vertically into a stone block 18 inches square and from 5 to 6 inches thick, about 4 feet below the surface of the ground.

Cinder (La Salle County, Ill., J. S. Bilby, 1920).—At Oglesby, about 160 yards north of the Illinois Central Railroad station, on the south side of a spur of the Chicago, Milwaukee & St. Paul Railway leading to a cement plant, 8 yards east of the east end of the Chicago, Milwaukee & St. Paul Railway overhead bridge V 420 over the Illinois Central Railroad tracks, 10 yards west of the cement plant inclosure gate, and 1.34 meters (4.40 feet) south of the south and nearest rail. The station mark is a stake 2 by 4 inches in size, with a nail with a cross filed on the head, and the reference mark is a cross and "USRM 20" stamped on the nearest bolt in the lengthwise ties. The reference mark is on the same side of the track, 7.28 meters (23.88 feet) from the station, in azimuth $110^{\circ} 40'$.

Oglesby (La Salle County, Ill., J. S. Bilby, 1920).—About $\frac{3}{8}$ mile south of the Illinois Central Railroad station at Oglesby, on the east side of the Illinois Central Railroad track, 325 yards south of an overhead bridge, 80 yards south of semaphore signal A 8524, on the east bank of a deep cut, and 24.61 meters (80.74 feet) east of the east and nearest rail of the main-line track. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a.

The reference mark is on the same side of the track, near the fence line, 11.26 meters (36.94 feet) from the station, in azimuth $204^{\circ} 56'$. The elevation of the station mark is 182.379 meters (598.355 feet).

Macoupin (La Salle County, Ill., J. S. Bilby, 1920).—About $\frac{3}{4}$ mile south of Oglesby, on the west side of the Illinois Central Railroad track, on the west edge of a cut just west of the Marquette cement plant, 160 yards west of the Marquette cement storehouse, and 32.90 meters (107.94 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 10.77 meters (35.33 feet) from the station, in azimuth $159^{\circ} 06'$.

McHenry (La Salle County, Ill., J. S. Bilby, 1920).—About $1\frac{1}{4}$ miles south of Oglesby, on the west side of the Illinois Central Railroad track, 160 yards north of a signpost marked "Station 1 mile," 80 yards south of a semaphore signal, 100 yards south of culvert A 851-6, and 10.17 meters (33.37 feet) west of the west and nearest rail. The station mark is a stake 2 by 4 inches in size, with a nail in the top and a cross filed on the nail. The reference mark, a stake 2 by 4 inches in size, is on the same side of the track, near the fence line, 11.47 meters (37.63 feet) from the station, in azimuth $173^{\circ} 46'$.

Macon (La Salle County, Ill., J. S. Bilby, 1920).—About $1\frac{1}{2}$ miles south of Oglesby, on the west side of the Illinois Central Railroad track, 40 yards northwest of a signpost marked "Station 1 mile," 145 yards south of a semaphore signal, and 9.86 meters (32.35 feet) west of the west and nearest rail. The station and reference marks are stakes 2 by 4 inches in size, each with a nail in the top and a cross filed on the nail. The reference mark is on the same side of the track, 13.70 meters (44.95 feet) from the station, in azimuth $189^{\circ} 38'$.

McLean (La Salle County, Ill., J. S. Bilby, 1920).—About $2\frac{1}{2}$ miles north of Tonica, on the east side of the Illinois Central Railroad track, 220 yards north of the second section road crossing north of Tonica, and 5.76 meters (18.90 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, at an estimated distance of 10 meters (33 feet) from the station, in azimuth $41^{\circ} 17'$. The elevation of the station mark is 204.208 meters (669.972 feet) and of the reference mark 204.074 meters (669.533 feet).

Bench mark G. S. 665 (U. S. G. S.).—About 2.5 miles north of Tonica, La Salle County, Ill., and 3 miles south of Oglesby, on the Illinois Central Railroad and south of a highway, 10 feet east of a small wild-cherry tree, 0.8 foot north of a fence, and 100 feet west of the track. An iron post stamped "665." Elevation, 202.873 meters (665.593 feet).

Tonica (La Salle County, Ill., J. S. Bilby, 1920).—About 1 mile north of Tonica railroad station, on the west side of the Illinois Central Railroad track, $\frac{3}{4}$ mile north of the stock pens, 30 yards north of the north switch signal for a siding, and 5.16 meters (16.93 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, near the fence line, 20.63 meters (67.68 feet) from the station, in azimuth $260^{\circ} 45'$. The elevation of the station mark is 205.340 meters (673.686 feet) and of the reference mark 205.033 meters (672.679 feet).

Madison (La Salle County, Ill., J. S. Bilby, 1920).—About 3 miles south of Tonica and $1\frac{1}{2}$ miles north of Lostant, on the east side of the Illinois Central Railroad track, 8 yards north of the second section road crossing north of Lostant, and 8.85 meters (29.04 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 21.41 meters (70.24 feet) from the station, in azimuth $235^{\circ} 15'$. The elevation of the station mark is 219.530 meters (720.241 feet) and of the reference mark 218.491 meters (716.833 feet).

Bench mark K 7.—At Lostant, La Salle County, Ill., about 150 meters (492 feet) northwest of the Illinois Central Railroad passenger station, in the step at the northeast corner of the Bell Building. A brass disk. Elevation, 214.362 meters (703.286 feet).

Marion (La Salle County, Ill., J. S. Bilby, 1920).—About 1 mile south of Lostant, on the west side of the Illinois Central Railroad track, 300 yards north of the first section road crossing south of Lostant, 80 yards south of a signpost marked "Station 1 mile," and 7.51 meters (24.64 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 23.28 meters (76.38 feet) from the station, in azimuth $92^{\circ} 26'$. The eleva-

tion of the station mark is 219.048 meters (718.660 feet) and of the reference mark 219.050 meters (718.667 feet).

Bench mark J 7.—At Wenona, Marshall County, Ill., about 100 meters (328 feet) west of the Illinois Central Railroad passenger station, in the sidewalk at the north-east corner of the State Bank of Wenona. A brass disk. Elevation, 213.126 meters (699.231 feet).

Bench mark I 7.—At Wenona, Marshall County, Ill., 100 meters (328 feet) north of the city hall, in the southwest corner of the rock base of the brick water tower. A brass disk. Elevation, 213.256 meters (699.657 feet).

Bench mark H 7.—At Wenona, Marshall County, Ill., about 0.2 mile west of the Illinois Central Railroad passenger station, in the concrete step on the south corner of the main entrance to the Wenona High School. A brass disk. Elevation, 208.620 meters (684.447 feet).

Santa Fe (La Salle County, Ill., J. S. Bilby, 1920).—About $2\frac{1}{2}$ miles south of Wenona, on the east side of the Illinois Central Railroad track, in the southeast abutment of the Atchison, Topeka & Santa Fe Railway bridge over the Illinois Central Railroad, 1.76 meters (5.77 feet) south of the south and nearest rail of the Atchison, Topeka & Santa Fe Railway, 0.765 meter (2.51 feet) north of the south edge of the abutment, and 0.83 meter (2.72 feet) east of the east end of the south truss of the bridge. The station mark is a bronze tablet set in the concrete abutment. There is no reference mark. The elevation of the station mark is 220.407 meters (723.119 feet).

Bench mark L 7.—At Rutland, Marshall County, Ill., about 100 meters (328 feet) from the Illinois Central Railroad passenger station, in the southeast corner of the sidewalk in front of the Rutland State Bank. A brass disk. Elevation, 216.874 meters (711.527 feet).

Rut (La Salle County, Ill., J. S. Bilby, 1920).—About 2 miles north of Minonk, on the west side of the Illinois Central Railroad track, 190 yards north of the second road crossing north of Minonk, 90 yards north of the south end of the first cut north of the above crossing, 75 yards south of a signpost marked "Section 502," and 7.21 meters (23.65 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 22.14 meters (72.64 feet) from the station, in azimuth $96^{\circ} 37'$. The elevation of the station mark is 227.062 meters (744.953 feet).

Bench mark M 7.—At Minonk, Woodford County, Ill., 35 meters (115 feet) north of the Illinois Central Railroad passenger station, and 2 meters (7 feet) east of the track, in the sidewalk on the south side of the street. A brass disk. Elevation 229.995 meters (754.575 feet).

Bench mark N 7.—At Minonk, Woodford County, Ill., 100 meters (328 feet) west of the Illinois Central Railroad passenger station, in the first concrete step at the southeast corner of the bank of Minonk. A brass disk. Elevation, 230.503 meters (756.242 feet).

Menok (Woodford County, Ill., J. S. Bilby, 1920).—About $\frac{1}{2}$ mile south of Minonk, on the east side of the Illinois Central Railroad track, 100 yards south of the Illinois Oil Co. tanks, 20 yards south of the first switch signal south of the oil tanks, on the edge of the bank of the first cut south of the railroad station, and 7.60 meters (24.93 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 25.02 meters (82.09 feet) from the station, in azimuth $293^{\circ} 34'$. The elevation of the station mark is 232.129 meters (761.577 feet).

Woodford (Woodford County, Ill., J. S. Bilby, 1920).—About 3 miles south of Minonk, on the west side of the Illinois Central Railroad track, $\frac{1}{2}$ mile north of the Woodford Elevator Co., 4 yards south of the center of the second road crossing north of the above elevator, and 2.35 meters (7.71 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track and on the opposite side of the road, near the fence line, 17.92 meters (58.79 feet) from the station, in azimuth $135^{\circ} 21'$. The elevation of the station mark is 222.500 meters (729.935 feet) and of the reference mark 222.653 meters (730.487 feet).

Panola (Woodford County, Ill., J. S. Bilby, 1920).—At Panola, 80 yards north of the railroad station, on the east side of the Illinois Central Railroad track, in the center of the concrete walk which joins the north end of the railroad station platform, and 3.14 meters (10.3 feet) east of the east and nearest rail. The station mark is a bronze tablet set in the concrete walk. The reference mark is a bronze tablet set in concrete as described in note 11a. The reference mark is on the same side of the track,

11.96 meters (39.24 feet) from the station, in azimuth $332^{\circ} 29'$. The elevation of the station mark is 223.862 meters (734.454 feet) and of the reference mark 224.238 meters (735.688 feet).

El Paso (Woodford County, Ill., J. S. Bilby, 1920).—At El Paso, on the west side of the Illinois Central Railroad track, 50 yards north of the Illinois Central Railroad station, 15 yards north of the north side of the baggage room, and 4.85 meters (15.91 feet) west of the west and nearest rail. The station mark is a bronze tablet set in the concrete base of a lamp-post which is at the edge of the brick station platform. The reference mark is a bronze tablet set in concrete as described in note 11a and is on the same side of the track, just south of First Street, 81.19 meters (which equals 266.37 feet, but the field notes also show a measurement of 269.04 feet, and it is not known which is correct) from the station, in azimuth $171^{\circ} 14'$. The elevation of the station mark is 228.154 meters (748.535 feet).

Bench mark O 7.—At El Paso, Woodford County, Ill., in the southeast corner of the step of the main entrance to the Woodford County Bank. A brass disk. Elevation, 227.886 meters (747.656 feet).

Bench mark P 7.—At El Paso, Woodford County, Ill., in the step at the southeast corner of the Farmers State Bank. A brass disk. Elevation, 231.090 meters (758.168 feet).

Kappa (Woodford County, Ill., J. S. Bilby, 1920).—About $\frac{1}{4}$ mile north of the railroad station at Kappa, on the east side of the Illinois Central Railroad track, 160 yards north of the north grain elevator, 25 yards west of the residence of John Hall, and 29.94 meters (98.23 feet) east of the east and nearest rail. The station and underground marks are bronze tablets set in concrete as described in notes 1a and 7a. The corners of the residence of John Hall are used for reference marks. The northwest corner of the house is 27.22 meters (89.30 feet) from the station, in azimuth $217^{\circ} 07'$ and the southwest corner is 22.65 meters (74.31 feet) from the station, in azimuth $240^{\circ} 23'$. The elevation of the station mark is 224.337 meters (736.012 feet).

Marshal (McLean County, Ill., J. S. Bilby, 1920; 1921).—About $2\frac{1}{2}$ miles south of Kappa, on the east side of the Illinois Central Railroad track, $\frac{1}{2}$ mile north of the second section road crossing south of Kappa, and 10.01 meters (32.84 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 20.96 meters (68.77 feet) from the station, in azimuth $238^{\circ} 14'$. The elevation of the station mark is 230.827 meters (757.305 feet) and of the reference mark 230.841 meters (757.351 feet).

Kerrick (McLean County, Ill., J. S. Bilby, 1920; 1921).—About 1 mile south of Kerrick, on the west side of the Illinois Central Railroad track, $\frac{1}{4}$ mile south of the first road crossing south of Kerrick, on the bank of a cut, and 4.86 meters (15.94 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 23.94 meters (78.54 feet) from the station, in azimuth $92^{\circ} 27'$. The elevation of the station mark is 206.444 meters (677.458 feet) and of the reference mark 266.178 meters (873.286 feet).

Bench mark T 7.—At Bloomington, McLean County, Ill., at the intersection of North Monroe and North East Streets, near the curb, in the northwest corner of the concrete pavement in front of the City Hall. A brass disk. Elevation, 246.016 meters (807.137 feet).

Bench mark U 7; P (U. S. G. S.).—At Bloomington, McLean County, Ill., in the wall at the southeast corner of the courthouse, about 2 feet above the ground. An aluminum disk. Elevation, 252.923 meters (829.798 feet).

Bench mark S 7.—At Bloomington, McLean County, Ill., in the concrete pavement, 4 meters (13 feet) south of the Illinois Central Railroad passenger station. A brass disk. Elevation, 252.156 meters (827.282 feet).

Bloomington (McLean County, Ill., J. S. Bilby, 1920; 1921).—About 2 miles south of Bloomington, on the east side of the Illinois Central Railroad track, $\frac{1}{2}$ mile south of the Cleveland, Cincinnati, Chicago & St. Louis Railway crossing, 120 yards north of a road crossing, and 6.73 meters (22.08 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track near the fence line, 19.06 meters (62.53 feet) from the station, in azimuth $198^{\circ} 10'$. The elevation of the station mark is 264.184 meters (866.744 feet) and of the reference mark 263.726 meters (865.241 feet).

Curve (McLean County, Ill., J. S. Bilby, 1920).—About $3\frac{1}{2}$ miles south of Bloomington, on the east side of the Illinois Central Railroad track, $\frac{1}{2}$ mile southeast of the Illinois Traction System station Curve, $\frac{1}{4}$ mile north of a grain elevator at a section road crossing, 30 yards north of a signpost marked "Section 538," and 4.58 meters

(15.03 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 14.60 meters (47.90 feet) from the station, in azimuth $216^{\circ} 53'$. The elevation of the station mark is 248.032 meters (813.752 feet) and of the reference mark 248.020 meters (813.712 feet).

Stines (McLean County, Ill., J. S. Bilby, 1920).—About 6 miles south of Bloomington, on the west side of the Illinois Central Railroad track, 30 yards southeast of the interurban station Stines, on the west bank of a deep cut, and 11.67 meters (38.29 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 22.75 meters (74.64 feet) from the station, in azimuth $72^{\circ} 44'$. The elevation of the station mark is 246.001 meters (807.088 feet) and of the reference mark 244.762 meters (803.023 feet).

Harlan (McLean County, Ill., J. S. Bilby, 1920).—About $2\frac{1}{2}$ miles north of Heyworth, on the west side of the Illinois Central Railroad track, 100 yards southwest of culvert A 786-9, $\frac{1}{2}$ mile north of the interurban station Harlan, on the west bank of the second cut north of station Harlan, and 32.06 meters (105.18 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the edge of the bank, 18.54 meters (60.83 feet) from the station, in azimuth $301^{\circ} 33'$. The elevation of the station mark is 232.014 meters (761.199 feet) and of the reference mark 230.277 meters (755.500 feet).

Bench mark Q 7.—At Heyworth, McLean County, Ill., in the sidewalk in front of the Farmers State Bank. A brass disk. Elevation, 228.420 meters (749.408 feet).

Bench mark R 7.—At Heyworth, McLean County, Ill., in the northeast corner of the sidewalk, 15 meters (49 feet) west of the Illinois Traction System Interurban Station. A brass disk. Elevation, 226.260 meters (742.321 feet).

Heyworth (McLean County, Ill., J. S. Bilby, 1920).—About 1 mile south of Heyworth, on the west side of the Illinois Central Railroad track, $\frac{1}{2}$ mile north of the first section road crossing south of Heyworth, on the bank near the center of the second cut south of Heyworth, and 9.32 meters (30.58 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the west edge of the cut, 11.36 meters (37.27 feet) from the station, in azimuth $27^{\circ} 00'$.

Wapella (De Witt County, Ill., J. S. Bilby, 1920).—At Wapella, at the south end of the railroad station platform, on the east side of the Illinois Central Railroad track, 0.80 meter (2.62 feet) south of the north edge of the concrete walk, and 1.97 meters (6.46 feet) east of the east and nearest rail. The station mark is a bronze tablet set in the concrete sidewalk, and the reference mark is a bronze tablet set in concrete as described in note 11a. The reference mark is on the same side of the track, in the railroad station lawn, 17.28 meters (56.69 feet) from the station, in azimuth $257^{\circ} 28'$. The elevation of the station mark is 228.046 meters (748.181 feet) and of the reference mark 228.318 meters (749.073 feet).

Harras (De Witt County, Ill., J. S. Bilby, 1920).—About $1\frac{1}{2}$ miles north of Clinton, on the east side of the Illinois Central Railroad track, $\frac{3}{8}$ mile south of Harris Crossing, and 1.60 meters (5.25 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, near the fence line, 28.84 meters (94.62 feet) from the station, in azimuth $79^{\circ} 59'$. The elevation of the station mark is 225.642 meters (740.294 feet) and of the reference mark 225.642 meters (740.294 feet).

Clinton (De Witt County, Ill., J. S. Bilby, 1920).—At Clinton, on the east side of the Illinois Central Railroad track, 10 yards southeast of the Illinois Central Railroad freight station, 8 yards north of the center of Macon Street, 1.58 meters (5.18 feet) north of the north edge of the sidewalk, and 1.33 meters (4.36 feet) east of the east and nearest rail. The station and underground marks are bronze tablets set in concrete as described in notes 1a and 7a. The reference mark is a bronze tablet set in the concrete sidewalk, on the opposite side of the track, 12.36 meters (40.55 feet) from the station, in azimuth $74^{\circ} 41'$. The elevation of the station mark is 222.783 meters (730.914 feet) and of the reference mark 222.776 meters (730.891 feet).

Bench mark V 7 (U. S. G. S.).—At Clinton, De Witt County, Ill., in the east end of the first stone step at the south entrance to the courthouse. An aluminum disk. Elevation, 227.431 meters (746.163 feet).

Weld (De Witt County, Ill., J. S. Bilby, 1920).—About 2 miles south of Clinton, on the east side of the Illinois Central Railroad track, 270 yards south of the first section road crossing south of Clinton, 380 yards north of milepost 771, 270 yards

north of culvert A 771-2, and 6.84 meters (22.44 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 26.43 meters (86.71 feet) from the station, in azimuth $237^{\circ} 46'$. The elevation of the station mark is 226.371 meters (742.686 feet) and of the reference mark 225.586 meters (740.110 feet).

Ospur (De Witt County, Ill., J. S. Bilby, 1920).—At Ospur, on the west side of the Illinois Central Railroad track, in the railroad station platform, 6.30 meters (20.67 feet) southeast of the southeast corner of the railroad station, and 3.56 meters (11.68 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 28.13 meters (92.29 feet) from the station, in azimuth $60^{\circ} 22'$. The elevation of the station mark is 221.573 meters (726.944 feet) and of the reference mark 220.915 meters (724.785 feet).

Maroa (Macon County, Ill., J. S. Bilby, 1920).—At Maroa, on the west side of the Illinois Central Railroad track, 30 yards south of the railroad station platform, 270 yards north of milepost 765, and 1.34 meters (4.40 feet) west of the west and nearest rail. The station and underground marks are bronze tablets set in concrete as described in notes 1a and 7a and the reference mark is a bronze tablet set in the concrete sidewalk. The reference mark is on the opposite side of the track, 9.14 meters (29.99 feet) from the station, in azimuth $231^{\circ} 17'$. The elevation of the station mark is 219.924 meters (721.534 feet) and of the reference mark 220.049 meters (721.944 feet).

Bench mark W 7 (U. S. G. S.).—At Emery, Macon County, Ill., on the Illinois Central Railroad, 100 feet north of the railroad station, and 30 feet east of the main track. A disk in the top of a concrete post. Elevation, 210.036 meters (689.093 feet).

Emery (Macon County, Ill., J. S. Bilby, 1920).—About 1 mile south of Emery, on the west side of the Illinois Central Railroad track, 100 yards northeast of the Illinois Traction System station Roesor, on the bank of the first cut south of Emery, and 5.56 meters (18.24 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, near the fence line, 36.48 meters (119.68 feet) from the station, in azimuth $259^{\circ} 42'$. The elevation of the station mark is 211.685 meters (694.503 feet) and of the reference mark 210.713 meters (691.314 feet).

Forsyth (Macon County, Ill., J. S. Bilby, 1920).—At Forsyth, on the east side of the Illinois Central Railroad track, in the railroad station platform, 12.11 meters (39.73 feet) southwest of the southwest corner of the railroad station, and 1.69 meters (5.54 feet) east of the east and nearest rail. The station and underground marks are bronze tablets set in concrete as described in notes 1a and 7a. The reference mark is a U. S. Geological Survey bench mark, 18.75 meters (61.52 feet) from the station, in azimuth $230^{\circ} 55'$. The elevation of the station mark is 207.552 meters (680.944 feet) and of the reference mark 206.989 meters (679.096 feet).

Hickory (Macon County, Ill., J. S. Bilby, 1920).—About 1 mile north of Decatur, on the west side of the Illinois Central Railroad track, 50 yards south of the Illinois Traction System crossing under the Illinois Central Railroad, in the upper end of the railroad yards. The station and underground marks are bronze tablets set in concrete as described in notes 1a and 7a. There is no reference mark. The elevation of the station mark is 208.183 meters (683.014 feet).

Pit (Macon County, Ill., J. S. Bilby, 1920).—At Decatur, on the east side of the Illinois Central Railroad track, 100 yards north of the railroad station, 75 yards north of the Wabash Railroad crossing, directly west of the center of the roundhouse, and 2.42 meters (7.94 feet) east of the east and nearest rail of the main-line track. The station mark is a bronze tablet set in concrete as described in note 1a. There is no underground mark and no reference mark. The elevation of the station mark is 204.736 meters (671.705 feet).

Bench mark X 7 (U. S. G. S.).—At Decatur, Macon County, Ill., in the northwest corner of the intersection of North Main Street and the Wabash Railroad right of way. A disk in a concrete post. Elevation, 208.129 meters (682.837 feet).

Decatur (Macon County, Ill., J. S. Bilby, 1920).—At Decatur, on the east side of Illinois Central Railroad track, 200 yards south of the railroad station, 30 yards north of the center of North Street, 30 yards south of milepost 752, and 1.45 meters (4.76 feet) east of the east and nearest rail of the main-line track. The station mark is a bronze tablet set in concrete as described in note 1a. There is no underground mark. The reference mark is a bronze tablet set in the north curb of North Street, 15.87 meters (52.07 feet) from the station, in azimuth $3^{\circ} 42'$. The elevation of the station mark is 204.490 meters (670.898 feet) and of the reference mark 204.456 meters (670.786 feet).

Cliker (Macon County, Ill., J. S. Bilby, 1920).—About 3 miles south of Decatur, on the west side of the Illinois Central Railroad track, 50 yards south of a signpost marked "Decatur Junction 1 mile," near the center of the first curve south of Decatur railroad station, 15 yards northwest of milepost 749, 325 yards north of the crossing of a road which extends east from Walnut Grove Schoolhouse, and 10.48 meters (34.38 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 15.74 meters (51.64 feet) from the station, in azimuth $189^{\circ} 17'$. The elevation of the station mark is 207.772 meters (681.665 feet) and of the reference mark 207.517 meters (680.829 feet).

Elvin (Macon County, Ill., J. S. Bilby, 1920).—About $1\frac{1}{2}$ miles north of Elwin, on the west side of the Illinois Central Railroad track, $\frac{3}{8}$ mile south of the crossing of the road which extends east from Walnut Grove Schoolhouse, on the bank of a deep cut, and 7.08 meters (23.23 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 10.86 meters (35.63 feet) from the station, in azimuth $43^{\circ} 05'$. The elevation of the station mark is 215.581 meters (707.285 feet).

Mason (Macon County, Ill., J. S. Bilby, 1920).—About $\frac{3}{4}$ mile south of Elwin, on the east side of the Illinois Central Railroad track, 80 yards north of the switch signal for the south end of the siding at Elwin, 200 yards north of milepost 746, and 3.20 meters (10.50 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 13.47 meters (44.19 feet) from the station, in azimuth $319^{\circ} 27'$. The elevation of the station mark is 222.224 meters (729.080 feet) and of the reference mark 221.575 meters (726.951 feet).

Short (Macon County, Ill., J. S. Bilby, 1920).—About $1\frac{1}{2}$ miles north of Macon, on the west side of the Illinois Central Railroad track, $\frac{3}{4}$ mile north of the first road crossing north of Macon, 80 yards north of milepost 744, and 1.96 meters (6.43 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 26.75 meters (87.76 feet) from the station, in azimuth $99^{\circ} 43'$. The elevation of the station mark is 222.555 meters (730.166 feet) and of the reference mark 222.203 meters (729.011 feet).

Macon (Macon County, Ill., J. S. Bilby, 1920).—At Macon, on the east side of the Illinois Central Railroad track, in the south end of the railroad station platform, 0.73 meter (2.39 feet) north of the north edge of a sidewalk, 28.65 meters (94.00 feet) south of the southeast corner of the railroad station, and 3.29 meters (10.79 feet) east of the east and nearest rail. The station and underground marks are bronze tablets set in concrete as described in notes 1a and 7a, and the reference mark is a bronze tablet set in the north abutment of a concrete culvert. The reference mark is on the opposite side of the track, 13.87 meters (45.51 feet) from the station, in azimuth $100^{\circ} 59'$. The elevation of the station mark is 220.023 meters (721.859 feet) and of the reference mark 219.978 meters (721.711 feet).

Moweaqua (Shelby County, Ill., J. S. Bilby, 1920).—At Moweaqua, in the south end of the railroad station platform, on the east side of the Illinois Central Railroad track, 21.20 meters (69.55 feet) south of the southwest corner of the railroad station, and 2.08 meters (6.82 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, in the south edge of the railroad station lawn, 17.42 meters (57.15 feet) from the station, in azimuth $317^{\circ} 01'$. The elevation of the station mark is 192.770 meters (632.446 feet) and of the reference mark 193.242 meters (633.995 feet).

Ray (Christian County, Ill., J. S. Bilby, 1920).—About 3 miles north of Assumption, on the west side of the Illinois Central Railroad track, $\frac{3}{4}$ mile south of Radford, 25 yards south of the first road crossing south of Radford, on the bank of the first cut south of Radford, 160 yards north of milepost 732, and 7.14 meters (23.43 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 9.34 meters (30.64 feet) from the station, in azimuth $128^{\circ} 06'$. The elevation of the station mark is 193.473 meters (634.753 feet) and of the reference mark 192.598 meters (631.882 feet).

Assumption (Christian County, Ill., J. S. Bilby, 1920).—At Assumption, 80 yards south of the railroad station, on the east side of the Illinois Central Railroad track, 2 yards west of the railroad watchman's shelter, 0.62 meter (2.03 feet) south of the

south and nearest curb, and 3.76 meters (12.34 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, near the village lawn fence, 21.33 meters (69.98 feet) from the station, in azimuth $87^{\circ} 17'$. The elevation of the station mark is 196.785 meters (645.619 feet) and of the reference mark 197.033 meters (646.432 feet).

Bench mark Z 7.—At Assumption, Christian County, Ill., about 100 meters (328 feet) south of the Illinois Central Railroad passenger station, at the foot of the steps on the south side of the red brick band stand, and 25 meters (82 feet) east of the main track. A brass disk. Elevation, 197.543 meters (648.106 feet)

Dunkel (Christian County, Ill., J. S. Bilby, 1920).—About 2 miles south of Dunkel, on the east side of the Illinois Central Railroad track, 430 yards south of the second road crossing south of Dunkel, on the bank of the deepest cut south of Dunkel, and 14.94 meters (49.02 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 13.95 meters (45.77 feet) from the station, in azimuth $273^{\circ} 46'$. The elevation of the station mark is 212.138 meters (695.989 feet) and of the reference mark 210.647 meters (691.098 feet).

Bench mark D 8.—At Pana, Christian County, Ill., in the concrete platform at the Union Station, 3 meters (10 feet) south of the southeast corner of the Union block-signal house, 1 meter (3 feet) north of the New York Central Railroad track, and 8 meters (26 feet) east of its intersection with the track of the Illinois Central Railroad. A brass disk. Elevation, 213.661 meters (700.986 feet).

Bench mark E 8.—At Pana, Christian County, Ill., in the front face of the Pana National Bank, 1 meter (3 feet) above the sidewalk. A brass disk. Elevation, 214.256 meters (702.938 feet).

Bench mark F 8.—At Pana, Christian County, Ill., in the steps at the southeast entrance to the Pana High School. A brass disk. Elevation, 217.264 meters (712.807 feet).

Pana (Christian County, Ill., J. S. Bilby, 1920).—At Pana, on the west side of the Illinois Central Railroad track, $\frac{1}{2}$ mile south of the railroad station, 160 yards south of the Penwell Coal Mine, on the bank of the first cut south of the railroad station, and 10.67 meters (35.00 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track but across the switch tracks to the west, 21.65 meters (71.03 feet) from the station, in azimuth $92^{\circ} 46'$. The elevation of the station mark is 218.083 meters (715.494 feet).

Bench mark A 8.—About 2.2 miles north of Oconee, Shelby County, Ill., on the Illinois Central Railroad, 0.4 mile south of milepost 715. A knob carved on the southeast corner of the concrete culvert No. 714-6. Elevation, 197.698 meters (648.614 feet).

Watson (Shelby County, Ill., J. S. Bilby, 1920).—About $\frac{3}{4}$ mile north of Oconee, on the east side of the Illinois Central Railroad track, 325 yards south of the first road crossing north of Oconee, $\frac{1}{4}$ mile south of a signpost marked "Station 1 mile," and 7.52 meters (24.67 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 21.30 meters (69.88 feet) from the station, in azimuth $279^{\circ} 01'$. The elevation of the station mark is 207.780 meters (681.692 feet) and of the reference mark 207.794 meters (681.737 feet).

Oconee (Shelby County, Ill., J. S. Bilby, 1920).—At Oconee, on the west side of the Illinois Central Railroad track, in front of the railroad station, between the main line and the first track west, 11.61 meters (38.09 feet) northwest of the southwest corner of the railroad station, 12.55 meters (41.17 feet) southwest of the northwest corner of the railroad station, and 1.32 meters (4.33 feet) west of the west and nearest rail of the main-line track. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, in the depot lawn, 24.96 meters (81.89 feet) from the station, in azimuth $319^{\circ} 15'$. The elevation of the station mark is 207.309 meters (680.146 feet) and of the reference mark 206.742 meters (678.286 feet).

Warren (Shelby County, Ill., J. S. Bilby, 1920).—About 3 miles south of Oconee, on the west side of the Illinois Central Railroad track, 35 yards north of the north edge of overhead bridge A 709-6, and 10.34 meters (33.92 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same

side of the track, near the fence line, 18.60 meters (61.02 feet) from the station, in azimuth $90^{\circ} 38'$. The elevation of the station mark is 203.911 meters (668.998 feet) and of the reference mark 203.289 meters (666.957 feet).

Leach (Fayette County, Ill., J. S. Bilby, 1920).—About 3 miles north of Ramsey, on the east side of the Illinois Central Railroad track, 3 yards southwest of section A 14 tool house, 18 yards northeast of milepost 706, and 4.15 meters (13.62 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 22.57 meters (74.05 feet) from the station, in azimuth $259^{\circ} 12'$. The elevation of the station mark is 197.539 meters (648.093 feet) and of the reference mark 197.698 meters (648.614 feet).

Ramsey (Fayette County, Ill., J. S. Bilby, 1920).—About $\frac{3}{4}$ mile north of Ramsey, on the east side of the Illinois Central Railroad track, about 275 yards south of the first road crossing north of Ramsey, 200 yards south of the north switch signal for the siding at Ramsey, 100 yards north of the railroad crossing sign, and 2.08 meters (6.82 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 23.20 meters (76.12 feet) from the station, in azimuth $266^{\circ} 34'$. The elevation of the station mark is 190.372 meters (624.579 feet) and of the reference mark 189.495 meters (621.702 feet).

Bench mark C 8.—At Ramsey, Fayette County, Ill., in the concrete sidewalk at the northwest corner of the intersection of North Superior and Fifth Streets. A brass disk. Elevation, 186.619 meters (612.266 feet).

Bench mark B 8.—At Ramsey, Fayette County, Ill., in the concrete sidewalk in the northwest corner of the intersection of North Superior and Sixth Streets. A brass disk. Elevation, 185.965 meters (610.120 feet).

Moore (Fayette County, Ill., J. S. Bilby, 1920).—About $3\frac{1}{4}$ miles north of Vera, on the east side of the Illinois Central Railroad track, $\frac{1}{4}$ mile south of Moore's siding, 200 yards north of milepost 699, and 8.78 meters (28.81 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 21.16 meters (69.42 feet) from the station, in azimuth $256^{\circ} 29'$. The elevation of the station mark is 178.104 meters (584.330 feet) and of the reference mark 177.414 meters (582.066 feet).

Lost (Fayette County, Ill., J. S. Bilby, 1920).—About 1 mile north of Vera, on the west side of the Illinois Central Railroad track, 200 yards north of the north switch signal for the siding at Vera, and 6.22 meters (20.41 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 23.35 meters (76.61 feet) from the station, in azimuth $85^{\circ} 55'$. The elevation of the station mark is 172.369 meters (565.514 feet) and of the reference mark 171.378 meters (562.263 feet).

Vera (Fayette County, Ill., J. S. Bilby, 1920).—At Vera, on the west side of the Illinois Central Railroad track, 46 yards northwest of the northwest corner of the railroad station, in front of the loading chute of the stock pens, between the main line and the first siding west, and 2.05 meters (6.73 feet) west of the west and nearest rail of the main line track. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the opposite side of the track, near the fence line, 33.98 meters (108.53 feet) from the station, in azimuth $269^{\circ} 25'$. The elevation of the station mark is 169.604 meters (556.442 feet) and of the reference mark 169.331 meters (555.547 feet).

Jim (Fayette County, Ill., J. S. Bilby, 1920).—About 1 mile south of Vera, on the east side of the Illinois Central Railroad track, $\frac{1}{2}$ mile north of a signpost marked "Station 1 mile," 5 yards south of the second road crossing south of Vera, and 7.07 meters (23.20 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track but on the opposite side of the road, near the fence line, 17.55 meters (57.58 feet) from the station, in azimuth $193^{\circ} 42'$. The elevation of the station mark is 162.971 meters (534.681 feet) and of the reference mark 162.827 meters (534.208 feet).

Bench mark G 8.—About 1.8 miles south of Vera, Fayette County, Ill., on the Illinois Central Railroad, 0.3 mile north of milepost 693, on the south abutment of steel bridge No. A 693-3, 1.5 meters (4.9 feet) west of the track and in line with the inside face of the end post of the bridge. A knob carved in the stone rubble masonry. Elevation, 151.851 meters (498.198 feet).

Clem (Fayette County, Ill., J. S. Bilby, 1920).—About 3 miles south of Vera, on the east side of the Illinois Central Railroad track, 50 yards north of the third road crossing south of Vera, and 14.40 meters (47.24 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 14.58 meters (47.84 feet) from the station, in azimuth $266^{\circ} 14'$. The elevation of the station mark is 146.655 meters (481.151 feet) and of the reference mark 146.758 meters (481.489 feet).

Garner (Fayette County, Ill., J. S. Bilby, 1920).—About 1 mile north of the railroad station at Vandalia, on the west side of the Illinois Central Railroad track, 30 yards southwest of signposts marked "Yard limit" and "Station 1 mile," $\frac{1}{4}$ mile north of the fourth road crossing south of Vera, and 15.65 meters (51.35 feet) west of the west and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 23.76 meters (77.95 feet) from the station, in azimuth $28^{\circ} 24'$. The elevation of the station mark is 159.440 meters (523.096 feet) and of the reference mark 158.688 meters (520.629 feet).

Dow (Fayette County, Ill., J. S. Bilby, 1920).—About $\frac{1}{2}$ mile north of the railroad station at Vandalia, on the east side of the Illinois Central Railroad track, 160 yards northeast of the railroad water tower, 125 yards north of the first road crossing north of Vandalia, 270 yards south of milepost 691, and 10.05 meters (32.97 feet) east of the east and nearest rail. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the track, near the fence line, 18.55 meters (60.86 feet) from the station, in azimuth $246^{\circ} 18'$. The elevation of the station mark is 157.365 meters (516.288 feet) and of the reference mark 157.110 meters (515.452 feet).

Cocagne (Fayette County, Ill., J. S. Bilby, 1920).—About $1\frac{1}{2}$ miles northwest of Vandalia, in Vandalia Township, on the farm of Surfine Cocagne, 380 yards directly north of his barn, on the east side of a fence line, in sec. 7, T. 6 N., R. 1 E. The station, underground, and reference marks are bronze tablets set in concrete as described in notes 1a, 7a, and 11a. The reference mark is on the same side of the fence line, 11.03 meters (36.19 feet) from the station, in azimuth $2^{\circ} 55'$. The elevation of the station mark is 178.182 meters (584.585 feet) and of the reference mark 178.091 meters (584.287 feet).

Bench mark J 8.—At Vandalia, Fayette County, Ill., in the concrete curbing of the platform at the southwest corner of the Union Passenger Station, 5 meters (16 feet) east of the track, close to the wall of the building. A brass disk. Elevation, 154.642 meters (507.355 feet).

Bench mark K 8.—At Vandalia, Fayette County, Ill., in the front face of the First National Bank at the southeast corner of the intersection of Gallatin and Fifth Streets, 1.5 meters (4.9 feet) above the sidewalk. A brass disk. Elevation, 157.104 meters (515.432 feet).

Bench mark L 8 (U. S. G. S.).—At Vandalia, Fayette County, Ill., T. 6 N., R. 1 E., near the southeast corner of section 16, at the intersection of the National and Shobonier roads. An iron pipe stamped "474." Elevation, 144.398 meters (473.746 feet).

Bench mark H 8.—About 0.5 mile south of Vandalia, Fayette County, Ill., on the Illinois Central Railroad, on concrete bridge No. 689-0 over the Kaskaskia River, and 2 meters (7 feet) west of the track. A knob carved in the north abutment. Elevation, 149.078 meters (489.100 feet).

Sturgess (Fayette County, Ill., G. A. Fairfield, 1883; 1920).—About 1 mile south of Vandalia, on the grounds of the Vandalia Country and Golf Club, 30 yards north of the country clubhouse. The station mark is a white marble post about 6 inches square and 30 inches long, projecting 4 to 6 inches above the ground, and inscribed with letters "U. S. C. & G. S." The underground mark is the apex of an earthenware pyramid about 30 inches below the surface of the ground. The pyramid is about 6 inches on an edge and has on one face the raised letters "U. S. C. S." The reference mark is a white marble post, slightly smaller than the station mark, with an arrow in the top pointing toward the station. In 1908 a magnetic station was established near the station and marked by a stone post, projecting about 4 inches above the surface of the ground, and inscribed with the letters "U. S. C. & G. S. 1908." The reference mark is 14.35 meters (47.08 feet) from the station, in azimuth $287^{\circ} 34'$. The magnetic station mark is 19.11 meters (62.70 feet) from the station, in azimuth $141^{\circ} 42'$. The elevation of the station mark is 200.901 meters (659.123 feet) and of the reference mark 200.559 meters (658.001 feet).

Lengths—Feet to meters (from 1 to 1000 units)

[Reduction factor: 1 foot=0.3048006096 meter.]

Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.
0	0.0	50	15.24003	100	30.48006	150	45.72009	200	60.96012
1	0.30480	1	15.54483	1	30.78486	1	46.02489	1	61.26492
2	0.60960	2	15.84963	2	31.08966	2	46.32969	2	61.56972
3	0.91440	3	16.15443	3	31.39446	3	46.63449	3	61.87452
4	1.21920	4	16.45923	4	31.69926	4	46.93929	4	62.17932
5	1.52400	5	16.76403	5	32.00406	5	47.24409	5	62.48412
6	1.82880	6	17.06883	6	32.30886	6	47.54889	6	62.78893
7	2.13360	7	17.37363	7	32.61366	7	47.85370	7	63.09373
8	2.43840	8	17.67843	8	32.91846	8	48.15850	8	63.39853
9	2.74321	9	17.98324	9	33.22327	9	48.46330	9	63.70333
10	3.04801	60	18.28804	110	33.52807	160	48.76810	210	64.00813
1	3.35281	1	18.59284	1	33.83287	1	49.07290	1	64.31293
2	3.65761	2	18.89764	2	34.13767	2	49.37770	2	64.61773
3	3.96241	3	19.20244	3	34.44247	3	49.68250	3	64.92253
4	4.26721	4	19.50724	4	34.74727	4	49.98730	4	65.22733
5	4.57201	5	19.81204	5	35.05207	5	50.29210	5	65.53213
6	4.87681	6	20.11684	6	35.35687	6	50.59690	6	65.83693
7	5.18161	7	20.42164	7	35.66167	7	50.90170	7	66.14173
8	5.48641	8	20.72644	8	35.96647	8	51.20650	8	66.44653
9	5.79121	9	21.03124	9	36.27127	9	51.51130	9	66.75133
20	6.09601	70	21.33604	120	36.57607	170	51.81610	220	67.05613
1	6.40081	1	21.64084	1	36.88087	1	52.12090	1	67.36093
2	6.70561	2	21.94564	2	37.18567	2	52.42570	2	67.66574
3	7.01041	3	22.25044	3	37.49047	3	52.73051	3	67.97054
4	7.31521	4	22.55524	4	37.79528	4	53.03531	4	68.27534
5	7.62002	5	22.86005	5	38.10008	5	53.34011	5	68.58014
6	7.92482	6	23.16485	6	38.40488	6	53.64491	6	68.88494
7	8.22962	7	23.46965	7	38.70968	7	53.94971	7	69.18974
8	8.53442	8	23.77445	8	39.01448	8	54.25451	8	69.49454
9	8.83922	9	24.07925	9	39.31928	9	54.55931	9	69.79934
30	9.14402	80	24.38405	130	39.62408	180	54.86411	230	70.10414
1	9.44882	1	24.68885	1	39.92888	1	55.16891	1	70.40894
2	9.75362	2	24.99365	2	40.23368	2	55.47371	2	70.71374
3	10.05842	3	25.29845	3	40.53848	3	55.77851	3	71.01854
4	10.36322	4	25.60325	4	40.84328	4	56.08331	4	71.32334
5	10.66802	5	25.90805	5	41.14808	5	56.38811	5	71.62814
6	10.97282	6	26.21285	6	41.45288	6	56.69291	6	71.93294
7	11.27762	7	26.51765	7	41.75768	7	56.99771	7	72.23774
8	11.58242	8	26.82245	8	42.06248	8	57.30251	8	72.54254
9	11.88722	9	27.12725	9	42.36728	9	57.60732	9	72.84734
40	12.19202	90	27.43205	140	42.67208	190	57.91212	240	73.15214
1	12.49682	1	27.73685	1	42.97688	1	58.21692	1	73.45694
2	12.80163	2	28.04165	2	43.28168	2	58.52172	2	73.76174
3	13.10643	3	28.34645	3	43.58648	3	58.82652	3	74.06654
4	13.41123	4	28.65125	4	43.89128	4	59.13132	4	74.37134
5	13.71603	5	28.95605	5	44.19608	5	59.43612	5	74.67614
6	14.02083	6	29.26085	6	44.50088	6	59.74092	6	74.98094
7	14.32563	7	29.56565	7	44.80568	7	60.04572	7	75.28574
8	14.63043	8	29.87045	8	45.11048	8	60.35052	8	75.59054
9	14.93523	9	30.17525	9	45.41528	9	60.65532	9	75.89534

Lengths—Feet to meters (from 1 to 1000 units)—Continued.

Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.
250	76.20015	300	91.44018	350	106.68021	400	121.92024	450	137.16027
1	76.50495	1	91.74498	1	106.98501	1	122.22504	1	137.46507
2	76.80975	2	92.04978	2	107.28981	2	122.52985	2	137.76988
3	77.11455	3	92.35458	3	107.59462	3	122.83465	3	138.07468
4	77.41935	4	92.65939	4	107.89942	4	123.13945	4	138.37948
5	77.72416	5	92.96419	5	108.20422	5	123.44425	5	138.68428
6	78.02896	6	93.26899	6	108.50902	6	123.74905	6	138.98908
7	78.33376	7	93.57379	7	108.81382	7	124.05385	7	139.29388
8	78.63856	8	93.87859	8	109.11862	8	124.35865	8	139.59868
9	78.94336	9	94.18339	9	109.42342	9	124.66345	9	139.90348
260	79.24816	310	94.48819	360	109.72822	410	124.96825	460	140.20828
1	79.55296	1	94.79299	1	110.03302	1	125.27305	1	140.51308
2	79.85776	2	95.09779	2	110.33782	2	125.57785	2	140.81788
3	80.16256	3	95.40259	3	110.64262	3	125.88265	3	141.12268
4	80.46736	4	95.70739	4	110.94742	4	126.18745	4	141.42748
5	80.77216	5	96.01219	5	111.25222	5	126.49225	5	141.73228
6	81.07696	6	96.31699	6	111.55702	6	126.79705	6	142.03708
7	81.38176	7	96.62179	7	111.86182	7	127.10185	7	142.34188
8	81.68656	8	96.92659	8	112.16662	8	127.40665	8	142.64668
9	81.99136	9	97.23139	9	112.47142	9	127.71145	9	142.95148
270	82.29616	320	97.53620	370	112.77622	420	128.01626	470	143.25628
1	82.60097	1	97.84100	1	113.08103	1	128.32106	1	143.56109
2	82.90577	2	98.14580	2	113.38583	2	128.62586	2	143.86589
3	83.21057	3	98.45060	3	113.69063	3	128.93066	3	144.17069
4	83.51537	4	98.75540	4	113.99543	4	129.23546	4	144.47549
5	83.82017	5	99.06020	5	114.30023	5	129.54026	5	144.78029
6	84.12497	6	99.36500	6	114.60503	6	129.84506	6	145.08509
7	84.42977	7	99.66980	7	114.90983	7	130.14986	7	145.38989
8	84.73457	8	99.97460	8	115.21463	8	130.45466	8	145.69469
9	85.03937	9	100.27940	9	115.51943	9	130.75946	9	145.99949
280	85.34417	330	100.58420	380	115.82423	430	131.06426	480	146.30429
1	85.64897	1	100.88900	1	116.12903	1	131.36906	1	146.60909
2	85.95377	2	101.19380	2	116.43383	2	131.67386	2	146.91389
3	86.25857	3	101.49860	3	116.73863	3	131.97866	3	147.21869
4	86.56337	4	101.80340	4	117.04343	4	132.28346	4	147.52349
5	86.86817	5	102.10820	5	117.34823	5	132.58827	5	147.82829
6	87.17297	6	102.41300	6	117.65303	6	132.89307	6	148.13309
7	87.47777	7	102.71780	7	117.95783	7	133.19787	7	148.43789
8	87.78257	8	103.02260	8	118.26263	8	133.50267	8	148.74269
9	88.08737	9	103.32741	9	118.56744	9	133.80747	9	149.04750
290	88.39218	340	103.63221	390	118.87224	440	134.11227	490	149.35230
1	88.69698	1	103.93701	1	119.17704	1	134.41707	1	149.65710
2	89.00178	2	104.24181	2	119.48184	2	134.72187	2	149.96190
3	89.30658	3	104.54661	3	119.78664	3	135.02667	3	150.26670
4	89.61138	4	104.85141	4	120.09144	4	135.33147	4	150.57150
5	89.91618	5	105.15621	5	120.39624	5	135.63627	5	150.87630
6	90.22098	6	105.46101	6	120.70104	6	135.94107	6	151.18110
7	90.52578	7	105.76581	7	121.00584	7	136.24587	7	151.48590
8	90.83058	8	106.07061	8	121.31064	8	136.55067	8	151.79070
9	91.13538	9	106.37541	9	121.61544	9	136.85547	9	152.09550

Lengths—Feet to meters (from 1 to 1000 units)—Continued.

Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.
500	152.40030	580	167.64034	600	182.88037	650	198.12040	700	213.38043
1	152.70511	1	167.94514	1	183.18517	1	198.42520	1	213.68523
2	153.00991	2	168.24994	2	183.48997	2	198.73000	2	213.99003
3	153.31471	3	168.55474	3	183.79477	3	199.03480	3	214.29483
4	153.61951	4	168.85954	4	184.09957	4	199.33960	4	214.59963
5	153.92431	5	169.16434	5	184.40437	5	199.64440	5	214.89443
6	154.22911	6	169.46914	6	184.70917	6	199.94920	6	215.19923
7	154.53391	7	169.77394	7	185.01397	7	200.25400	7	215.49403
8	154.83871	8	170.07874	8	185.31877	8	200.55880	8	215.79883
9	155.14351	9	170.38354	9	185.62357	9	200.86360	9	216.10363
510	155.44831	560	170.68834	610	185.92837	660	201.16840	710	216.40843
1	155.75311	1	170.99314	1	186.23317	1	201.47320	1	216.71323
2	156.05791	2	171.29794	2	186.53797	2	201.77800	2	217.01803
3	156.36271	3	171.60274	3	186.84277	3	202.08280	3	217.32283
4	156.66751	4	171.90754	4	187.14757	4	202.38760	4	217.62763
5	156.97231	5	172.21234	5	187.45237	5	202.69240	5	217.93243
6	157.27711	6	172.51714	6	187.75717	6	202.99720	6	218.23723
7	157.58191	7	172.82194	7	188.06197	7	203.30200	7	218.54203
8	157.88671	8	173.12674	8	188.36677	8	203.60680	8	218.84683
9	158.19151	9	173.43154	9	188.67157	9	203.91160	9	219.15163
520	158.49632	570	173.73635	620	188.97638	670	204.21641	720	219.45644
1	158.80112	1	174.04115	1	189.28118	1	204.52121	1	219.76124
2	159.10592	2	174.34595	2	189.58598	2	204.82601	2	220.06604
3	159.41072	3	174.65074	3	189.89078	3	205.13081	3	220.37084
4	159.71552	4	174.95554	4	190.19558	4	205.43561	4	220.67564
5	160.02032	5	175.26035	5	190.50038	5	205.74041	5	220.98044
6	160.32512	6	175.56515	6	190.80518	6	206.04521	6	221.28524
7	160.62992	7	175.86995	7	191.10998	7	206.35001	7	221.59004
8	160.93472	8	176.17474	8	191.41478	8	206.65481	8	221.89484
9	161.23952	9	176.47954	9	191.71958	9	206.95961	9	222.19964
530	161.54432	580	176.78435	630	192.02438	680	207.26441	730	222.50445
1	161.84912	1	177.08915	1	192.32918	1	207.56922	1	222.80925
2	162.15392	2	177.39395	2	192.63398	2	207.87402	2	223.11405
3	162.45872	3	177.69874	3	192.93879	3	208.17882	3	223.41885
4	162.76353	4	178.00354	4	193.24359	4	208.48362	4	223.72365
5	163.06833	5	178.30834	5	193.54839	5	208.78842	5	224.02845
6	163.37313	6	178.61314	6	193.85319	6	209.09322	6	224.33325
7	163.67793	7	178.91794	7	194.15799	7	209.39802	7	224.63805
8	163.98273	8	179.22274	8	194.46279	8	209.70282	8	224.94285
9	164.28753	9	179.52754	9	194.76759	9	210.00762	9	225.24765
540	164.59233	590	179.83234	640	195.07239	690	210.31242	740	225.55245
1	164.89713	1	180.13714	1	195.37719	1	210.61722	1	225.85725
2	165.20193	2	180.44194	2	195.68199	2	210.92202	2	226.16205
3	165.50673	3	180.74674	3	195.98679	3	211.22682	3	226.46685
4	165.81153	4	181.05154	4	196.29159	4	211.53162	4	226.77165
5	166.11633	5	181.35634	5	196.59639	5	211.83642	5	227.07645
6	166.42113	6	181.66114	6	196.90119	6	212.14122	6	227.38125
7	166.72593	7	181.96594	7	197.20599	7	212.44602	7	227.68605
8	167.03073	8	182.27074	8	197.51079	8	212.75082	8	227.99085
9	167.33553	9	182.57554	9	197.81559	9	213.05562	9	228.29565

Lengths—Feet to meters (from 1 to 1000 units)—Continued.

Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.
750	228.60046	800	243.84049	850	259.08052	900	274.32055	950	289.56058
1	228.90528		244.14529	1	259.38532	1	274.62535	1	289.86538
2	229.21006		244.45009	2	259.69012	2	274.93015	2	290.17018
3	229.51486		244.75489	3	259.99492	3	275.23495	3	290.47498
4	229.81966		245.05969	4	260.29972	4	275.53975	4	290.77978
5	230.12446	5	245.36449	5	260.60452	5	275.84455	5	291.08458
6	230.42928	6	245.66929	6	260.90932	6	276.14935	6	291.38938
7	230.73406	7	245.97409	7	261.21412	7	276.45415	7	291.69418
8	231.03886	8	246.27889	8	261.51892	8	276.75895	8	291.99898
9	231.34366	9	246.58369	9	261.82372	9	277.06375	9	292.30378
760	231.64846	810	246.88849	860	262.12852	910	277.36855	960	292.60858
1	231.95328		247.19329	1	262.43332	1	277.67335	1	292.91338
2	232.25806		247.49809	2	262.73813	2	277.97815	2	293.21818
3	232.56287		247.80289	3	263.04293	3	278.28295	3	293.52298
4	232.86767		248.10770	4	263.34773	4	278.58775	4	293.82778
5	233.17247	5	248.41250	5	263.65253	5	278.89255	5	294.13258
6	233.47727	6	248.71730	6	263.95733	6	279.19735	6	294.43738
7	233.78207	7	249.02210	7	264.26213	7	279.50215	7	294.74218
8	234.08687	8	249.32690	8	264.56693	8	279.80695	8	295.04698
9	234.39167	9	249.63170	9	264.87173	9	280.11175	9	295.35178
770	234.69647	820	249.93650	870	265.17653	920	280.41655	970	295.65658
1	235.00127		250.24130	1	265.48133	1	280.72135	1	295.96138
2	235.30607		250.54610	2	265.78613	2	281.02615	2	296.26618
3	235.61087		250.85090	3	266.09093	3	281.33095	3	296.57098
4	235.91567		251.15570	4	266.39573	4	281.63575	4	296.87578
5	236.22047	5	251.46050	5	266.70053	5	281.94055	5	297.18058
6	236.52527	6	251.76530	6	267.00533	6	282.24535	6	297.48538
7	236.83007	7	252.07010	7	267.31013	7	282.55015	7	297.79018
8	237.13487	8	252.37490	8	267.61493	8	282.85495	8	298.09500
9	237.43967	9	252.67971	9	267.91973	9	283.15975	9	298.39980
780	237.74447	830	252.98451	880	268.22453	930	283.46455	980	298.70460
1	238.04928		253.28931	1	268.52933	1	283.76935	1	299.00940
2	238.35408		253.59411	2	268.83413	2	284.07415	2	299.31420
3	238.65888		253.89891	3	269.13893	3	284.37895	3	299.61900
4	238.96368		254.20371	4	269.44373	4	284.68375	4	299.92380
5	239.26848	5	254.50851	5	269.74853	5	284.98855	5	300.22860
6	239.57328	6	254.81331	6	270.05333	6	285.29335	6	300.53340
7	239.87808	7	255.11811	7	270.35813	7	285.59815	7	300.83820
8	240.18288	8	255.42291	8	270.66293	8	285.90295	8	301.14300
9	240.48768	9	255.72771	9	270.96773	9	286.20775	9	301.44780
790	240.79248	840	256.03251	890	271.27253	940	286.51255	990	301.75260
1	241.09728		256.33731	1	271.57733	1	286.81735	1	302.05740
2	241.40208		256.64211	2	271.88213	2	287.12215	2	302.36220
3	241.70688		256.94691	3	272.18693	3	287.42695	3	302.66700
4	242.01168		257.25171	4	272.49173	4	287.73175	4	302.97180
5	242.31648	5	257.55652	5	272.79653	5	288.03655	5	303.27660
6	242.62128	6	257.86132	6	273.10133	6	288.34135	6	303.58140
7	242.92608	7	258.16612	7	273.40613	7	288.64615	7	303.88620
8	243.23088	8	258.47092	8	273.71093	8	288.95095	8	304.19100
9	243.53568	9	258.77572	9	274.01573	9	289.25575	9	304.49580

Lengths—Meters to feet (from 1 to 1000 units).

[Reduction factor: 1 meter=3.28083333 feet.]

Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.
0		50	164.04167	100	828.08333	150	492.12500	200	656.16667
1	3.28083	1	107.32250	1	331.36417	1	495.40583	1	659.44750
2	6.56167	2	170.60333	2	334.04500	2	498.08667	2	662.72833
3	9.84250	3	173.88417	3	337.92583	3	501.96750	3	666.00917
4	13.12333	4	177.16500	4	341.20667	4	505.24833	4	669.29000
5	16.40417	5	180.44583	5	344.48750	5	508.52917	5	672.57083
6	19.68500	6	183.72667	6	347.76833	6	511.81000	6	675.85167
7	22.96583	7	187.00750	7	351.04917	7	515.09083	7	679.13250
8	26.24667	8	190.28833	8	354.33000	8	518.37167	8	682.41333
9	29.52750	9	193.56917	9	357.61083	9	521.65250	9	685.69417
10	32.80833	60	196.85000	110	360.89167	160	524.93333	210	688.97500
1	36.08917	1	200.13083	1	364.17250	1	528.21417	1	692.25583
2	39.37000	2	203.41167	2	367.45333	2	531.49500	2	695.53667
3	42.65083	3	206.69250	3	370.73417	3	534.77583	3	698.81750
4	45.93167	4	209.97333	4	374.01500	4	538.05667	4	702.09833
5	49.21250	5	213.25417	5	377.29583	5	541.33750	5	705.37917
6	52.49333	6	216.53500	6	380.57667	6	544.61833	6	708.66000
7	55.77417	7	219.81583	7	383.85750	7	547.89917	7	711.94083
8	59.05500	8	223.09667	8	387.13833	8	551.18000	8	715.22167
9	62.33583	9	226.37750	9	390.41917	9	554.46083	9	718.50250
20	65.61667	70	229.65833	120	393.70000	170	557.74167	220	721.78333
1	68.89750	1	232.93917	1	396.98083	1	561.02250	1	725.06417
2	72.17833	2	236.22000	2	400.26167	2	564.30333	2	728.34500
3	75.45917	3	239.50083	3	403.54250	3	567.58417	3	731.62583
4	78.74000	4	242.78167	4	406.82333	4	570.86500	4	734.90667
5	82.02083	5	246.06250	5	410.10417	5	574.14583	5	738.18750
6	85.30167	6	249.34333	6	413.38500	6	577.42667	6	741.46833
7	88.58250	7	252.62417	7	416.66583	7	580.70750	7	744.74917
8	91.86333	8	255.90500	8	419.94667	8	583.98833	8	748.03000
9	95.14417	9	259.18583	9	423.22750	9	587.26917	9	751.31083
80	98.42500	80	262.46667	130	426.50833	180	590.55000	230	754.59167
1	101.70583	1	265.74750	1	429.78917	1	593.83083	1	757.87250
2	104.98667	2	269.02833	2	433.07000	2	597.11167	2	761.15333
3	108.26750	3	272.30917	3	436.35083	3	600.39250	3	764.43417
4	111.54833	4	275.59000	4	439.63167	4	603.67333	4	767.71500
5	114.82917	5	278.87083	5	442.91250	5	606.95417	5	770.99583
6	118.11000	6	282.15167	6	446.19333	6	610.23500	6	774.27667
7	121.39083	7	285.43250	7	449.47417	7	613.51583	7	777.55750
8	124.67167	8	288.71333	8	452.75500	8	616.79667	8	780.83833
9	127.95250	9	291.99417	9	456.03583	9	620.07750	9	784.11917
40	131.23333	90	295.27500	140	459.31667	190	623.35833	240	787.40000
1	134.51417	1	298.55583	1	462.59750	1	626.63917	1	790.68083
2	137.79500	2	301.83667	2	465.87833	2	629.92000	2	793.96167
3	141.07583	3	305.11750	3	469.15917	3	633.20083	3	797.24250
4	144.35667	4	308.39833	4	472.44000	4	636.48167	4	800.52333
5	147.63750	5	311.67917	5	475.72083	5	639.76250	5	803.80417
6	150.91833	6	314.96000	6	479.00167	6	643.04333	6	807.08500
7	154.19917	7	318.24083	7	482.28250	7	646.32417	7	810.36583
8	157.48000	8	321.52167	8	485.56333	8	649.60500	8	813.64667
9	160.76083	9	324.80250	9	488.84417	9	652.88583	9	816.92750

Lengths—Meters to feet (from 1 to 1000 units)—Continued

Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.
250	820.20833	300	984.25000	350	1,148.29167	400	1,312.33333	450	1,476.37500
1	823.48917	1	987.93083	1	1,151.67250	1	1,315.61417	1	1,470.65583
2	826.77000	2	990.81167	2	1,154.85333	2	1,318.89500	2	1,482.63667
3	830.05083	3	994.09250	3	1,158.13417	3	1,322.17583	3	1,486.21750
4	833.33167	4	997.37333	4	1,161.41500	4	1,325.45667	4	1,489.49833
5	836.61250	5	1,000.65417	5	1,164.69583	5	1,328.73750	5	1,492.77917
6	839.89333	6	1,003.93500	6	1,167.97667	6	1,332.01833	6	1,496.06000
7	843.17417	7	1,007.21583	7	1,171.25750	7	1,335.29917	7	1,499.34083
8	846.45500	8	1,010.49667	8	1,174.53833	8	1,338.58000	8	1,502.62167
9	849.73583	9	1,013.77750	9	1,177.81917	9	1,341.86083	9	1,505.90250
260	853.01667	310	1,017.05833	360	1,181.10000	410	1,345.14167	460	1,509.18333
1	856.29750	1	1,020.33917	1	1,184.38083	1	1,348.42250	1	1,512.46417
2	859.57833	2	1,023.62000	2	1,187.66167	2	1,351.70333	2	1,515.74500
3	862.85917	3	1,026.90083	3	1,190.94250	3	1,354.98417	3	1,519.02583
4	866.14000	4	1,030.18167	4	1,194.22333	4	1,358.26500	4	1,522.30667
5	869.42083	5	1,033.46250	5	1,197.50417	5	1,361.54583	5	1,525.58750
6	872.70167	6	1,036.74333	6	1,200.78500	6	1,364.82667	6	1,528.86833
7	875.98250	7	1,040.02417	7	1,204.06583	7	1,368.10750	7	1,532.14917
8	879.26333	8	1,043.30500	8	1,207.34667	8	1,371.38833	8	1,535.43000
9	882.54417	9	1,046.58583	9	1,210.62750	9	1,374.66917	9	1,538.71083
270	885.82500	320	1,049.86667	370	1,213.90833	420	1,377.95000	470	1,541.99167
1	889.10583	1	1,053.14750	1	1,217.18917	1	1,381.23083	1	1,545.27250
2	892.38667	2	1,056.42833	2	1,220.47000	2	1,384.51167	2	1,548.55333
3	895.66750	3	1,059.70917	3	1,223.75083	3	1,387.79250	3	1,551.83417
4	898.94833	4	1,062.99000	4	1,227.03167	4	1,391.07333	4	1,555.11500
5	902.22917	5	1,066.27083	5	1,230.31250	5	1,394.35417	5	1,558.39583
6	905.51000	6	1,069.55167	6	1,233.59333	6	1,397.63500	6	1,561.67667
7	908.79083	7	1,072.83250	7	1,236.87417	7	1,400.91583	7	1,564.95750
8	912.07167	8	1,076.11333	8	1,240.15500	8	1,404.19667	8	1,568.23833
9	915.35250	9	1,079.39417	9	1,243.43583	9	1,407.47750	9	1,571.51917
280	918.63333	330	1,082.67500	380	1,246.71667	430	1,410.75833	480	1,574.80000
1	921.91417	1	1,085.95583	1	1,249.99750	1	1,414.03917	1	1,578.08083
2	925.19500	2	1,089.23667	2	1,253.27833	2	1,417.32000	2	1,581.36167
3	928.47583	3	1,092.51750	3	1,256.55917	3	1,420.60083	3	1,584.64250
4	931.75667	4	1,095.79833	4	1,259.84000	4	1,423.88167	4	1,587.92333
5	935.03750	5	1,099.07917	5	1,263.12083	5	1,427.16250	5	1,591.20417
6	938.31833	6	1,102.36000	6	1,266.40167	6	1,430.44333	6	1,594.48500
7	941.59917	7	1,105.64083	7	1,269.68250	7	1,433.72417	7	1,597.76583
8	944.88000	8	1,108.92167	8	1,272.96333	8	1,437.00500	8	1,601.04667
9	948.16083	9	1,112.20250	9	1,276.24417	9	1,440.28583	9	1,604.32750
290	951.44167	340	1,115.48333	390	1,279.52500	440	1,443.56667	490	1,607.60833
1	954.72250	1	1,118.76417	1	1,282.80583	1	1,446.84750	1	1,610.88917
2	958.00333	2	1,122.04500	2	1,286.08667	2	1,450.12833	2	1,614.17000
3	961.28417	3	1,125.32583	3	1,289.36750	3	1,453.40917	3	1,617.45083
4	964.56500	4	1,128.60667	4	1,292.64833	4	1,456.69000	4	1,620.73167
5	967.84583	5	1,131.88750	5	1,295.92917	5	1,459.97083	5	1,624.01250
6	971.12667	6	1,135.16833	6	1,299.21000	6	1,463.25167	6	1,627.29333
7	974.40750	7	1,138.44917	7	1,302.49083	7	1,466.53250	7	1,630.57417
8	977.68833	8	1,141.73000	8	1,305.77167	8	1,469.81333	8	1,633.85500
9	980.96917	9	1,145.01083	9	1,309.05250	9	1,473.09417	9	1,637.13583

Lengths—Meters to feet (from 1 to 1000 units)—Continued.

Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.
500	1,640.41667	550	1,804.45833	600	1,968.80000	650	2,182.54167	700	2,296.58333
1	1,643.09750	1	1,807.73917	1	1,971.78083	1	2,185.82250	1	2,299.86417
2	1,646.97833	2	1,811.02000	2	1,975.06167	2	2,189.10333	2	2,303.14500
3	1,650.25917	3	1,814.30083	3	1,978.34250	3	2,192.38417	3	2,306.42583
4	1,653.54000	4	1,817.58167	4	1,981.62333	4	2,195.66500	4	2,309.70667
5	1,656.82083	5	1,820.86250	5	1,984.90417	5	2,198.94583	5	2,312.98750
6	1,660.10167	6	1,824.14333	6	1,988.18500	6	2,202.22667	6	2,316.26833
7	1,663.38250	7	1,827.42417	7	1,991.46583	7	2,205.50750	7	2,319.54917
8	1,666.66333	8	1,830.70500	8	1,994.74667	8	2,208.78833	8	2,322.83000
9	1,669.94417	9	1,833.98583	9	1,998.02750	9	2,212.06917	9	2,326.11083
510	1,673.22500	560	1,837.26667	610	2,001.30833	660	2,165.85000	710	2,329.39167
1	1,676.50583	1	1,840.54750	1	2,004.58917	1	2,169.13083	1	2,332.67250
2	1,679.78667	2	1,843.82833	2	2,007.87000	2	2,172.41167	2	2,335.95333
3	1,683.06750	3	1,847.10917	3	2,011.15083	3	2,175.69250	3	2,339.23417
4	1,686.34833	4	1,850.39000	4	2,014.43167	4	2,178.97333	4	2,342.51500
5	1,689.62917	5	1,853.67083	5	2,017.71250	5	2,182.25417	5	2,345.79583
6	1,692.91000	6	1,856.95167	6	2,020.99333	6	2,185.53500	6	2,349.07667
7	1,696.19083	7	1,860.23250	7	2,024.27417	7	2,188.81583	7	2,352.35750
8	1,699.47167	8	1,863.51333	8	2,027.55500	8	2,192.09667	8	2,355.63833
9	1,702.75250	9	1,866.79417	9	2,030.83583	9	2,195.37750	9	2,358.91917
520	1,706.03333	570	1,870.07500	620	2,034.11667	670	2,199.18833	720	2,362.20000
1	1,709.31417	1	1,873.35583	1	2,037.39750	1	2,202.46917	1	2,365.48083
2	1,712.59500	2	1,876.63667	2	2,040.67833	2	2,205.75000	2	2,368.76167
3	1,715.87583	3	1,879.91750	3	2,043.95917	3	2,209.03083	3	2,372.04250
4	1,719.15667	4	1,883.19833	4	2,047.24000	4	2,212.31167	4	2,375.32333
5	1,722.43750	5	1,886.47917	5	2,050.52083	5	2,215.59250	5	2,378.60417
6	1,725.71833	6	1,889.76000	6	2,053.80167	6	2,218.87333	6	2,381.88500
7	1,728.99917	7	1,893.04083	7	2,057.08250	7	2,222.15417	7	2,385.16583
8	1,732.28000	8	1,896.32167	8	2,060.36333	8	2,225.43500	8	2,388.44667
9	1,735.56083	9	1,899.60250	9	2,063.64417	9	2,228.71583	9	2,391.72750
530	1,738.84167	580	1,902.88333	630	2,066.92500	680	2,230.96667	730	2,395.00833
1	1,742.12250	1	1,906.16417	1	2,070.20583	1	2,234.24750	1	2,398.28917
2	1,745.40333	2	1,909.44500	2	2,073.48667	2	2,237.52833	2	2,401.57000
3	1,748.68417	3	1,912.72583	3	2,076.76750	3	2,240.80917	3	2,404.85083
4	1,751.96500	4	1,916.00667	4	2,080.04833	4	2,244.09000	4	2,408.13167
5	1,755.24583	5	1,919.28750	5	2,083.32917	5	2,247.37083	5	2,411.41250
6	1,758.52667	6	1,922.56833	6	2,086.61000	6	2,250.65167	6	2,414.69333
7	1,761.80750	7	1,925.84917	7	2,089.89083	7	2,253.93250	7	2,417.97417
8	1,765.08833	8	1,929.13000	8	2,093.17167	8	2,257.21333	8	2,421.25500
9	1,768.36917	9	1,932.41083	9	2,096.45250	9	2,260.49417	9	2,424.53583
540	1,771.65000	590	1,935.69167	640	2,099.73333	690	2,263.77500	740	2,427.81667
1	1,774.93083	1	1,938.97250	1	2,103.01417	1	2,267.05583	1	2,431.09750
2	1,778.21167	2	1,942.25333	2	2,106.29500	2	2,270.33667	2	2,434.37833
3	1,781.49250	3	1,945.53417	3	2,109.57583	3	2,273.61750	3	2,437.65917
4	1,784.77333	4	1,948.81500	4	2,112.85667	4	2,276.89833	4	2,440.94000
5	1,788.05417	5	1,952.09583	5	2,116.13750	5	2,280.17917	5	2,444.22083
6	1,791.33500	6	1,955.37667	6	2,119.41833	6	2,283.46000	6	2,447.50167
7	1,794.61583	7	1,958.65750	7	2,122.69917	7	2,286.74083	7	2,450.78250
8	1,797.89667	8	1,961.93833	8	2,125.98000	8	2,290.02167	8	2,454.06333
9	1,801.17750	9	1,965.21917	9	2,129.26083	9	2,293.30250	9	2,457.34417

Lengths—Meters to feet (from 1 to 1000 units)—Continued.

Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.
750	2,460.62500	800	2,624.66667	850	2,788.70833	900	2,952.75000	950	3,116.79167
1	2,463.90583	1	2,627.94750	1	2,791.98917	1	2,956.03083	1	3,120.07250
2	2,467.18667	2	2,631.22833	2	2,795.27000	2	2,959.31167	2	3,123.35333
3	2,470.46750	3	2,634.50917	3	2,798.55083	3	2,962.59250	3	3,126.63417
4	2,473.74833	4	2,637.79000	4	2,801.83167	4	2,965.87333	4	3,129.91500
5	2,477.02917	5	2,641.07083	5	2,805.11250	5	2,969.15417	5	3,133.19583
6	2,480.31000	6	2,644.35167	6	2,808.39333	6	2,972.43500	6	3,136.47667
7	2,483.59083	7	2,647.63250	7	2,811.67417	7	2,975.71583	7	3,139.75750
8	2,486.87167	8	2,650.91333	8	2,814.95500	8	2,978.99667	8	3,143.03833
9	2,490.15250	9	2,654.19417	9	2,818.23583	9	2,982.27750	9	3,146.31917
760	2,493.43333	810	2,657.47500	860	2,821.51667	910	2,985.55833	960	3,149.60000
1	2,496.71417	1	2,660.75583	1	2,824.79750	1	2,988.83917	1	3,152.88083
2	2,499.99500	2	2,664.03667	2	2,828.07833	2	2,992.12000	2	3,156.16167
3	2,503.27583	3	2,667.31750	3	2,831.35917	3	2,995.40083	3	3,159.44250
4	2,506.55667	4	2,670.59833	4	2,834.64000	4	2,998.68167	4	3,162.72333
5	2,509.83750	5	2,673.87917	5	2,837.92083	5	3,001.96250	5	3,166.00417
6	2,513.11833	6	2,677.16000	6	2,841.20167	6	3,005.24333	6	3,169.28500
7	2,516.39917	7	2,680.44083	7	2,844.48250	7	3,008.52417	7	3,172.56583
8	2,519.68000	8	2,683.72167	8	2,847.76333	8	3,011.80500	8	3,175.84667
9	2,522.96083	9	2,687.00250	9	2,851.04417	9	3,015.08583	9	3,179.12750
770	2,526.24167	820	2,690.28333	870	2,854.32500	920	3,018.36667	970	3,182.40833
1	2,529.52250	1	2,693.56417	1	2,857.60583	1	3,021.64750	1	3,185.68917
2	2,532.80333	2	2,696.84500	2	2,860.88667	2	3,024.92833	2	3,188.97000
3	2,536.08417	3	2,700.12583	3	2,864.16750	3	3,028.20917	3	3,192.25083
4	2,539.36500	4	2,703.40667	4	2,867.44833	4	3,031.49000	4	3,195.53167
5	2,542.64583	5	2,706.68750	5	2,870.72917	5	3,034.77083	5	3,198.81250
6	2,545.92667	6	2,709.96833	6	2,874.01000	6	3,038.05167	6	3,202.09333
7	2,549.20750	7	2,713.24917	7	2,877.29083	7	3,041.33250	7	3,205.37417
8	2,552.48833	8	2,716.53000	8	2,880.57167	8	3,044.61333	8	3,208.65500
9	2,555.76917	9	2,719.81083	9	2,883.85250	9	3,047.89417	9	3,211.93583
780	2,559.05000	830	2,723.09167	880	2,887.13333	930	3,051.17500	980	3,215.21667
1	2,562.33083	1	2,726.37250	1	2,890.41417	1	3,054.45583	1	3,218.49750
2	2,565.61167	2	2,729.65333	2	2,893.69500	2	3,057.73667	2	3,221.77833
3	2,568.89250	3	2,732.93417	3	2,896.97583	3	3,061.01750	3	3,225.05917
4	2,572.17333	4	2,736.21500	4	2,900.25667	4	3,064.29833	4	3,228.34000
5	2,575.45417	5	2,739.49583	5	2,903.53750	5	3,067.57917	5	3,231.62083
6	2,578.73500	6	2,742.77667	6	2,906.81833	6	3,070.86000	6	3,234.90167
7	2,582.01583	7	2,746.05750	7	2,910.09917	7	3,074.14083	7	3,238.18250
8	2,585.29667	8	2,749.33833	8	2,913.38000	8	3,077.42167	8	3,241.46333
9	2,588.57750	9	2,752.61917	9	2,916.66083	9	3,080.70250	9	3,244.74417
790	2,591.85833	840	2,755.90000	890	2,919.94167	940	3,083.98333	990	3,248.02500
1	2,595.13917	1	2,759.18083	1	2,923.22250	1	3,087.26417	1	3,251.30583
2	2,598.42000	2	2,762.46167	2	2,926.50333	2	3,090.54500	2	3,254.58667
3	2,601.70083	3	2,765.74250	3	2,929.78417	3	3,093.82583	3	3,257.86750
4	2,604.98167	4	2,769.02333	4	2,933.06500	4	3,097.10667	4	3,261.14833
5	2,608.26250	5	2,772.30417	5	2,936.34583	5	3,100.38750	5	3,264.42917
6	2,611.54333	6	2,775.58500	6	2,939.62667	6	3,103.66833	6	3,267.71000
7	2,614.82417	7	2,778.86583	7	2,942.90750	7	3,106.94917	7	3,270.99083
8	2,618.10500	8	2,782.14667	8	2,946.18833	8	3,110.23000	8	3,274.27167
9	2,621.38583	9	2,785.42750	9	2,949.46917	9	3,113.51083	9	3,277.55250

PART II.

GENERAL STATEMENT.

The precise traverse from the vicinity of Racine, Wis., to Vandalia, Ill., the results of which are given in Part I, was run at the request of the U. S. Geological Survey for the purpose of furnishing control for their topographic sheets. It is also a part of the general scheme for placing precise control stations within 100 miles of every point in the United States.

The line of this traverse in general follows the railroad right of way, the only two exceptions being through the cities of Rockford and La Salle, Ill., where the use of the improved streets and highways for traverse measurements was found more economical. The Illinois River was crossed at La Salle and a connection was made to stations of the river triangulation.

The traverse line was adjusted as a whole, holding fixed the positions at each end. These positions had been previously determined by precise triangulation and rigidly adjusted on the North American datum by means of least squares.

FIELD WORK.

The original plan was to start this traverse from stations of the Wisconsin State survey triangulation, in the vicinity of Beloit, Wis., and to run approximately due south to the vicinity of Vandalia, where the line was to be tied in to stations of the transcontinental triangulation. However, a careful search failed to recover any of the triangulation stations near Beloit, so the field work was started at a point between Beloit, Wis., and Rockton, Ill., without any connection to stations whose geographic positions were fixed, and the measurements were continued to the south until the connection with fixed triangulation stations near Vandalia was made. In the meantime a reconnaissance was made from Beloit eastward to the U. S. Lake Survey triangulation near Racine, and it was decided to extend the traverse so as to make a connection with the fixed Lake Survey stations.

Work was started on the traverse about the middle of August, 1920, with J. S. Bilby, signalman, chief of party. At first the party was in two sections, with Mr. Bilby in direct charge of the reconnaissance, signal building, and observing and Mr. Mourhess in charge of the taping. About a month later Mr. Mourhess was relieved in order that he might return to his regular duties at the Washington office, and the party was changed from a two-section party to two independent parties. C. L. Garner, hydrographic and geodetic engineer, was chief of the taping party for the remainder of the season, while Mr. Bilby continued in charge of the party doing the reconnaissance and signal building, etc.

After the traverse had been connected at Vandalia with the transcontinental triangulation the two parties moved back to Beloit and extended the traverse from there to Racine, Wis., to connect the northern end of the line with the Lake Survey triangulation. The season's work was completed soon after the middle of November, making the total time spent in the field on this line of traverse about $3\frac{1}{4}$ months.

RATE OF PROGRESS.

From Beloit to La Salle the taping of 86 miles was completed between August 18 and September 11, or at the rate of 108 miles per month. This was the most difficult section in the whole season's work. The taping on the remainder of the line consisted of 223 miles, which was completed in 8 weeks, or at the rate of 123 miles per month. The condition of the track in this section was, for the most part, favorable for traverse work.

COST.

The length of the traverse line from Racine to Vandalia is 309 miles, along which the geographic positions were determined for 189 permanently marked stations. The total cost of the field work, including a fair depreciation of the trucks used, salary of all members of the parties, and transportation of personnel and instruments to and from the field was \$11800. This makes the cost per mile of progress \$38 and the cost per marked station \$62.

The cost per mile of progress shown above is somewhat less than the cost per mile of the traverse through Indiana, which was \$50. This difference is probably satisfactorily accounted for by the favorable track conditions encountered in Illinois from just south of La Salle to Vandalia, a distance of over 150 miles, or about half the total length of the line. The cost per marked station is practically the same for both lines.

TRANSPORTATION.

Throughout the season automobile trucks were used as a means of transportation for all operations of the work. The total equipment was four three-quarter-ton trucks and two half-ton trucks. This mode of transportation was especially satisfactory on this work, as there are fairly good roads along nearly every section line, and in many cases there is a road close to and parallel with the railroad.

RECONNAISSANCE AND SIGNAL BUILDING.

The reconnaissance, signal building, and the observations of horizontal angles were carried on by one party, all operations being kept close together, so that employees could be readily shifted from the building to the observing party and used as light keepers if the observing party fell behind in its work.

In making the reconnaissance for the location of traverse stations several considerations must be kept continually in mind. First, of course, is that the stations must be intervisible with the smallest possible amount of building and clearing and so located that the distance between them may be measured economically and rapidly. The line of sight must not pass close to any object which will cause lateral refraction. The stations should be so placed as to be available for the use of local engineers and surveyors. Frequently at curves the best location for the station is at the point of intersection of the two tangents, though this is often prohibited by the local topography or by buildings. Along tangents, where possible, the stations should be alternated from one side of the right of way to the other to reduce any lateral refraction which might be caused if the line of sight were parallel to the track, as the track is nearly always at a higher temperature than the ground on the other side of the line of sight.

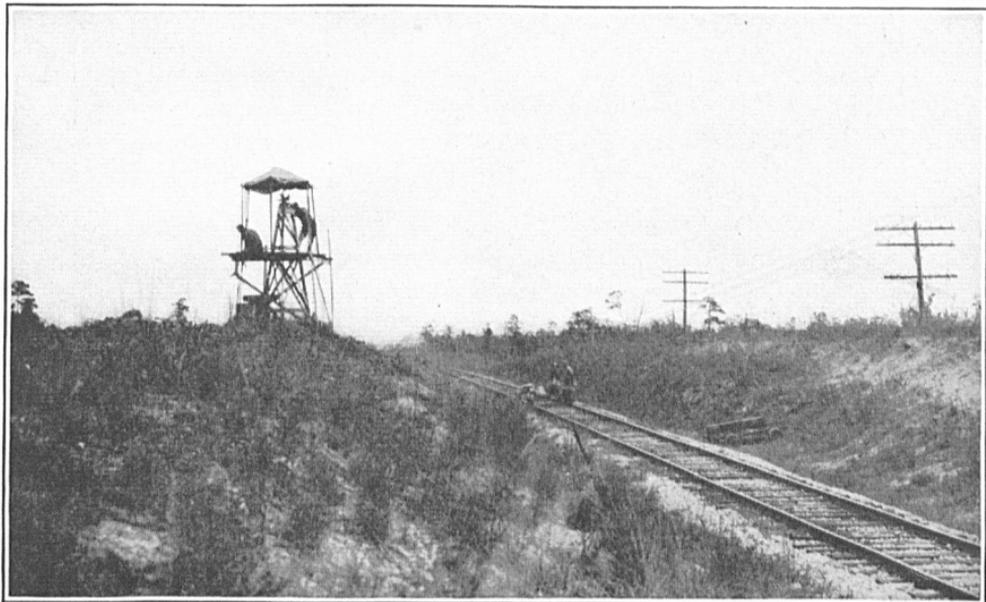


FIG. 2.—TRIPOD AND SCAFFOLD FOR ELEVATING THE INSTRUMENT AND OBSERVER.

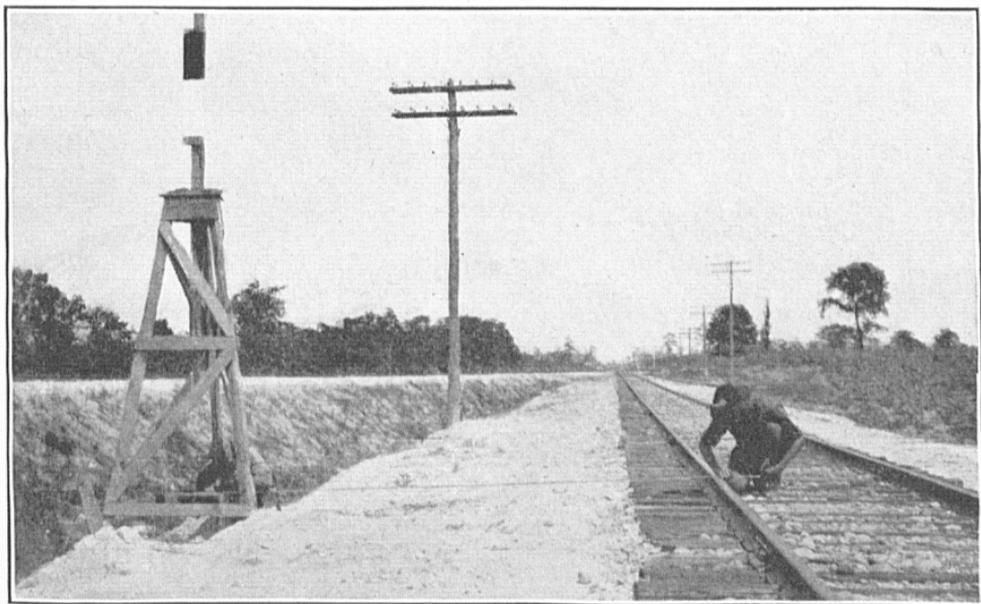


FIG. 3.—TRIPOD WITH TARGET IN PLACE.

Measuring the offset distance.



FIG. 4.—THE FORWARD END OF THE TAPE.

Applying tension to tape, marking the end of the tape on the rail with a glass cutter, and recording.



FIG. 5.—THE REAR END OF THE TAPE.

Making the mark on the rear end of the tape coincident with the mark on the rail.

HORIZONTAL ANGLE AND AZIMUTH OBSERVATIONS.

The horizontal angles were measured in the usual manner with a direction theodolite mounted on a stand similar to the one shown in Figure 3. The instrument ordinarily used on this work was a Troughton and Sims theodolite with a graduated circle 8 inches in diameter and with two micrometer microscopes reading to 2 seconds of arc. As it was impossible to make observations of the required accuracy during the middle of the day, except, of course, on cloudy days, all observations for horizontal angles were made in the early morning or late afternoon on targets or heliotropes or at night on signal lamps. General conditions along a railroad right of way are probably more unfavorable for the observation of horizontal angles of high accuracy than in any other place where it has ever been attempted to make them. The lines are almost always close to the ground, frequently passing close to embankments, buildings, poles, or trees, all of which may and frequently do cause lateral refraction. The instrument used on this work was not in perfect condition, and some of the large corrections to the angles may have been caused by instrumental imperfections.

For the observations for astronomic azimuth a direction theodolite with a graduated circle 12 inches in diameter, and three micrometer microscopes reading to 1 second of arc, was used. This is one of the instruments made by this bureau which has been used on precise triangulation for some 20 years. Azimuths were determined by observations on Polaris at any hour angle by the usual methods except that the Naval Observatory time signals as transmitted over the telegraph lines were used in place of time observations with the vertical circle. Observations were made on one night only at each azimuth station. The results obtained were satisfactory, having an average probable error slightly less than $\pm 0''.5$.

The following table shows for each station at which astronomic azimuths were observed, the station used as a mark, the date of observation, the astronomic azimuth, and the probable error:

Astronomic azimuths.

Stations.	Date.	Azimuth.	Probable error.
	1920.	° ' "	"
Dover to Midway.....	Oct. 28	230 54 25.6	± 0.18
Burlington to Oconto.....	Oct. 24	59 50 58.6	± 0.34
Fond to Elmore.....	Oct. 21	55 41 51.6	± 0.41
Buffalo to Clinton.....	Oct. 10	245 43 24.9	± 0.44
Rockton to Shaw.....	Aug. 17	209 11 12.9	± 0.92
Latham to Carroll.....	Aug. 21	195 10 59.1	± 0.47
Cumberland to Dekob.....	Aug. 22	45 27 08.3	± 0.43
Dewitt to Douglas.....	Aug. 24	144 00 53.7	± 0.34
Gallatin to Hocomb.....	Aug. 26	181 20 45.7	± 0.42
Fred to Scarboro.....	Aug. 31	172 30 33.7	± 0.37
Mendota to Kendall.....	Sept. 2	190 15 30.0	± 0.47
Vinson to Logan.....	Sept. 7	180 05 59.4	± 0.61
Toulea to McLean.....	Sept. 12	175 43 42.5	± 0.58
Kerrick to Marshall.....	Sept. 17	176 21 31.6	± 0.49
Ospur to Weld.....	Sept. 23	179 23 50.5	± 0.48
Macon to Short.....	Sept. 28	191 33 02.4	± 0.42
Leach to Warren.....	Oct. 5	179 42 25.4	± 0.57
Gartner to Sturgess.....	Oct. 8	352 10 10.9	± 0.37
Mean.....			± 0.48

DIFFERENCE BETWEEN ASTRONOMIC AND GEODETIC AZIMUTHS.

Since the topography of the country through which this traverse runs is very flat, no great difference was anticipated between the astronomic and geodetic azimuths. However, before starting the field work a study was made of the probable deflections which might be expected from results previously determined at the nearest Laplace stations.

The Laplace equation, used for computing the true geodetic azimuth when the coincident geodetic latitude and longitude, astronomic longitude, and astronomic azimuth are known, is

$$\alpha_G = \alpha_A + (\lambda_A - \lambda_G) \sin \phi_G,$$

where α_G is the geodetic azimuth, α_A the astronomic azimuth, λ_A the astronomic longitude, λ_G the geodetic longitude, and ϕ_G the geodetic latitude.

The following table gives the geodetic positions of the nearest Laplace stations, the seconds of the astronomic longitude, the astronomic minus the geodetic longitude, and in the last column the astronomic minus the geodetic longitude multiplied by the sine of the geodetic latitude. This last column gives the amount that an astronomic azimuth at that particular station should be corrected to make it a geodetic azimuth. Since this amount in each case is small, it was decided to hold the astronomic azimuths along the traverse as if they were true geodetic azimuths, thereby saving the cost of determining several astronomic longitude stations without reducing the accuracy of the azimuths by any appreciable amount.

Deflections in the prime vertical of Laplace stations near the traverse line.

Station.	Latitude, geodetic.	Longitude.		Astro- nomic minus geodetic longitude ($\lambda_A - \lambda_G$).	$(\lambda_A - \lambda_G) \sin \phi_G$.
		Geodetic.	Astro- nomic.		
	° ' "	° ' "	"	"	"
St. Louis.....	38 37 58.50	90 12 17.44	18.84	+1.40	+0.87
Vincennes.....	38 40 35.70	87 31 35.05	30.14	-4.91	-3.07
Parkersburg.....	38 34 51.52	88 01 49.00	48.30	-0.70	-0.44
Chicago L. H.....	41 53 20.50	87 36 51.46	48.24	-3.22	-2.15
Chicago, 1891.....	41 53 48.88	87 37 22.91	21.69	-1.22	-0.81
Chicago, 1883.....	41 50 00.08	87 36 49.12	47.91	-1.21	-0.81
Willow Springs.....	41 43 36.90	87 51 05.63	06.09	+0.46	+0.31
University of Illinois.....	40 06 18.84	88 13 33.45	28.17	-5.28	-3.40
Fort Howard.....	44 30 30.40	88 02 33.21	33.39	+0.18	+0.13

TAPE MEASUREMENTS.

Precise traverse measurements are made most economically and rapidly when the line of the traverse follows a railroad and the measurements are made with the tape supported throughout its length on the rail. With this method, however, few distances are measured directly from one station to another, but instead from a point on the rail opposite one station to a point on the rail opposite the next station. The distance and angle from the rail station to the station proper is measured and the actual distance between the stations is then computed from these data. Several different problems are met, depending on the location of the stations with respect to the rail, but these are fully explained in U. S. Coast and Geodetic Survey Special Publication No. 58. Of course, at the beginning of a curve the

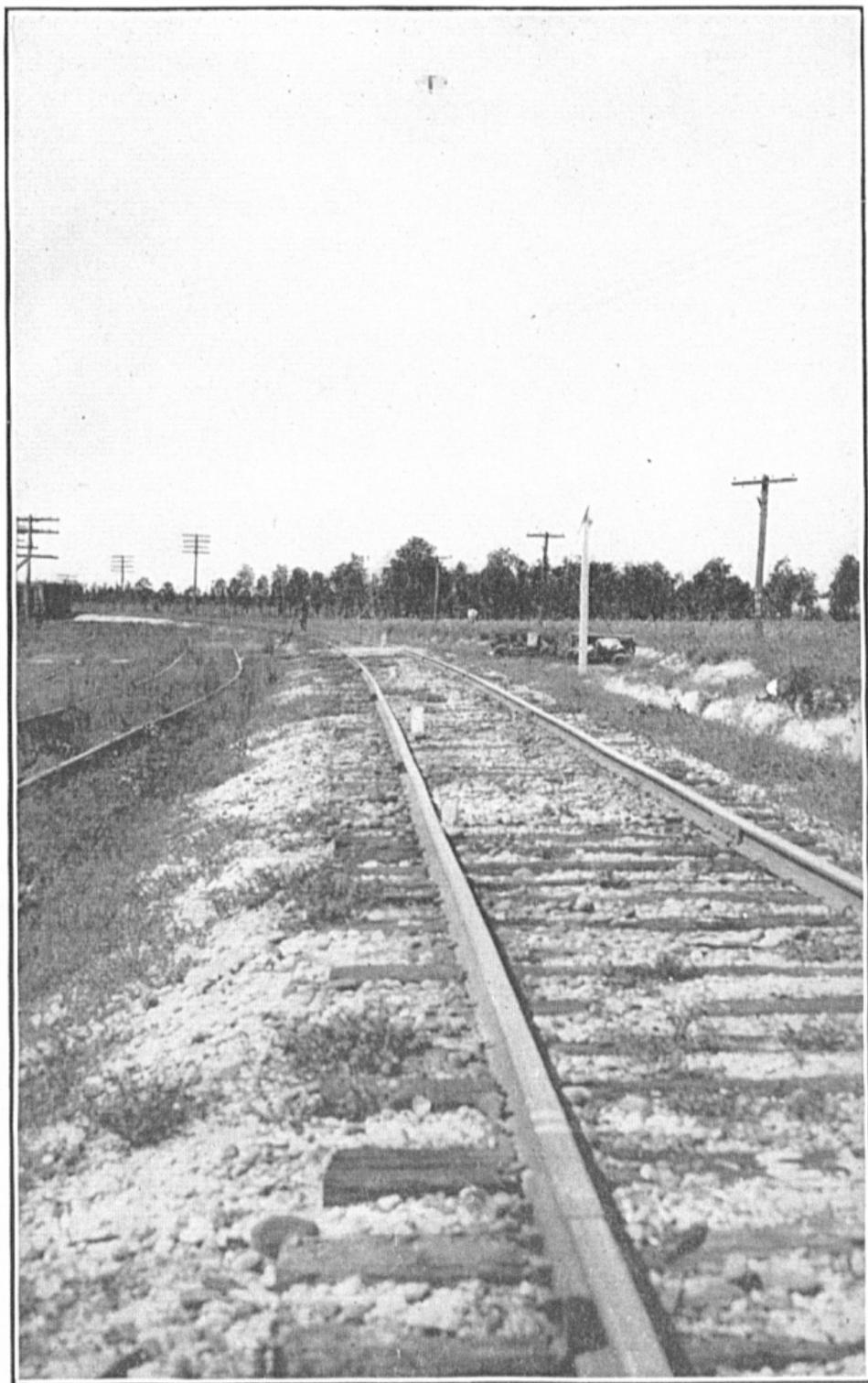


FIG. 6.—TAPE SUPPORTS AT THE BEGINNING OF A CURVE.



FIG. 7.—STAKES FROM STATION TO RAIL TANGENT.

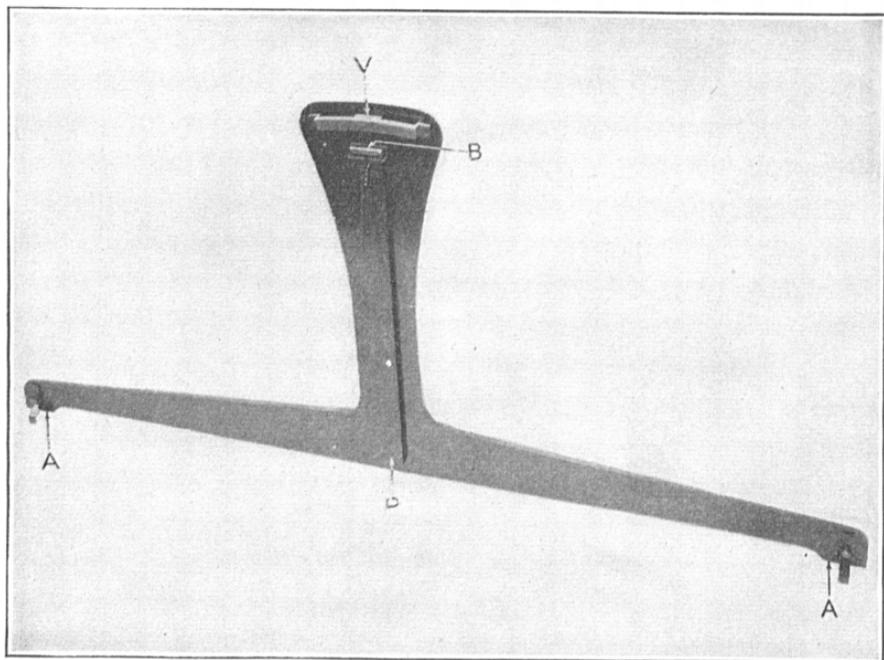


FIG. 8.—TRACK LEVEL.

taping must leave the rail and continue on line over stakes. Setting and aligning stakes and running the necessary wye levels over them greatly retards the progress of the taping as compared to making the measurement on the rail.

In carrying the traverse through Rockford, Ill., and also through La Salle, Ill., the best route was not along the railroad but along the improved streets. Here practically the same methods were used as when measuring on the rail. The tape was supported throughout on the pavement, and the tape ends were marked by fixing a short piece of adhesive tape to the pavement and marking on it with a sharp hard pencil.

Invar tapes, similar to those used for the measurement of base lines in precise triangulation, were used for the measurement of the traverse. The length and coefficient of expansion of these tapes were determined by the Bureau of Standards, the length to an accuracy of at least 1 part in 300 000. They were standardized under 15 kilograms tension when supported throughout, at five points (0, 12½, 25, 37½, and 50 meters), and at three points (0, 25, and 50 meters).

In the field the tension was maintained at 15 kilograms by means of a spring balance attached to the front end of the tape. This balance was tested daily by means of an accurate weight and corrected when necessary. Two thermometers attached to the tape, one about 1 meter from each end, gave the necessary temperatures.

The tape stretcher consisted of a shoe of galvanized iron about 18 inches long and just wide enough to fit easily over the top of the rail, with uprights of the same material projecting about 6 inches above the rail and making a bearing for a lever, to the lower end of which the tape was attached by means of a hook. (See Figs. 4 and 5.) This arrangement allowed the tension to be applied and at the same time held the tape close to the rail.

The tape ends were marked on the rail by means of an ordinary cheap glass cutter, this mark being indicated by a lumber crayon mark on the rail or cross-tie, or both. The end of each kilometer and the point on the rail opposite stations were marked by a three-cornered file cut to such a depth as to insure its lasting for perhaps a week, or at least until the check measure had been made.

The inclination corrections in the Illinois section were derived from precise levels for the measurements on the rail and from wye levels for the measurements over stakes. In Wisconsin the precise levels were not run, but instead the inclination of the tape was determined by means of a track level. This instrument is shown in Figure 8.

A check measurement of each distance was made with a 300-foot steel tape for the purpose of catching errors of the magnitude of a 50-meter tape length, or half this amount.

No setbacks greater than 1 decimeter were measured. All distances less than about 49.9 meters were measured as set-ups in order to avoid errors in recording. All set-ups shorter than a half tape length were measured in both meters and feet with a 30-meter steel pocket tape.

THE TRACK LEVEL.

The track level rests on two points, about 6 feet apart, designated as *A* in Figure 8. The bubble *B* is mounted on a movable arm pivoted at *P*, with a graduated arc and vernier *V*. The movable arm is about 30 inches long and is not supplied with a clamp and

slow-motion screw but resists movement by friction only. The scale is graduated to 10' with a vernier reading to minutes. With the long arm the bubble can be centered very quickly and about as accurately as with a short arm and slow-motion screw, while the graduations are of such a size as to be easily read. On the back is mounted a hinged leg, which falls away from the board as it is leaned backward and thus supports the instrument while the operator records the observation. The inclination of each tape length is determined by placing the track level on the rail near the middle of the tape and reading the inclination.

Since this track level was used here for the first time, a test was made to determine the accuracy which might be expected from the observations. The difference in elevation of the tape ends was determined for 2 kilometers by both wye-level and track-level observations. The resulting inclination correction for the first kilometer was 0.9 millimeter larger as derived from the track-level observations than from the wye level and 0.6 millimeter for the second kilometer. The discrepancy in both cases being considerably less than 1 part in 1 000 000 of the distance, the instrument was considered satisfactory.

OFFICE COMPUTATION.

The office computation includes the checking of the abstracts and lists of directions of the horizontal angles from the original record books, the computation of the inclination corrections and the mean elevations of the sections from the precise level, wye-level, and track-level observations, and the computation of the measured distances, which includes the corrections for temperature, tape standardization, set-ups and setbacks, inclination, and reduction to sea level. Usually these measured distances are to a point on the rail opposite the station at either or both ends, and it is necessary to make a projection computation to get the distance between the traverse stations. Sometimes the measurement is not made in a straight line but consists of a number of sections forming a loop between the two traverse stations, and then the loop must be closed and the various sections projected on the line between the two stations. Next, the geographic position of each traverse station and the azimuths of the lines between the stations are computed to obtain the discrepancies in latitude, longitude, and azimuth. The astronomic azimuths are computed for the stations where azimuth observations were made on Polaris. Finally, the traverse is adjusted by the method of least squares, holding fixed the geographic positions at each end and all the astronomic azimuths.

All the above computations for this traverse were made under the direct supervision of Mr. Sutcliffe, with the exception of the least squares adjustment, which was made by Mr. Mourhess and the azimuth computations, which were made by Miss Sarah Beall. The methods used for these computations are explained in detail in Special Publication No. 58, which also contains formulæ, tables, and sample computations. The only difference in the computation of this traverse from the methods explained there is that no precise levels were run over that portion of the line between Beloit and Racine, and the inclination corrections and mean elevations were obtained for that section from the track-level observations, checked by the profile of the railroad.

THE LEAST-SQUARES ADJUSTMENT.

In making the adjustment of the traverse the geodetic positions of the old stations at each end of the line were held fixed as previously determined by precise triangulation rigidly adjusted on the North American datum. The azimuths of 18 lines were also held as they were determined from observations on Polaris. The traverse was adjusted to fit these several conditions.

The method used in making the adjustment was devised as a practical means for the elimination of the discrepancies without too great an expenditure of time and labor. A development of this method is given in Special Publication No. 79. The equation for the latitude is—

$$0 = +7238.24(\phi_n - \phi_n)' + [(\phi_2 - \phi_1)'(V_{s1}) + (\phi_3 - \phi_2)'(V_{s2}) + \dots + (\phi_n - \phi_{n-1})'(V_{sn})] + a_1[(\lambda_n - \lambda_1)'(V_{c1}) + (\lambda_n - \lambda_2)'(V_{c2}) + \dots + (\lambda_n - \lambda_{n-1})'(V_{cn})],$$

and the corresponding equation for the longitude is—

$$0 = +7238.24(\lambda_n - \lambda_n)' + [(\lambda_2 - \lambda_1)'(V_{s1}) + (\lambda_3 - \lambda_2)'(V_{s2}) + \dots + (\lambda_n - \lambda_{n-1})'(V_{sn})] + a_2[(\phi_n - \phi_1)'(V_{c1}) + (\phi_n - \phi_2)'(V_{c2}) + \dots + (\phi_n - \phi_{n-1})'(V_{cn})],$$

where ϕ_n and λ_n represent the preliminary latitude and longitude of the final point as computed through the traverse; ϕ_n and λ_n , the fixed latitude and longitude of the final point; ϕ_1 and λ_1 , the preliminary latitude and longitude of the first station in the traverse; ϕ_2 and λ_2 , the same for the second station, etc.; s_1 , the length of the first line; s_2 , of the second line, etc.; V_{s1} , the correction to the length of the first line; V_{s2} , of the second line, etc.; c_1 , the first angle; c_2 , the second, etc.; V_{c1} , the correction to the first angle; V_{c2} , to the second angle, etc.; and a_1 and a_2 are as follows:

$$a_1 = +10^6 M \frac{B \text{ arc } 1''}{A_n \sec \phi_n},$$

$$a_2 = -10^6 M \frac{A_n \sec \phi_n \text{ arc } 1''}{B},$$

where M represents the modulus of the common system of logarithms and A and B the factors used in the position computation.

The corrections to the lengths are here expressed as units of the sixth place of decimals of the logarithm and the corrections to the angles are in seconds of angular measure. It must be remembered that in traverse, unlike triangulation, there is no mathematical relation between the lengths and angles. Consequently, it is necessary, in order to hold what is considered a proper relation between the proportion of the discrepancy put on the lengths and the proportion on the angles, to determine experimentally a system of weighting to accomplish this purpose.

DISCREPANCY IN GEOGRAPHIC POSITION.

The geodetic position of station Sturgess as computed through the traverse, after the azimuth equations were satisfied, from station Dover of the U. S. Lake Survey was too great by $0''.223$ (6.88 meters) of latitude and too small by $0''.057$ (1.37 meters) of longitude. The

total discrepancy was 7.02 meters. If it is assumed that the positions which were held fixed at each end of the line are without error and the whole error is in the traverse, then the discrepancy is 1 part in 71 000 of the length of the traverse. If this discrepancy is considered as the closing error of the loop formed by the traverse, the Lake Survey precise triangulation from Racine south to the trans-continental arc, and the precise triangulation along the latter arc to Vandalia, a distance of 625 miles, then it amounts to 1 part in 145 000 of the length of the loop.

CONDITION EQUATIONS.

In making the adjustment the angles at the stations, beginning at the northern end, were designated by odd numbers and the lengths of lines between stations by even numbers. At azimuth stations the meridian was held fixed as determined by the astronomic observations, and the angle between the meridian and a line of the traverse was allowed to take a correction in the same manner as an angle between traverse stations. At azimuth and other stations where there are two angles the angles were designated by placing a letter after the number, as, for example, (35), and (35a).

The formulæ for the distribution of latitude and longitude discrepancies are based on the assumption that the changes in the geodetic positions will be small. This being the case, it became necessary to distribute the angle discrepancies between some of the azimuth stations prior to the final adjustment. The closures in azimuth were predominantly of the same sign, thus causing a rather large change in the geographic position, too large to be eliminated by the equations used without making a preliminary solution. Consequently, equations Nos. 7 to 16, inclusive, do not show the actual azimuth discrepancy, but only that remaining after the approximate discrepancy had been distributed.

The last measured length of the traverse between the stations Garner and Dow was measured as a base line and so used for one figure of triangulation through which the actual connection to station Sturgess was made. This figure was adjusted previous to the final traverse adjustment and two triangles from it were used in the final adjustment. Equations 18 and 19 are the angle conditions from these triangles. Equations 20 and 21 are, respectively, the latitude and longitude conditions.

Condition equations.

- No.
1. 0 = +10.4 + (1) + (3) + (5) + (7) + (9) + (11) + (13) + (13a).
 2. 0 = + 2.1 - (13a) + (15) + (17) + (19) + (21) + (23) + (25) + (27) + (29) + (31) + (33) + (35) + (35a).
 3. 0 = + 4.7 - (35a) + (37) + (39) + (41) + (43) + (45) + (47) + (49) + (51) + (53) + (55) + (57) + (57a).
 4. 0 = - 2.4 - (57a) + (59) + (61) + (63) + (65) + (67) + (69) + (71) + (73) + (75) + (77) + (79) + (81) + (83) + (85) - (87a).
 5. 0 = -30.7 + (87) + (87a) + (89) + (91) + (93) + (95) + (97) + (99) + (101) + (103) + (105) - (107a).
 6. 0 = + 6.9 + (107) + (107a) + (109) + (111) + (113) + (115) + (117) + (119) + (121) + (123) + (125) + (127) + (129) + (131) - (133a).
 7. 0 = + 9.0 + (133) + (133a) + (135) + (137) + (139) + (141) + (143) + (145) + (147) + (149) + (151) + (153) + (155) + (157) + (159) + (161) + (163a).
 8. 0 = - 0.1 - (163a) + (163) + (165) + (167) + (169) + (171) + (173) + (175) + (177) + (179) + (181) + (183) + (185) - (187a).
 9. 0 = - 0.4 + (187) + (187a) + (189) + (191) + (193) + (195) + (197) + (199) + (201) + (203) + (205) + (207) + (209a).
 10. 0 = - 0.6 + (209) - (209a) + (211) + (213) + (215) + (217) + (219) + (221) + (223) + (225) + (227) + (229) - (231a).
 11. 0 = - 0.6 + (231) + (231a) + (233) + (235) + (237) + (239) + (241) + (243) + (245) + (247) - (249a).
 12. 0 = - 0.5 + (249) + (249a) + (251) + (253) + (255) + (257) + (259) + (261) + (263) + (265) + (267) + (269) + (271) + (273) + (275a).
 13. 0 = - 2.6 - (275a) + (275) + (277) + (279) + (281) + (283) + (285) + (287) + (289) + (291) + (293) + (295) + (297a).
 14. 0 = - 1.7 - (297a) + (297) + (299) + (301) + (303) + (305) + (307) + (309) + (311) + (313) + (315) + (317a).
 15. 0 = - 1.5 - (317a) + (317) + (319) + (321) + (323) + (325) + (327) + (329) + (331) + (333) + (335) + (337) - (339a).

No.

16. $\Omega = 2.0 + (339a) + (339) + (341) + (343) + (345) + (347) + (349) + (351) + (353) + (355) + (357a)$.
 17. $\Omega = 7.0 - (357a) + (357) + (359) + (361) + (363) + (365) + (367) + (369) + (371) - (371a)$.
 18. $\Omega = 0.0 + (371c) + (373) + (375)$.
 19. $\Omega = 0.0 + (371b) + (375a) + (377)$.
 20. $\Omega = +259.8529 + 10.00(1) + 0.04(2) + 10.04(3) + 0.16(4) + 0.99(5) - 0.19(6) + 8.88(7) - 0.11(8) + 8.20(9) + 8.18(11) + 8.06(13) - 0.09(14) + 7.94(15) - 0.06(16) + 7.83(17) - 0.26(18) + 6.90(19) - 0.14(20) + 6.48(21) - 0.01(22) + 6.42(23) + 0.02(24) + 6.37(25) + 0.06(26) + 0.32(27) + 0.25(28) + 5.84(29) + 5.49(31) - 0.08(32) + 5.34(33) - 0.11(34) + 5.07(35) - 0.27(36) + 4.77(37) - 0.09(38) + 4.68(39) - 0.53(40) + 3.96(41) - 0.08(42) + 3.80(43) - 0.34(44) + 3.33(45) - 0.04(46) + 3.23(47) - 0.06(48) + 3.03(49) - 0.06(50) + 2.93(51) - 0.30(52) + 2.47(53) - 0.12(54) + 2.29(55) - 0.17(56) + 2.00(57) - 0.04(58) + 1.89(59) - 0.07(60) + 1.71(61) + 0.05(62) + 1.62(63) + 0.01(64) + 1.58(65) - 0.01(66) + 1.56(67) - 0.39(68) + 1.14(69) - 0.26(70) + 0.86(71) - 0.04(72) + 0.79(73) - 0.02(74) + 0.71(75) + 0.64(77) - 0.02(78) + 0.62(79) - 0.24(80) + 0.50(81) - 0.10(82) + 0.44(83) - 0.07(84) + 0.39(85) - 0.22(86) + 0.30(87) - 0.25(88) + 0.33(89) - 0.12(90) + 0.40(91) - 0.13(92) + 0.42(93) - 0.15(94) + 0.49(95) - 0.38(96) + 0.50(97) - 0.13(98) + 0.54(99) - 0.10(100) + 0.53(101) - 0.03(102) + 0.52(103) - 0.09(104) + 0.49(105) - 0.27(106) + 0.41(107) - 0.08(108) + 0.41(109) - 0.08(110) + 0.30(111) - 0.03(112) + 0.38(113) - 0.14(114) + 0.30(115) - 0.08(116) + 0.28(117) - 0.03(118) + 0.25(119) - 0.04(120) + 0.24(121) - 0.11(122) + 0.25(123) - 0.28(124) + 0.30(125) - 0.08(126) + 0.30(127) - 0.05(128) + 0.30(129) - 0.09(130) + 0.20(131) - 0.02(132) + 0.28(133) - 0.06(134) + 0.23(135) - 0.19(136) + 0.23(137) - 0.06(138) + 0.22(139) - 0.16(140) + 0.18(141) - 0.04(142) + 0.17(143) - 0.01(144) + 0.15(145) - 0.11(146) - 0.08(147) - 0.05(148) + 0.06(149) - 0.11(150) + 0.02(151) - 0.05(152) + 0.09(153) - 0.04(154) + 0.14(155) - 0.08(156) + 0.14(157) - 0.20(158) + 0.14(159) - 0.21(160) + 0.14(161) - 0.07(162) - 0.18(163) - 0.03(164) + 0.18(165) - 0.30(166) + 0.18(167) - 0.23(168) + 0.19(169) - 0.14(170) + 0.14(171) - 0.28(172) + 0.14(173) - 0.16(174) + 0.18(175) - 0.33(176) + 0.09(177) - 0.63(178) - 0.10(179) - 0.12(180) + 0.09(181) - 0.51(182) + 0.05(183) - 0.85(184) + 0.06(185) - 0.25(186) - 0.05(187) - 0.18(188) + 0.06(189) - 0.27(190) - 0.04(191) - 0.20(192) - 0.04(193) - 0.16(194) - 0.08(195) - 0.31(196) - 0.10(197) - 0.78(198) - 0.17(199) - 0.76(200) + 0.46(201) + 0.58(202) - 0.84(204) + 0.75(205) - 1.31(206) + 0.66(207) - 0.24(208) + 0.69(209) - 0.46(210) + 0.78(211) - 0.30(212) + 0.72(213) - 0.31(214) + 0.60(215) - 0.29(216) + 0.49(217) - 0.52(218) + 0.39(219) - 0.26(220) + 0.39(221) - 0.09(222) + 0.36(223) - 0.58(224) + 0.12(225) - 0.35(226) - 0.03(227) - 0.24(228) - 0.09(229) - 0.20(230) - 0.12(231) - 0.09(232) - 0.12(233) - 0.04(234) - 0.17(235) - 0.23(236) - 0.16(237) - 0.01(238) - 0.16(239) - 1.32(240) - 0.15(241) - 0.60(242) - 0.14(243) - 0.18(244) - 0.09(245) - 0.17(246) + 0.05(247) - 0.13(248) + 0.05(249) - 0.10(250) + 0.05(251) - 0.11(252) + 0.05(253) + 0.03(255) - 0.12(256) + 0.04(257) - 0.08(258) + 0.05(259) + 0.02(260) + 0.10(261) - 0.58(262) + 0.06(263) - 0.09(264) - 0.50(265) - 0.08(266) + 0.44(267) - 0.10(268) - 0.39(269) - 0.03(270) - 0.38(271) - 0.52(272) - 0.31(273) - 0.42(274) + 0.33(275) - 1.18(276) - 0.40(277) - 0.71(278) + 0.44(279) - 1.99(280) - 0.56(281) - 1.27(282) + 0.64(283) - 0.88(284) - 0.60(285) - 0.72(286) + 0.73(287) - 1.25(288) + 0.80(289) - 0.81(290) + 0.85(291) - 1.08(292) - 0.93(293) - 0.84(294) + 1.06(295) - 1.85(296) + 1.14(297) - 1.73(298) + 1.22(299) - 0.37(300) - 1.24(301) - 0.70(302) + 1.21(303) - 0.03(304) + 1.20(305) - 0.85(306) + 1.27(307) - 1.40(308) - 1.39(309) - 0.74(310) + 1.44(311) - 0.41(312) + 1.45(313) - 0.64(314) + 1.40(315) - 0.60(316) - 1.46(317) - 0.03(318) + 1.48(319) - 1.24(320) + 1.51(321) - 0.65(322) + 1.53(323) - 1.11(324) - 1.56(325) - 0.38(326) + 1.56(327) - 0.07(328) + 1.55(329) - 0.69(330) + 1.30(331) - 0.22(332) - 1.26(333) - 0.50(334) + 1.19(335) - 0.54(336) + 1.11(337) - 0.48(338) + 1.04(339) - 1.50(340) - 0.82(341) - 1.06(342) + 0.67(343) - 0.84(344) + 0.55(345) - 1.60(346) + 0.32(347) - 0.83(348) - 0.26(349) - 1.51(350) - 0.02(351) - 0.27(352) - 0.05(353) - 0.72(354) - 0.05(355) - 0.95(356) - 0.04(357) - 0.70(358) - 0.04(359) - 1.10(360) - 0.04(361) - 0.77(362) - 0.07(363) - 0.28(364) - 0.07(365) - 0.26(366) - 0.05(367) - 0.40(368) - 0.01(369) - 0.28(370) - 0.01(371) + 0.01(373) + 0.01(375) + 0.01(377)$
21. $\Omega = -23.3071 + 0.03(1) - 0.01(2) + 6.04(3) + 0.01(4) + 6.05(5) + 0.21(6) + 6.03(7) + 0.12(8) + 6.02(9) + 0.01(10) + 6.02(11) + 0.01(12) + 6.02(13) - 0.02(14) + 0.02(15) + 0.02(16) + 6.01(17) - 0.17(18) + 5.99(19) + 0.08(20) + 5.98(21) + 0.01(22) + 5.99(23) + 0.01(24) + 5.98(25) + 0.01(26) + 5.98(27) + 0.06(28) + 0.06(29) + 0.06(30) + 0.02(31) + 0.03(32) + 6.02(33) + 0.05(34) + 6.00(35) + 0.05(36) + 5.98(37) - 0.02(38) + 5.97(39) + 0.13(40) + 5.92(41) + 0.02(42) + 5.92(43) + 0.10(44) + 5.89(45) + 0.02(46) + 5.88(47) + 0.04(48) + 5.88(49) + 0.02(50) + 5.87(51) + 0.08(52) + 5.84(53) + 0.03(54) + 5.83(55) + 0.05(56) + 5.82(57) + 0.02(58) + 5.82(59) + 0.03(60) + 5.81(61) + 0.02(62) + 5.81(63) + 0.01(64) + 5.81(65) + 5.81(67) + 0.08(68) + 5.78(69) + 0.05(70) + 5.75(71) + 0.01(72) + 5.75(73) + 0.02(74) + 5.75(75) + 0.01(76) + 5.75(77) + 5.75(79) + 0.02(80) + 5.72(81) + 0.01(82) + 5.72(83) + 0.01(84) + 5.71(85) + 0.02(86) + 5.69(87) - 0.01(88) + 5.67(89) - 0.01(90) + 5.60(91) - 5.65(93) - 0.01(94) + 5.63(95) - 0.01(96) + 5.60(97) + 5.59(99) + 5.58(101) + 5.57(103) + 0.01(104) + 5.57(105) + 0.01(106) + 5.54(107) + 5.54(109) + 5.53(111) + 5.52(113) + 0.02(114) + 5.51(116) + 0.01(118) + 5.51(117) + 5.51(119) + 5.50(121) + 5.49(123) - 0.01(124) + 5.47(125) + 5.46(127) + 5.46(129) + 5.45(131) + 5.44(133) + 0.01(134) + 5.44(135) + 5.42(137) + 5.42(139) - 0.01(140) + 5.40(141) + 5.40(143) + 5.40(145) + 0.01(146) + 5.39(147) + 5.39(149) + 0.01(150) + 5.38(151) - 0.01(152) + 5.37(153) - 0.01(154) + 5.37(155) + 5.36(157) + 5.34(159) + 5.32(161) - 0.01(162) + 5.32(163) + 5.32(165) + 5.29(167) + 5.27(169) + 0.01(170) + 5.25(171) + 5.23(173) + 5.21(175) + 0.01(176) + 5.18(177) + 5.13(179) - 5.12(181) + 0.01(182) + 5.07(183) + 5.04(185) - 5.02(187) + 5.00(189) + 0.02(190) + 4.98(191) + 4.96(193) + 0.01(194) + 4.94(195) + 4.92(197) + 0.01(198) + 4.84(199) - 0.12(200) + 4.78(201) - 0.02(202) + 4.78(203) - 0.03(204) + 4.70(205) - 0.02(206) + 4.58(207) + 4.56(209) - 0.02(210) + 4.52(211) + 0.01(212) + 4.49(213) + 0.02(214) + 4.40(215) + 0.02(216) + 4.43(217) + 0.02(218) + 4.38(219) + 4.36(221) + 4.35(223) - 0.04(224) + 4.30(225) + 0.03(226) + 4.27(227) - 0.01(228) + 4.25(229) + 4.23(231) + 4.22(233) - 0.01(234) + 4.22(235) + 4.20(237) + 4.11(239) + 3.99(241) + 3.83(243) - 0.01(244) + 3.92(245) - 0.03(246) + 3.90(247) + 3.89(248) + 3.88(251) + 3.87(253) + 3.87(255) + 3.86(257) + 3.85(259) - 0.02(260) + 3.86(261) - 0.06(262) + 3.80(263) + 3.80(265) + 0.01(266) + 3.70(267) + 0.01(268) + 3.78(269) + 3.78(271) + 0.01(272) + 3.73(273) + 3.69(275) + 0.01(276) + 3.59(277) - 0.01(278) + 3.52(279) - 0.02(280) + 3.34(281) - 0.01(282) + 3.23(283) - 0.01(284) + 3.15(285) - 0.01(286) + 3.08(287) - 0.01(288) + 2.97(289) - 0.01(290) + 2.90(291) - 0.01(292) + 2.80(293) - 0.02(294) + 2.74(295) - 0.02(296) + 2.58(297) - 0.02(298) + 2.42(299) + 2.39(301) + 2.38(303) + 2.27(305) - 0.01(306) - 2.19(307) - 0.02(308) + 2.04(309) - 0.01(310) + 1.99(311) + 1.96(313) + 1.91(315) + 1.84(317) + 1.78(319) - 0.01(320) + 1.85(321) - 1.59(323) + 1.49(325) + 1.46(327) + 1.45(329) + 0.05(330) + 1.39(331) + 0.01(332) + 1.37(333) - 0.01(334) + 1.32(335) + 0.01(336) + 1.27(337) - 0.01(338) + 1.23(339) + 0.04(340) + 1.08(341) - 0.03(342) + 1.00(343) + 0.02(344) - 0.02(345) - 0.04(346) + 0.78(347) + 0.02(348) + 0.70(349) - 0.04(350) + 0.57(351) + 0.54(353) + 0.48(355) + 0.40(357) + 0.33(359) + 0.23(361) - 0.01(362) + 0.16(363) + 0.14(365) - 0.01(366) + 0.12(367) - 0.01(368) + 0.09(369) + 0.05(371) - 0.05(373) - 0.05(375) - 0.05(376a) - 0.05(377)$

TABLES OF CORRECTIONS.

In the following tables are given the corrections to the angles and distances as derived from the least-squares adjustment. The first table, giving the corrections to the angles, has in the first column the name of the station, in the second the designation given to the angle in the adjustment, in the third the correction due to the azimuth adjustment when it was made previous to the final adjustment, in the fourth the correction due to the latitude and longitude adjustment, and in the last column the total correction. Where only the total correction is given the azimuth discrepancy was eliminated along with the discrepancy in position.

In the second table following are given the names of the two stations between which the measurements were made, the designation of this length in the adjustment, the correction to the seventh place of the logarithm of this length, and in the last column the proportional part by which the correction changes the length.

The average correction to an angle is $2''.0$, with a maximum of $4''.9$. The average correction to the length is 16 in the seventh place of the logarithm or 1 part in 270 000. Only 18 of the 185 lengths are corrected by as much as 1 part in 100 000, and the mean of these 18 corrections is 60 in the seventh place of the logarithm, or 1 part in 72 000. The maximum correction is to the length between stations Marion and Santa Fee, which amounts to 1 part in 50 000.

Table of corrections to the angles due to the distribution of the azimuth discrepancies and to the latitude and longitude adjustment.

Station.	Designation of angle in the adjustment.	Correction due to the azimuth.	Correction due to the adjustment.	Total correction.	Station.	Designation of angle in the adjustment.	Correction due to the azimuth.	Correction due to the adjustment.	Total correction.
Dover.....	1	"	"	-3.2	Cut.....	65	"	"	-0.3
Midway.....	3			-3.3	Cave.....	67			-0.3
Kansas.....	5			-3.2	Morgan.....	69			+0.3
Vilas.....	7			-1.6	Long.....	71			+0.7
Wilmont.....	9			-0.6	Slim.....	73			+0.8
Oneida.....	11			-0.5	Short.....	75			+0.9
Burlington.....	13			-0.4	Beloit.....	77			+1.0
Burlington.....	13a			+2.4	State Line.....	79			+1.0
Oconto.....	15			-2.7	Flat.....	81			+1.2
Lang.....	17			-2.5	Limit.....	83			+1.3
Kenosha.....	19			-1.2	Shaw.....	85			+1.4
Buneau.....	21			-0.5	Rockton.....	87			+2.9
Whistle.....	23			-0.4	Rockton.....	87a			+1.4
Bank.....	25			-0.4	Bond.....	89			+2.8
Iron.....	27			-0.3	Alexander.....	91			+2.7
Iowa.....	29			+0.4	Adams.....	93			+2.7
Elkhorn.....	31			+0.9	Roscoe.....	95			+2.6
Forest.....	33			+1.2	Boon.....	97			+2.4
Fond.....	35			+1.5	Brown.....	99			+2.5
Fond.....	35a			+4.3	Bureau.....	101			+2.5
Elorence.....	37			-2.3	Calhoun.....	103			+2.5
Delavan.....	39			-2.2	Carroll.....	105			+2.6
Dunn.....	41			-1.2	Latham.....	107			-0.5
Darien.....	43			-1.0	Latham.....	107a			-3.1
Door.....	45			-0.3	Cass.....	109			-0.5
Dodge.....	47			-0.1	Champaign.....	111			-0.4
Dane.....	49			+0.2	Christian.....	113			-0.4
Calumet.....	51			+0.3	Clark.....	115			-0.3
Burnett.....	53			+0.9	Clay.....	117			-0.2
Clinton.....	55			+1.2	Clinton.....	119			-0.2
Buffalo.....	57			+1.0	Genet.....	121			-0.2
Buffalo.....	57a			+2.5	Coles.....	123			-0.3
Bayfield.....	59			-0.8	Jones.....	125			-0.3
Barron.....	61			-0.5	Cook.....	127			-0.3
Ashland.....	63			-0.4	Ruby.....	129			-0.3

Table of corrections to the angles due to the distribution of the azimuth discrepancies and to the latitude and longitude adjustment—Continued.

Station.	Designation of angle in the adjustment.	Correction due to the azimuth.	Correction due to the adjustment.	Total correction.	Station.	Designation of angle in the adjustment.	Correction due to the azimuth.	Correction due to the adjustment.	Total correction.
Crawford.....	131	.....	.....	-0.3	La Salle.....	259	+1.9	+0.3	+2.2
Cumberland.....	133	.....	.....	-0.7	McDonough.....	261	+1.9	+0.2	+2.1
Cumberland.....	133a	.....	.....	-0.4	Cinder.....	263	+2.0	-0.3	+1.7
Dekob.....	135	+4.6	-0.6	+4.0	Oglesby.....	265	+1.9	-0.3	+1.6
Forest.....	137	+4.6	-0.6	+4.0	Macoupin.....	267	+1.9	-0.3	+1.6
Burton.....	139	+4.6	-0.6	+4.0	McHenry.....	269	+1.9	-0.2	+1.7
Guard.....	141	+4.6	-0.6	+4.0	Macon.....	271	+1.9	-0.2	+1.7
John.....	143	+4.5	-0.6	+3.9	McLean.....	273	+1.9	-0.1	+1.8
Church.....	145	+4.0	-0.5	+4.1	Tonica.....	275	+2.5	+1.1	+3.6
Park.....	147	+4.6	-0.4	+4.2	Tonica.....	275a	.....	-1.2	-1.2
Peach.....	149	+4.6	-0.4	+4.2	Madison.....	277	+2.5	+0.9	+3.4
Western.....	151	+4.6	-0.3	+4.3	Marion.....	279	+2.0	+0.8	+3.4
First.....	153	+4.5	-0.5	+4.0	Santa Feo.....	281	+2.5	+0.5	+3.0
Fourth.....	155	+4.6	-0.5	+4.1	Rut.....	283	+2.5	+0.4	+2.9
Gregory.....	157	+4.0	-0.5	+4.1	Monok.....	285	+2.6	+0.2	+2.8
Eighteenth.....	159	+4.6	-0.6	+4.0	Woodford.....	287	+2.5	+0.1	+2.6
Douglas.....	161	+4.0	-0.6	+4.0	Panola.....	289	+2.5	-0.1	+2.4
Dewitt.....	163	+3.5	0	+3.5	El Paso.....	291	+2.6	-0.2	+2.4
Dewitt.....	163a	.....	-0.6	-0.6	Kappa.....	293	+2.5	-0.3	+2.2
Dupage.....	165	+3.6	0	+3.6	Marshal.....	295	+2.5	-0.6	+1.9
Edgar.....	167	+3.5	0	+3.5	Kerrick.....	297	+2.5	+0.5	+3.0
Grant.....	169	+3.0	-0.1	+3.3	Kerrick.....	297a	.....	-1.4	-1.4
Edwards.....	171	+3.5	0	+3.5	Bloomington.....	299	+2.5	+0.3	+2.8
Effingham.....	173	+3.5	0	+3.5	Curve.....	301	+2.5	+0.3	+2.8
Fayette.....	175	+3.5	0	+3.5	Stines.....	303	+2.5	+0.3	+2.8
Ford.....	177	+3.6	0	+3.6	Harlan.....	305	+2.5	+0.3	+2.8
Franklin.....	179	+3.5	0	+3.5	Heyworth.....	307	+2.4	+0.1	+2.5
Fulton.....	181	+3.6	0	+3.6	Wapella.....	309	+2.5	-0.1	+2.4
Davis.....	183	+3.5	0	+3.5	Harras.....	311	+2.5	-0.3	+2.2
Hocomb.....	185	+3.6	0	+3.6	Clinton.....	313	+2.5	-0.3	+2.2
Gallatin.....	187	+4.3	+0.4	+4.7	Weld.....	315	+2.5	-0.3	+2.2
Gallatin.....	187a	.....	+0.4	+0.4	Ospur.....	317	-0.8	+0.1	-0.7
Green.....	189	+4.3	+0.3	+4.6	Ospur.....	317a	.....	-0.5	-0.5
Grundy.....	191	+4.3	+0.5	+4.8	Maroa.....	319	-0.8	+0.1	-0.7
Hamilton.....	193	+4.3	+0.4	+4.7	Emery.....	321	-0.8	-0.1	-0.9
Kings.....	195	+4.3	+0.5	+4.8	Forsyth.....	323	-0.7	-0.1	-0.8
Hancock.....	197	+4.2	+0.5	+4.7	Hickory.....	325	-0.8	-0.2	-1.0
Center.....	199	+4.3	+0.6	+4.9	Pit.....	327	-0.8	-0.2	-1.0
Henderson.....	201	+4.3	-0.4	+3.9	Decatur.....	329	-0.8	-0.2	-1.0
Iroquois.....	203	+4.3	-0.6	+3.7	Clicker.....	331	-0.7	+0.1	-0.6
Steward.....	205	+4.3	-0.9	+3.4	Elvin.....	333	-0.8	+0.1	-0.7
Scarboro.....	207	+4.3	-0.8	+3.5	Mason.....	335	-0.8	+0.2	-0.6
Fred.....	209	+2.6	-0.3	+2.3	Short.....	337	-0.8	+0.3	-0.5
Fred.....	209a	.....	-0.5	-0.5	Macon.....	339	+1.6	-0.5	+1.1
Jackson.....	211	+2.5	-0.6	+1.9	Macon.....	339a	.....	-0.9	-0.9
Jasper.....	213	+2.6	-0.4	+2.2	Moweaqua.....	341	+1.6	-0.3	+1.3
Roxbury.....	215	+2.5	-0.3	+2.2	Ray.....	343	+1.6	-0.1	+1.5
Jefferson.....	217	+2.6	-0.1	+2.5	Assumption.....	345	+1.6	0	+1.6
Jersey.....	219	+2.6	0	+2.6	Dunkel.....	347	+1.7	+0.3	+2.0
Davies.....	221	+2.6	0	+2.6	Pana.....	349	+1.6	+0.4	+2.0
Johnson.....	223	+2.5	0	+2.5	Watson.....	351	+1.6	+0.7	+2.3
Kane.....	225	+2.6	+0.3	+2.9	Oconee.....	353	+1.6	+0.7	+2.3
Kankakee.....	227	+2.5	+0.5	+3.0	Warren.....	355	+1.6	+0.6	+2.2
Kendall.....	229	+2.6	+0.6	+3.2	Leach.....	357	.....	.....	-0.5
Mendota.....	231	+2.2	+0.3	+2.5	Leach.....	357a	.....	.....	+1.1
Mendota.....	231a	.....	-0.4	-0.4	Ramsay.....	359	.....	.....	-0.6
Knox.....	233	+2.2	+0.3	+2.5	Moore.....	361	.....	.....	-0.6
Simpson.....	235	+2.2	+0.8	+2.5	Lost.....	363	.....	.....	-0.6
Lake.....	237	+2.2	+0.8	+2.5	Vern.....	365	.....	.....	-0.6
Culton.....	239	+2.3	+0.3	+2.6	Jim.....	367	.....	.....	-0.7
Lawrence.....	241	+2.2	+0.2	+2.4	Clem.....	369	.....	.....	-0.7
Lee.....	243	+2.2	+0.1	+2.3	Garner.....	371	.....	.....	-0.8
Livingston.....	245	+2.2	0	+2.2	Garner.....	371a	.....	.....	+0.8
Logan.....	247	+2.2	-0.2	+2.0	Garner.....	371b	.....	.....	0
Vinson.....	249	+1.9	+0.4	+2.3	Garner.....	371c	.....	.....	0
Vinson.....	249a	.....	+0.6	+0.6	Dow.....	373	.....	.....	0
Bowie.....	251	+1.9	+0.4	+2.3	Cocagne.....	375	.....	.....	0
Joy.....	253	+1.9	+0.4	+2.3	Cocagne.....	375a	.....	.....	0
Gooding.....	255	+1.9	+0.4	+2.3	Sturgess.....	377	.....	.....	0
Earl.....	257	+1.9	+0.4	+2.3					

Table of corrections to the measured lengths.

Stations.	Designation of length in adjustment.	Correction to length in seventh place of logarithm.	Ratio of the correction to total length as 1 part in—	Stations.	Designation of length in adjustment.	Correction to length in seventh place of logarithm.	Ratio of the correction to total length as 1 part in—
Dover-Midway.....	2	-2	2 171 000	Cook-Ruby.....	128	+2	2 171 000
Midway-Kansas.....	4	-7	620 000	Ruby-Crawford.....	130	+4	1 086 000
Kansas-Vilas.....	6	+12	362 000	Crawford-Cumberland.....	132	+1	4 343 000
Vilas-Wilmont.....	8	+7	620 000	Cumberland-Dekob.....	134	+3	1 448 000
Wilmont-Oneida.....	10	0	.....	Dekob-Forest.....	186	+8	543 000
Oneida-Burlington.....	12	0	.....	Forest-Burton.....	138	+3	1 448 000
Burlington-Oconto.....	14	+4	1 086 000	Burton-Guard.....	140	+7	620 000
Oconto-Lang.....	16	+3	1 448 000	Guard-John.....	142	+2	2 171 000
Lang-Kenosha.....	18	+15	290 000	John-Church.....	144	0	.....
Kenosha-Buneau.....	20	+8	543 000	Church-Park.....	146	+5	869 000
Buneau-Whistle.....	22	+1	4 343 000	Park-Peach.....	148	+2	2 171 000
Whistle-Bank.....	24	-1	4 343 000	Peach-Western.....	150	+5	869 000
Bank-Iron.....	26	-2	2 171 000	Western-First.....	152	+2	2 171 000
Iron-Iowa.....	28	-9	483 000	First-Fourth.....	154	+2	2 171 000
Iowa-Elkhorn.....	30	-7	620 000	Fourth-Gregory.....	156	+4	1 086 000
Elkhorn-Forest.....	32	+4	1 086 000	Gregory-Eighteenth.....	158	+9	483 000
Forest-Fond.....	34	+6	724 000	Eighteenth-Douglas.....	160	+9	483 000
Fond-Eloreance.....	36	+13	334 000	Douglas-Dewitt.....	162	+3	1 448 000
Eloreance-Delavan.....	38	+4	1 086 000	Dewitt-Dupage.....	164	+1	4 843 000
Delavan-Dunn.....	40	+26	167 000	Dupage-Edgar.....	166	+13	334 000
Dunn-Darien.....	42	+4	1 086 000	Edgar-Grant.....	168	+11	395 000
Darien-Door.....	44	+17	255 000	Grant-Edwards.....	170	+6	724 000
Door-Dodge.....	46	+2	2 171 000	Edwards-Effingham.....	172	+12	362 000
Dodge-Dane.....	48	+3	1 448 000	Effingham-Fayette.....	174	+7	620 000
Dane-Calumet.....	50	+3	1 448 000	Fayette-Ford.....	176	+15	290 000
Calumet-Burnett.....	52	+15	290 000	Ford-Franklin.....	178	+28	155 000
Burnett-Clinton.....	54	+6	724 000	Franklin-Fulton.....	180	+5	869 000
Clinton-Buffalo.....	56	+8	543 000	Fulton-Davis.....	182	+23	189 000
Buffalo-Bayfield.....	58	+2	2 171 000	Davis-Hocomb.....	184	+15	290 000
Bayfield-Barron.....	60	+4	1 086 000	Hocomb-Gallatin.....	186	+11	395 000
Barron-Ashland.....	62	-2	2 171 000	Gallatin-Green.....	188	+8	543 000
Ashland-Cut.....	64	0	.....	Green-Grundy.....	190	+12	362 000
Cut-Cave.....	66	0	.....	Grundy-Hamilton.....	192	+9	483 000
Cave-Morgan.....	68	+19	229 000	Hamilton-Kings.....	194	+7	620 000
Morgan-Long.....	70	+12	362 000	Kings-Hancock.....	196	+14	310 000
Long-Slim.....	72	+2	2 171 000	Hancock-Center.....	198	+35	124 000
Slim-Short.....	74	+1	4 343 000	Center-Henderson.....	200	+31	140 000
Short-Beloit.....	76	0	.....	Henderson-Iroquois.....	202	0	.....
Beloit-State Line.....	78	+1	4 343 000	Iroquois-Steward.....	204	+38	121 000
State Line-Flat.....	80	+11	395 000	Steward-Scarboro.....	206	+58	75 000
Flat-Limit.....	82	+5	869 000	Scarboro-Fred.....	208	+11	395 000
Limit-Shaw.....	84	+3	1 448 000	Fred-Jackson.....	210	+20	217 000
Shaw-Rockton.....	86	+10	434 000	Jackson-Jasper.....	212	+17	255 000
Rockton-Bond.....	88	+11	395 000	Jasper-Roxbury.....	214	+14	310 000
Bond-Alexander.....	90	+5	869 000	Roxbury-Jefferson.....	216	+13	334 000
Alexander-Adams.....	92	+6	724 000	Jefferson-Jersey.....	218	+23	189 000
Adams-Roscoe.....	94	+6	724 000	Jersey-Daviss.....	220	+11	395 000
Roscoe-Boon.....	96	+17	255 000	Daviss-Johnson.....	222	+4	1 086 000
Boon-Brown.....	98	+6	724 000	Johnson-Kane.....	224	+26	167 000
Brown-Bureau.....	100	+4	1 086 000	Kane-Kankakee.....	226	+16	271 000
Bureau-Calhoun.....	102	+1	4 343 000	Kankakee-Kendall.....	228	+11	395 000
Calhoun-Carroll.....	104	+4	1 086 000	Kendall-Mandota.....	230	+9	483 000
Carroll-Latham.....	106	+12	362 000	Mandota-Knox.....	232	+4	1 086 000
Latham-Cass.....	108	+4	1 086 000	Knox-Simpson.....	234	+2	2 171 000
Cass-Champaign.....	110	+4	1 086 000	Simpson-Lake.....	236	+10	434 000
Champaign-Christlan.....	112	+1	4 343 000	Lake-Culton.....	238	+45	97 000
Christlan-Clark.....	114	+6	724 000	Culton-Lawrence.....	240	+58	75 000
Clark-Clay.....	116	+2	2 171 000	Lawrence-Lee.....	242	+26	167 000
Clay-Clinton.....	118	+1	4 343 000	Lee-Livingston.....	244	+8	543 000
Clinton-Genet.....	120	+2	2 171 000	Livingston-Logan.....	246	+7	620 000
Genet-Coles.....	122	+5	869 000	Logan-Vinson.....	248	+6	724 000
Coles-Jones.....	124	+12	362 000	Vinson-Bowie.....	250	+4	1 086 000
Jones-Cook.....	126	+4	1 086 000	Bowie-Joy.....	252	+5	869 000

Table of corrections to the measured lengths—Continued.

Stations.	Designation of length in adjustment.	Correc-tion to length in seventh place of loga-rithm.	Ratio of the correc-tion to total length as 1 part in—	Stations.	Designation of length in adjust-ment.	Correc-tion to length in seventh place of loga-rithm.	Ratio of the correc-tion to total length as 1 part in—
Joy-Gooding.....	254	0	.....	Clinton-Weld.....	314	+24	181 000
Gooding-Earl.....	258	+5	869 000	Weld-Ospur.....	316	+30	145 000
Earl-La Salle.....	258	+4	1 086 000	Ospur-Maroa.....	318	+41	106 000
La Salle-McDonough.....	230	+1	4 343 000	Maroa-Emer-y.....	320	+55	79 000
McDonough-Cinder.....	262	+24	181 000	Emery-Forsyth.....	322	+29	150 000
Cinder-Oglesby.....	264	+4	1 086 000	Forsyth-Hickory.....	324	+49	89 000
Oglesby-Macoupin.....	266	+4	1 086 000	Hickory-Pit.....	326	+17	255 000
Macoupin-McHenry.....	268	+5	869 000	Pit-Decatur.....	328	+3	1 448 000
McHenry-Macon.....	270	+1	4 343 000	Decatur-Clker.....	330	+31	140 000
Macon-McLean.....	272	+23	189 000	Clker-Elvin.....	332	+10	434 000
McLean-Tonica.....	274	+19	229 000	Elvin-Mason.....	334	+22	107 000
Tonica-Madison.....	276	+52	94 000	Mason-Short.....	336	+24	181 000
Madison-Marion.....	278	+31	140 000	Short-Macon.....	338	+21	207 000
Marion-Santa Fee.....	280	+87	50 000	Macon-Moweaqua.....	340	+67	65 000
Santa Fee-Rut.....	282	+56	78 000	Moweaqua-Ray.....	342	+47	92 000
Rut-Menok.....	284	+39	111 000	Ray-Assumption.....	344	+37	117 000
Menok-Woodford.....	286	+32	136 000	Assumption-Dunkel.....	346	+71	61 000
Woodford-Panola.....	288	+55	79 000	Dunkel-Pana.....	348	+37	117 000
Panola-El Paso.....	290	+36	121 000	Pana-Watson.....	350	+67	65 000
El Paso-Kappa.....	292	+47	92 000	Watson-Oconee.....	352	+12	362 000
Kappa-Marshal.....	294	+28	155 000	Oconee-Warren.....	354	+32	136 000
Marshal-Kerrick.....	296	+81	64 000	Warren-Leach.....	356	+42	103 000
Kerrick-Bloomington.....	298	+70	57 000	Leach-Ramsey.....	358	+31	140 000
Bloomington-Curve.....	300	+16	271 000	Ramsey-Moore.....	360	+49	89 000
Curve-Stines.....	302	+31	140 000	Moore-Lost.....	362	+34	128 000
Stines-Harlan.....	304	+28	155 000	Lost-Vera.....	364	+12	362 000
Harlan-Heyworth.....	306	+37	117 000	Vera-Jim.....	366	+11	395 000
Heyworth-Wapella.....	308	+65	67 000	Jim-Clem.....	368	+17	255 000
Wapella-Harras.....	310	+32	136 000	Clem-Garner.....	370	+12	362 000
Harras-Clinton.....	312	+18	241 000				

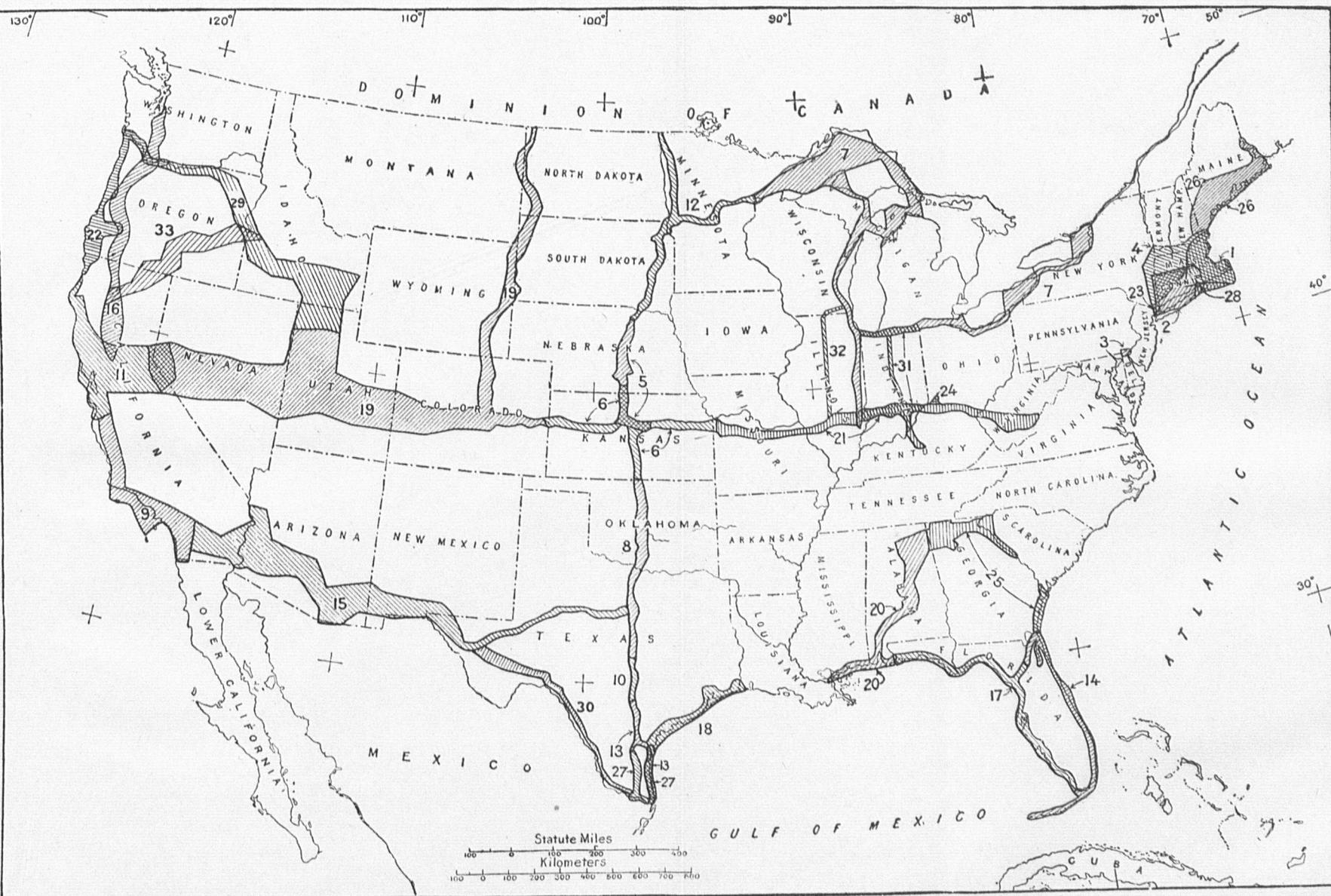


FIG. 9.—INDEX MAP SHOWING AREAS IN THE UNITED STATES COVERED BY PUBLISHED TRIANGULATION AND TRAVERSE WHICH HAVE BEEN RIGIDLY COMPUTED ON THE NORTH AMERICAN DATUM.

1. Appendix 8, Report for 1885 (superseded by Special Publication No. 76).
2. Appendix 8, Report for 1888.
3. Appendix 8, Report for 1893.
4. Appendix 10, Report for 1894 (superseded by Special Publication No. 76).
5. Appendix 6, Report for 1901.

6. Special Publication No. 70.
7. Appendix EEE, Annual Report of the Chief of Engineers, 1902.
8. Appendix 4, Report for 1903 (superseded by S. P. No. 88).
9. Appendix 9, Report for 1904.
10. Appendix 5, Report for 1905 (superseded by S. P. No. 88).
11. Appendix 5, Report for 1910.

12. Appendix 4, Report for 1911.
13. Appendix 5, Report for 1911 (superseded by S. P. No. 88).
14. Appendix 6, Report for 1911.
15. Special Publication No. 11.
16. Special Publication No. 13.
17. Special Publication No. 16.
18. Special Publication No. 17.
19. Special Publication No. 19.

20. Special Publication No. 24.
21. Special Publication No. 30.
22. Special Publication No. 31.
23. Report on the triangulation of Greater New York.
24. Report on a plan of sewerage for the city of Cincinnati.
25. Special Publication No. 43.
26. Special Publication No. 46.

27. Special Publication No. 54.
28. Special Publication No. 62.
29. Special Publication No. 74.
30. Special Publication No. 78.
31. Special Publication No. 79.
32. Special Publication No. 86.
33. Special Publication No. 84.

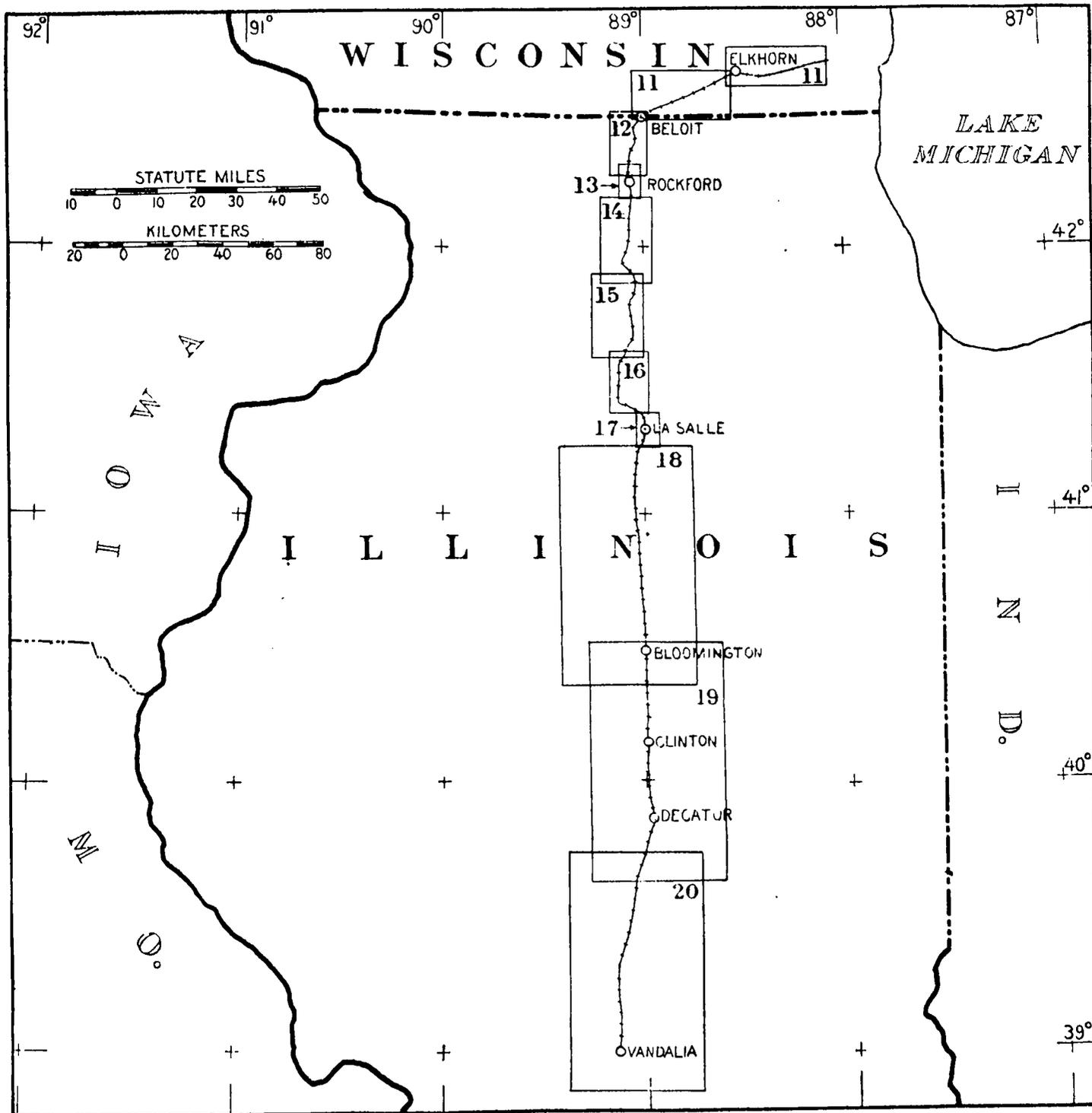


FIG. 10.—INDEX MAP OF ILLINOIS, SHOWING THE BOUNDARIES OF THE SKETCHES, FIGS. 11 TO 20.

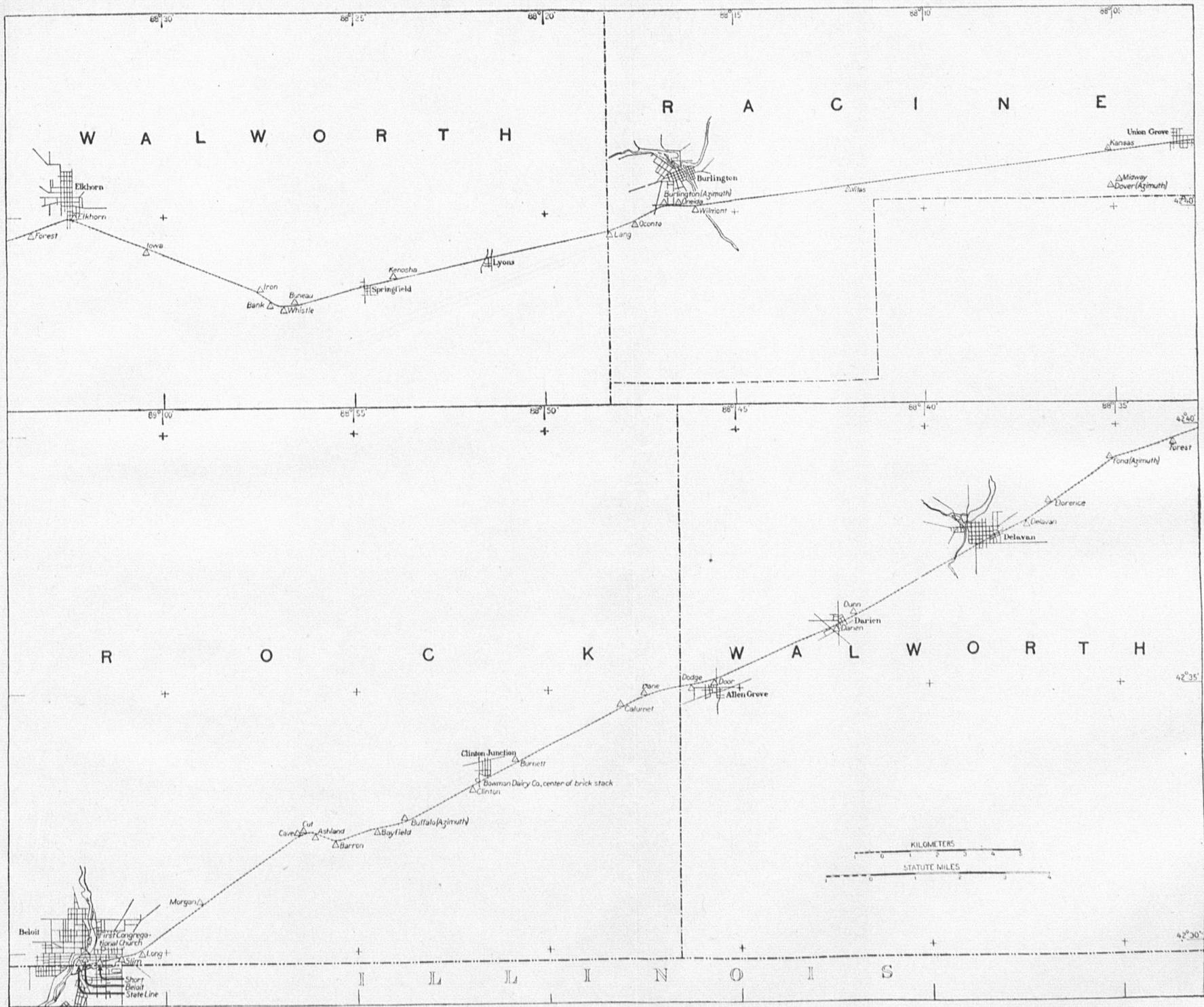


FIG. 11.—PRECISE TRAVERSE, VICINITY OF RACINE TO БЕЛОIT, WIS.

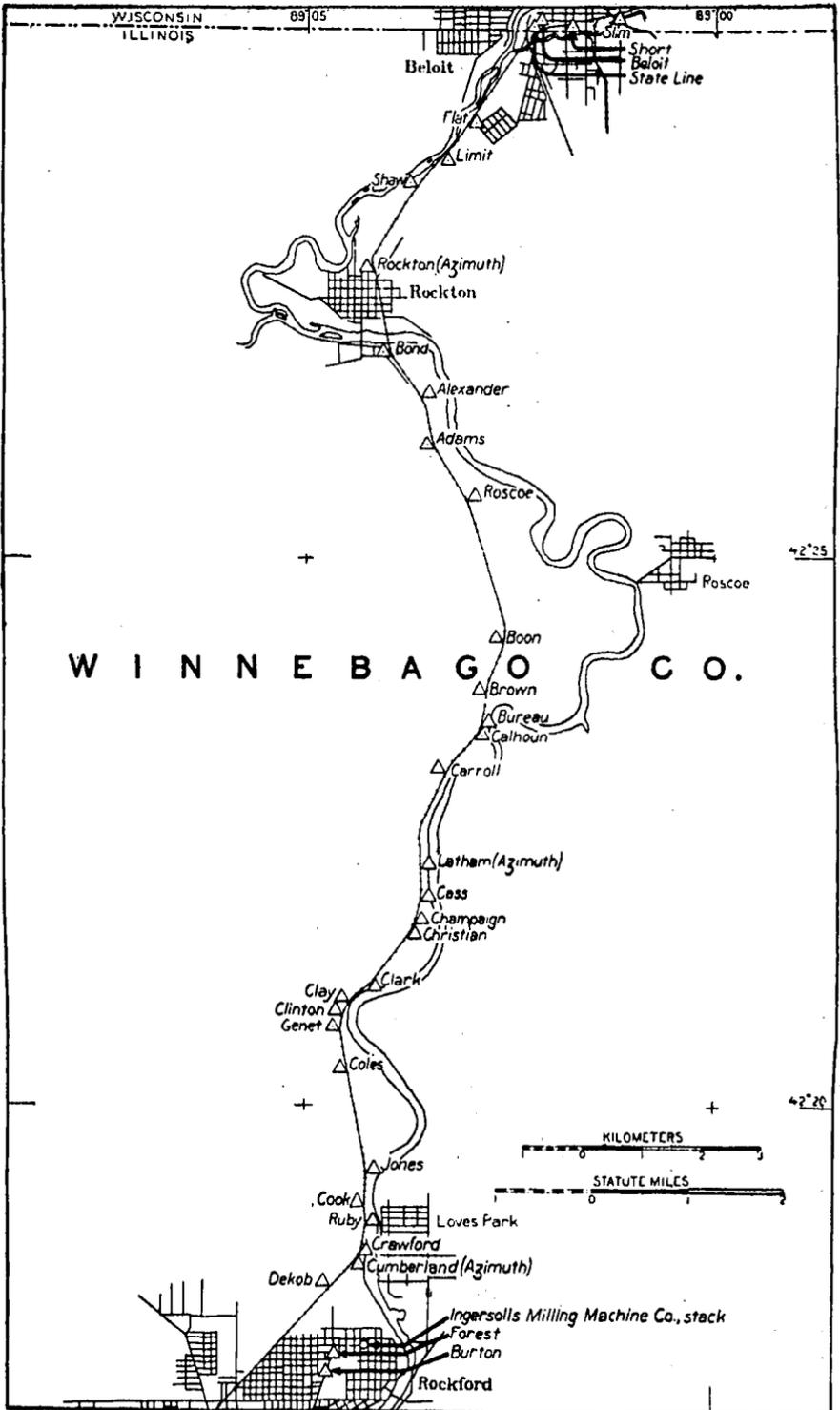


FIG. 12.—Precise traverse, Beloit, Wis., to Rockford, Ill.

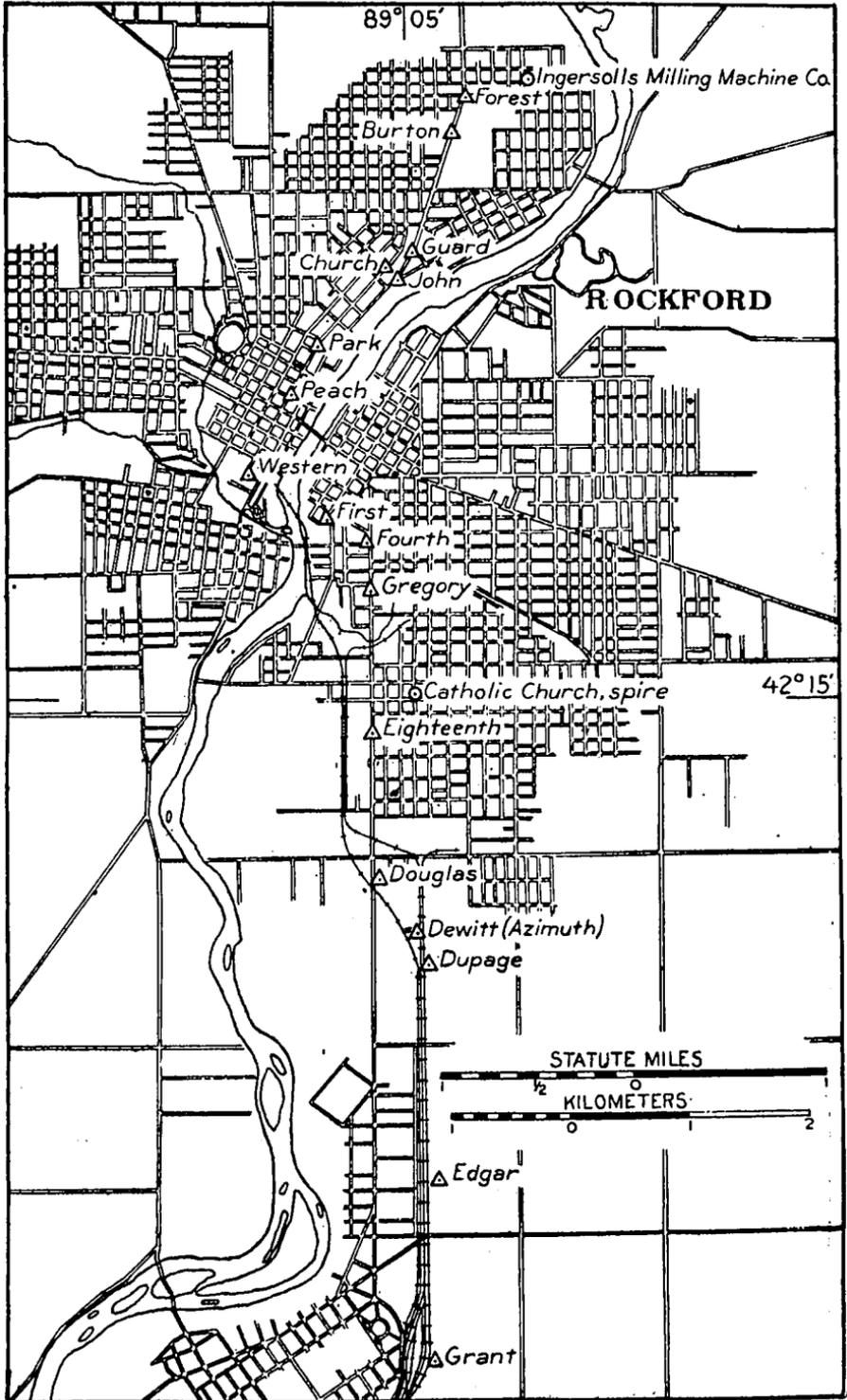


FIG. 13.—Precise traverse, Rockford and vicinity.

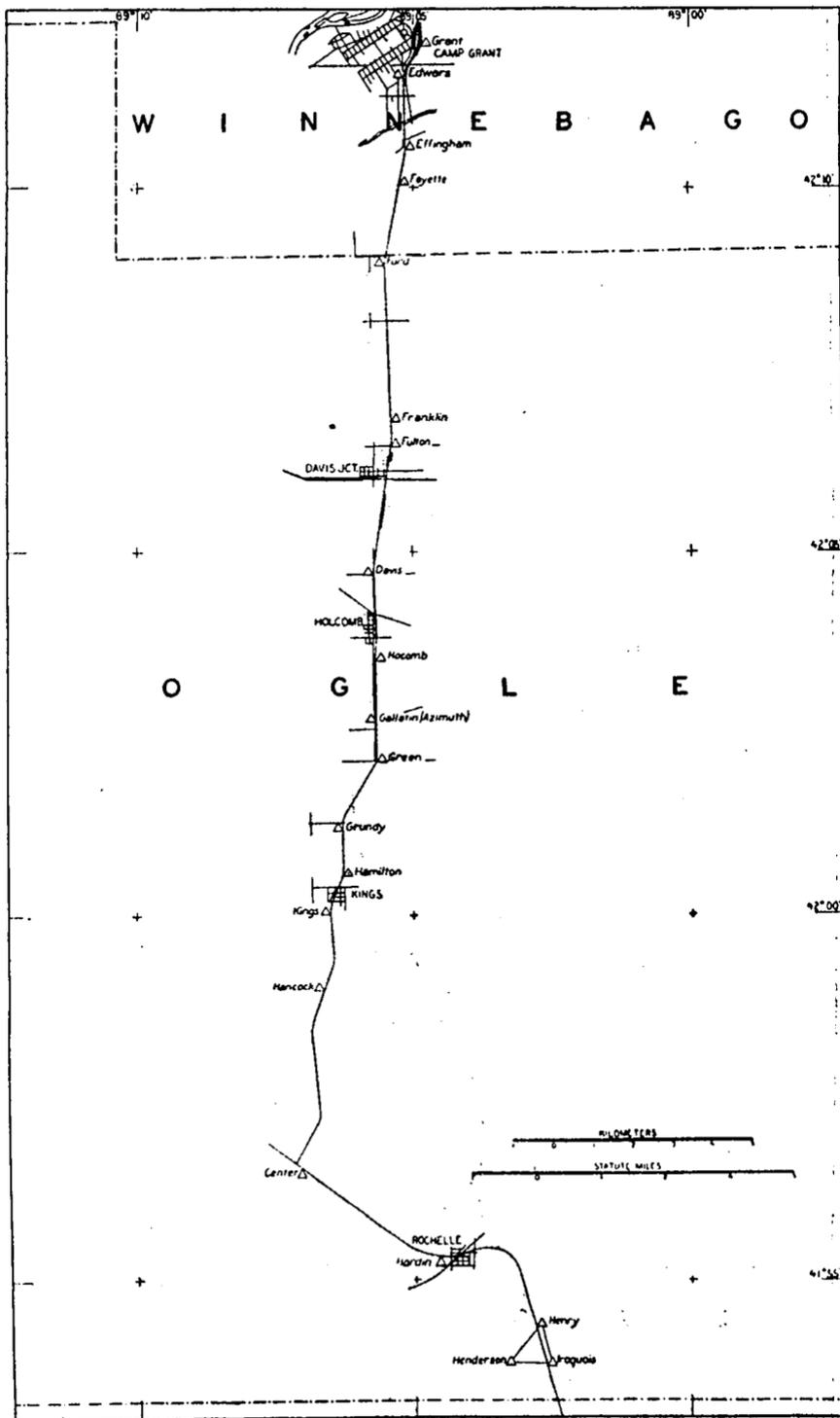


FIG. 14.—Precise traverse, vicinity of Rockford to Rochelle.

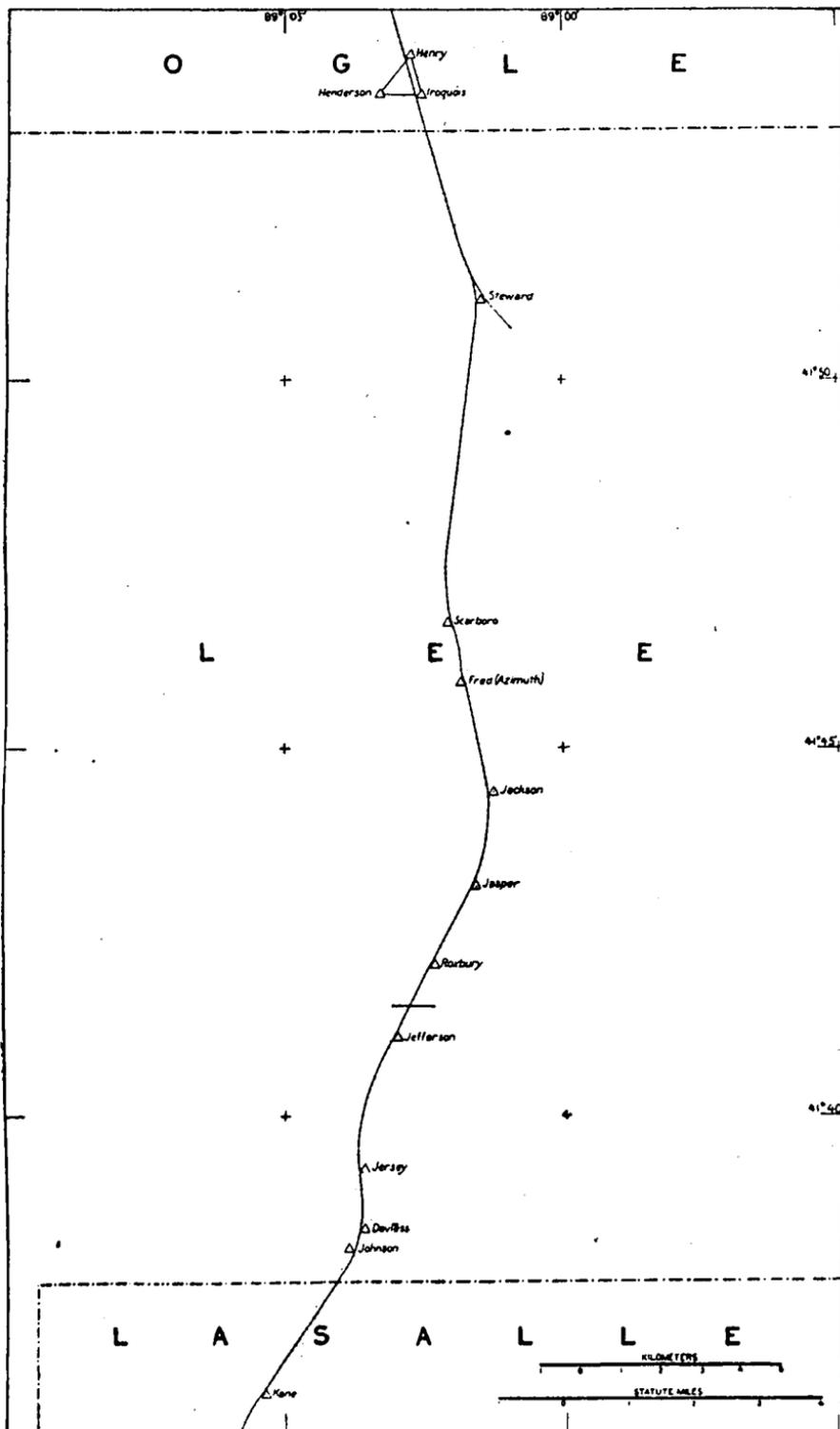


FIG. 15.—Precise traverse, Rochelle to vicinity of Mendota.

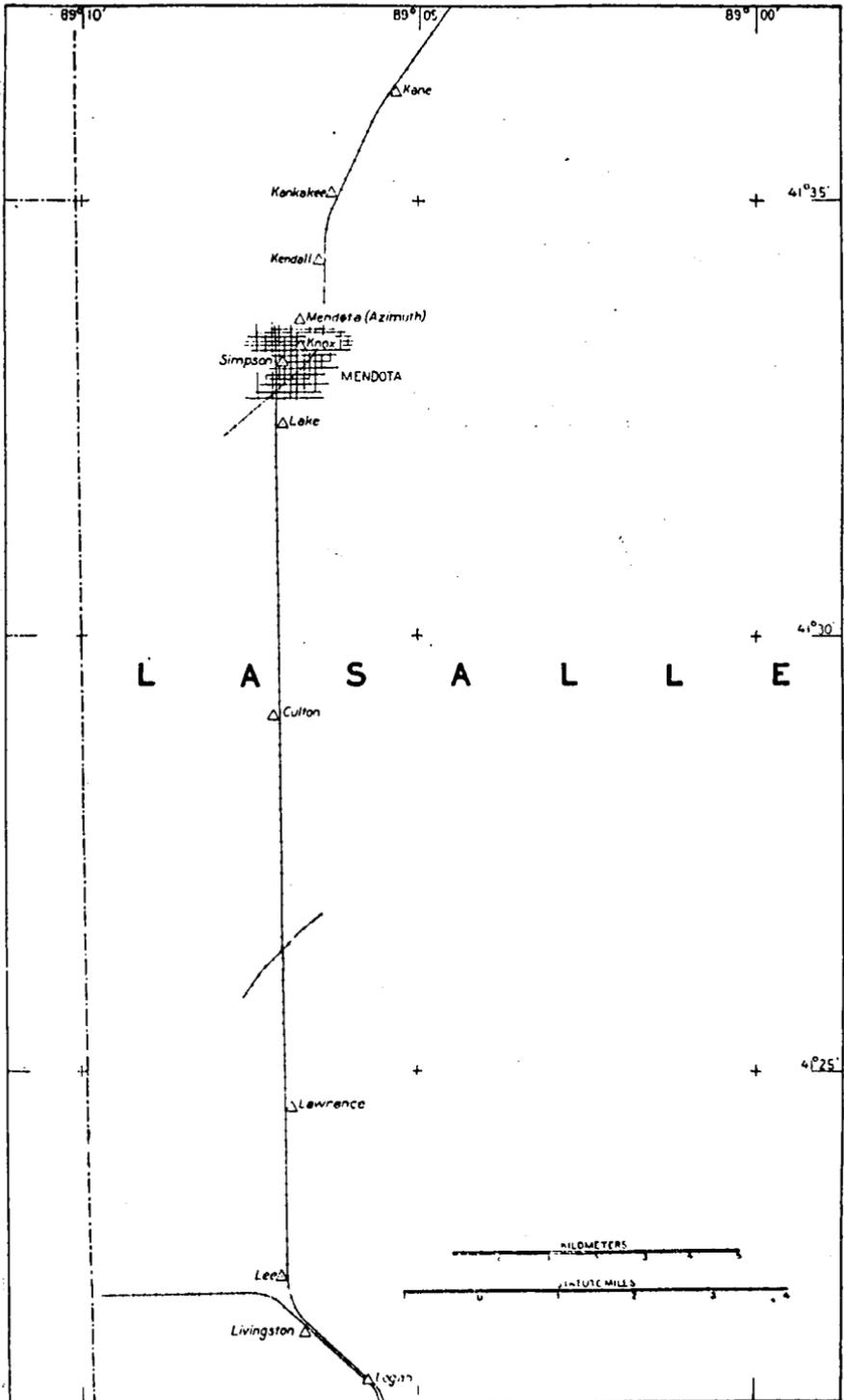


FIG. 16.—Precise traverse, vicinity of Mendota to La Salle.

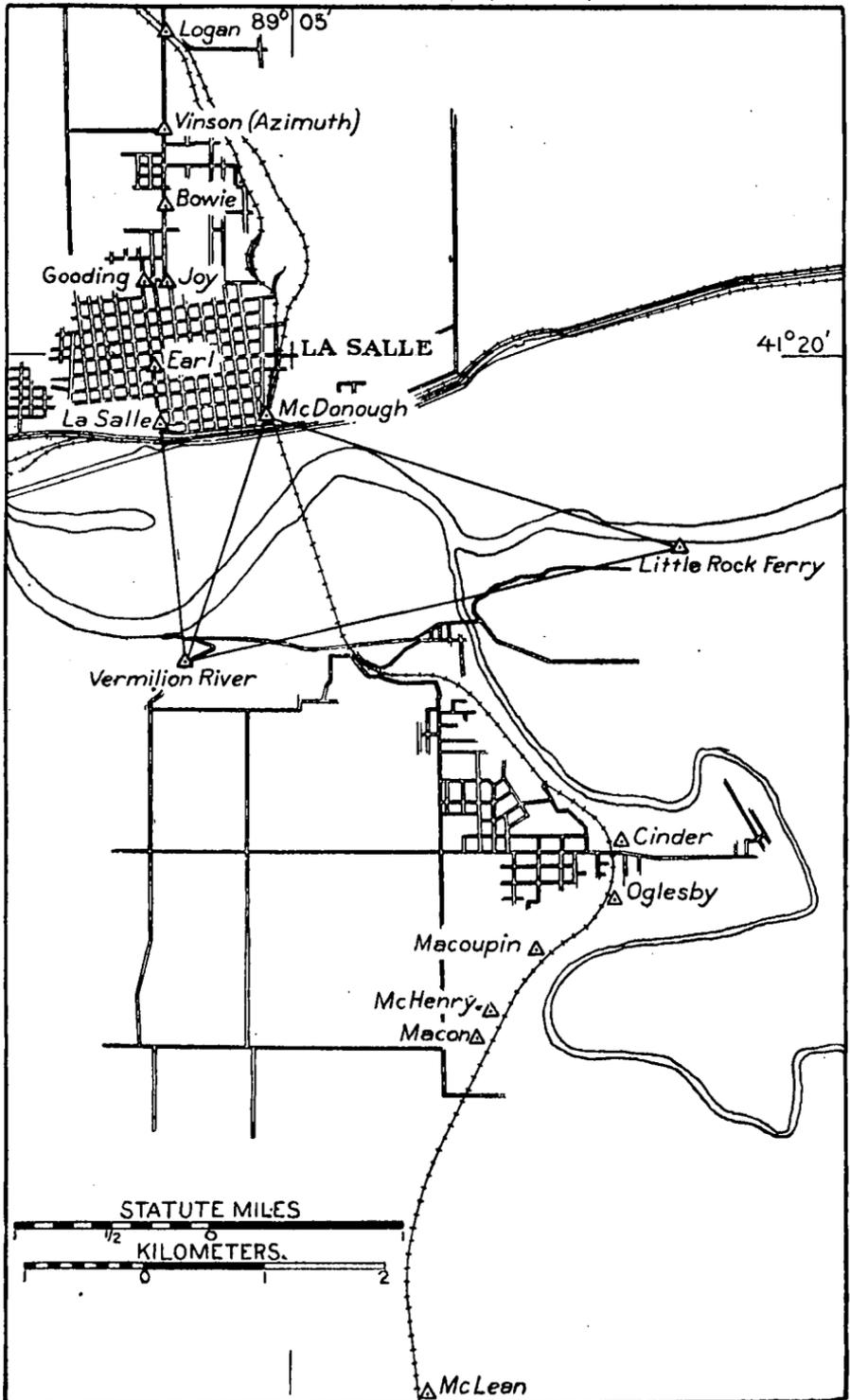


FIG. 17.—Precise traverse, La Salle and vicinity.

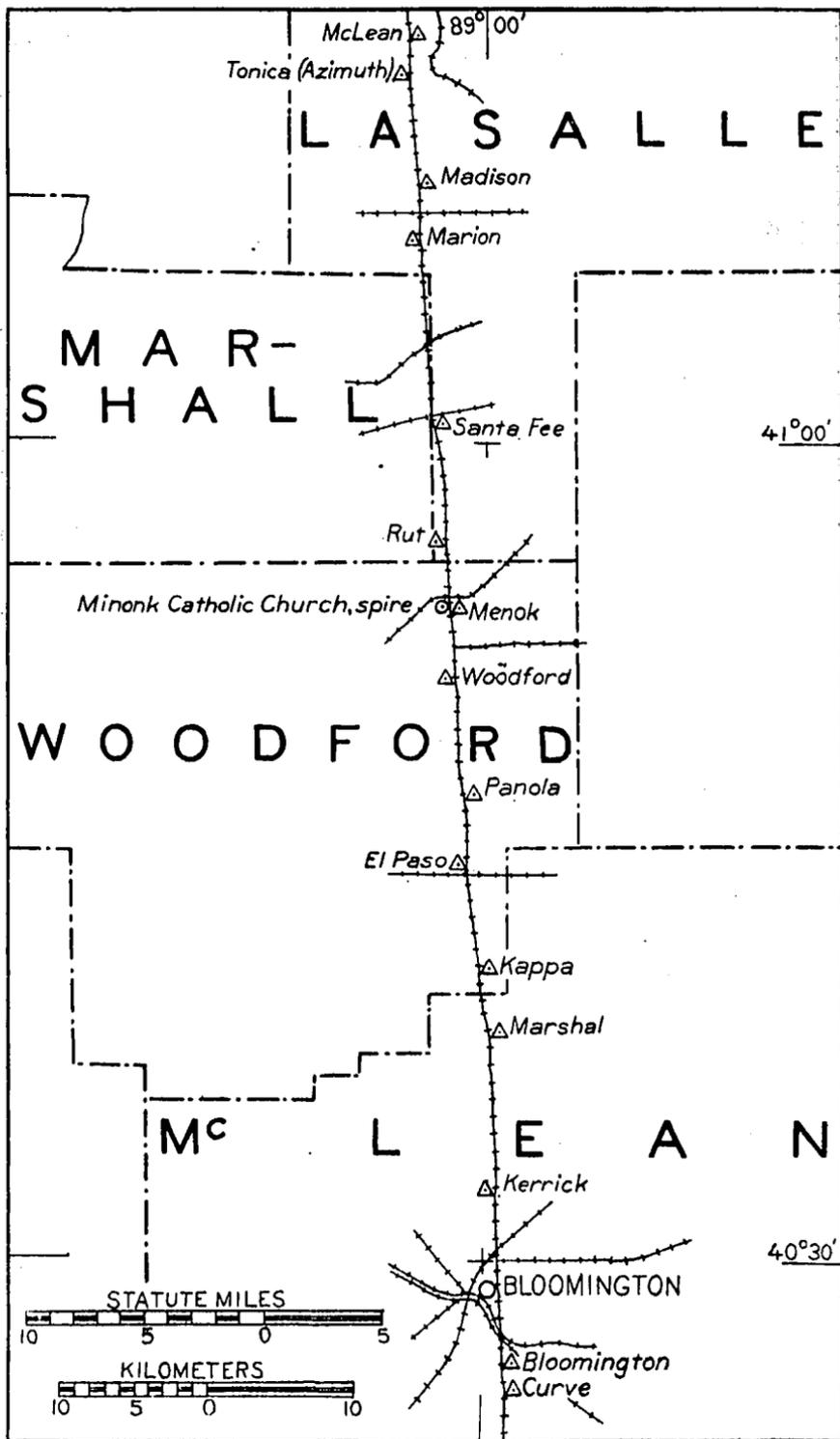


FIG. 18.—Precise traverse, vicinity of La Salle to Bloomington.

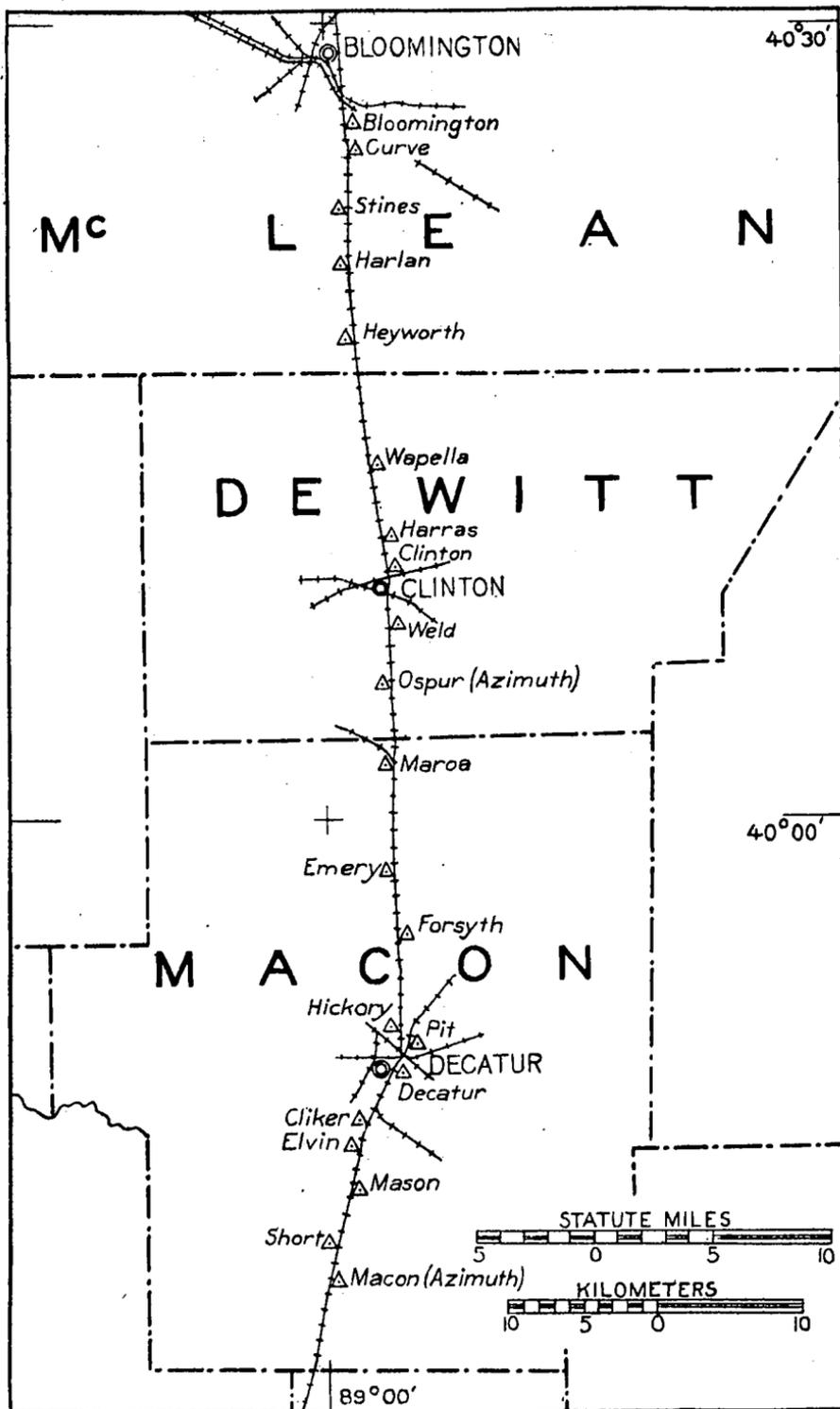


FIG. 19.—Precise traverse, Bloomington to Macon.

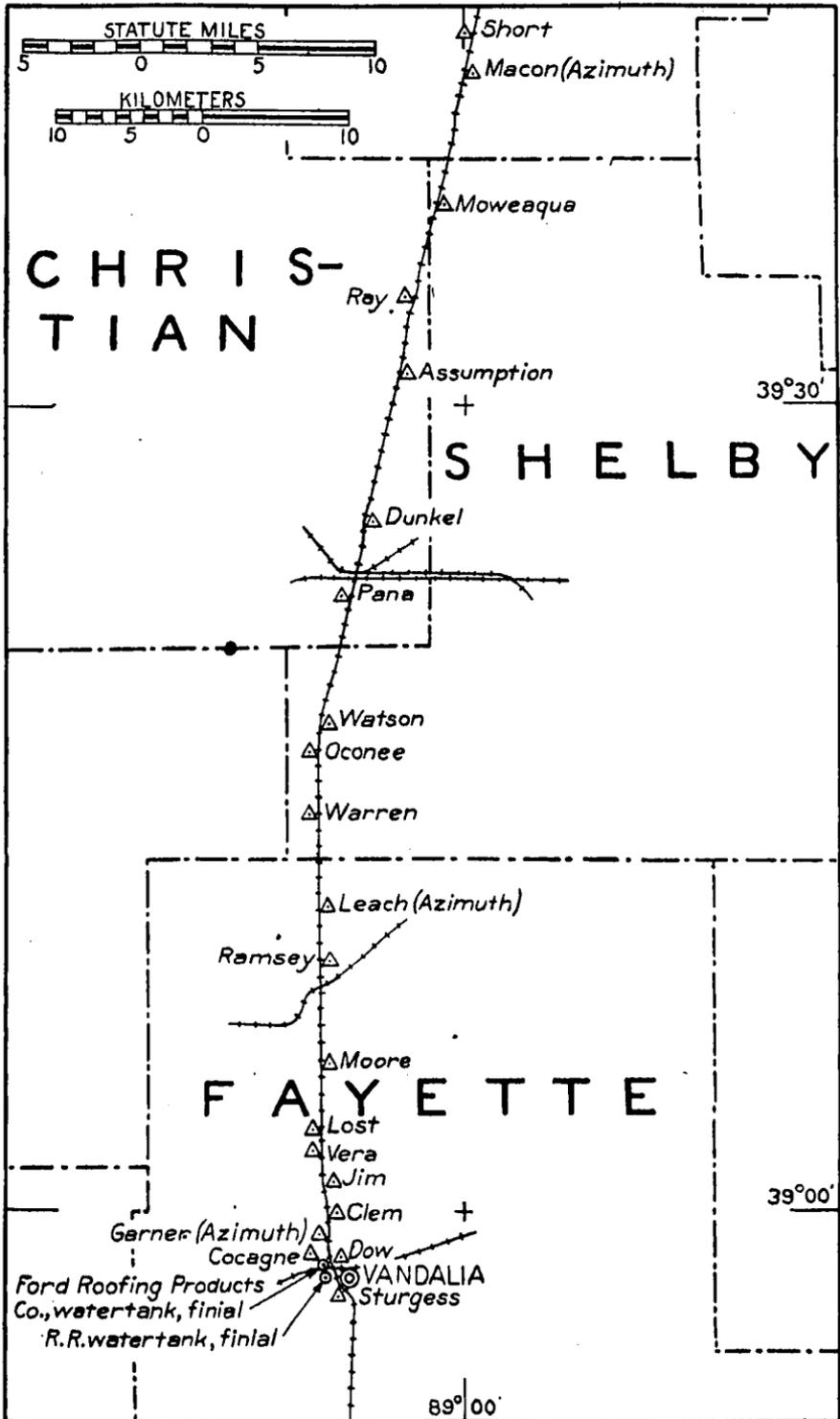


FIG. 20.—Precise traverse, Macon to Vandalla.

INDEX TO POSITIONS, DESCRIPTIONS, ELEVATIONS, AND SKETCHES.

Station.	Position.	Description.	Elevation.	Sketch.	Station.	Position.	Description.	Elevation.	Sketch.
	Page.	Page.	Page.	No.		Page.	Page.	Page.	No.
A 8, bench mark (Oconee).....		44	44		Bowman Dairy Co., stack, Clinton Junction.....	17			11
Adams.....	11	25	25	12	Brown.....	11	26	26	12
Alexander.....	11	25	26	12	Buffalo.....	11	23		11
Ashland.....	11	23		11	Bureau.....	10	21		11
Assumption.....	17	43	43	20	Bureau.....	12	26		12
B 8, bench mark (Ramsey).....		45	45		Burlington.....	10	20		11
Bank.....	10	21		11	Burnett.....	11	23		11
Barron.....	11	23		11	Burton.....	12	28	28	12, 13
Bayfield.....	11	23		11	C 7, bench mark (Rockford).....		29	29	
Beloit.....	11	24		11, 12	C 8, bench mark (Ramsey).....		45	45	
Beloit, First Congregational Church, spire.....	17			11	Calhoun.....	12	26		12
Bench marks:					Calumet.....	11	23		11
A 8 (Oconee).....		44	44		Carroll.....	12	26	26	12
B 8 (Ramsey).....		45	45		Cass.....	12	26	26	12
C 7 (Rockford).....		29	29		Catholic Church, spire, Minonk.....	18			18
C 8 (Ramsey).....		45	45		Catholic Church, spire, Rockford.....	18			13
D 7 (Rochelle).....		33	33		Cave.....	11	24		11
D 8 (Pana).....		44	44		Center.....	13	32	32	14
E 7 (Rochelle).....		33	33		Champaign.....	12	26		12
E 8 (Pana).....		44	44		Christian.....	12	27		12
F 7 (Mendota).....		35	35		Church.....	12	29	29	13
F 8 (Pana).....		44	44		Cinder.....	15	37		17
G 7 (Mendota).....		35	35		Clark.....	12	27		12
G 8 (Vera).....		45	45		Clay.....	12	27		12
G. S. 665 (Tonica).....		38	38		Clom.....	17	46	46	20
G. S. 720 (Rockford).....		29	29		Clmer.....	16	43	43	19
G. S. 789 (Davis Junction).....		31	31		Clinton (Dewitt Co., Ill.).....	16	41	41	19
H 6 (Rockford).....		29	29		Clinton (Rock Co., Wla.).....	11	23		11
H 7 (Wenona).....		39	39		Clinton (Winnebago Co., Ill.).....	12	27		12
H 8 (Vandalla).....		46	46		Clinton Junction, Bowman Dairy Co., stack.....	17			11
I 6 (Rockford).....		29	29		Cocagne.....	17	46	46	20
I 7 (Wenona).....		39	39		Coles.....	12	27	27	12
J 7 (Wenona).....		39	39		Cook.....	12	27		12
J 8 (Vandalla).....		46	46		Crawford.....	12	28	28	12
K 7 (Lodant).....		38	38		Culton.....	14	35	35	16
K 8 (Vandalla).....		46	46		Cumberland.....	12	28	28	12
L 7 (Rutland).....		39	39		Curve.....	16	40	40	18, 19
L 8 (Vandalla).....		46	46		Cut.....	11	23		11
M 7 (Minonk).....		39	39		D 7, bench mark (Rochelle).....		33	33	
N 7 (Minonk).....		39	39		D 8, bench mark (Pana).....		44	44	
O 7 (El Paso).....		40	40		Dano.....	10	23		11
P (Bloomington).....		40	40		Darlon.....	10	22		11
P 7 (El Paso).....		40	40		Davless.....	14	34	34	15
P. B. M. 78 (Monroe Center).....		31	31		Davis.....	13	31	31	14
Permanent (Davis Junction).....		31	31		Decatur.....	16	42	42	19
Q 7 (Heyworth).....		41	41		Dekob.....	12	28	28	12
R 7 (Heyworth).....		41	41		Delavan.....	10	22		11
S 7 (Bloomington).....		40	40		Dewitt.....	13	30	30	13
Sanitary B. M. (La Salle).....		37	37		Dodge.....	10	22		11
T 7 (Bloomington).....		40	40		Door.....	10	22		11
T. B. M. 340 (La Salle).....		37	37		Douglas.....	13	30	30	13
U 7 (Bloomington).....		40	40		Dover.....	10	20	20	11
V 7 (Clinton).....		41	41		Dow.....	17	46	46	20
W 7 (Emory).....		42	42		Dunkel.....	17	44	44	20
X 7 (Decatur).....		42	42		Dunn.....	10	22		11
Z 7 (Assumption).....		44	44		Dupage.....	13	30	30	13
Bloomington.....	16	40	40	18, 19					
Bond.....	11	25	25	12					
Boon.....	11	26		12					
Bowle.....	15	36	30	17					

Station.	Position.	Description.	Elevation.	Sketch.	Station.	Position.	Description.	Elevation.	Sketch.
	Page.	Page.	Page.	No.		Page.	Page.	Page.	No.
E 7, bench mark (Rochelle).....		33	33		Iowa.....	10	21		11
E 8, bench mark (Pana).....		44	44		Iron.....	10	21		11
Earl.....	15	37	37	17	Iroquois.....	14	33	33	14, 15
Edgar.....	13	30	30	13	J 7, bench mark (Wenona).....		39	39	
Edwards.....	13	30	30	14	J 8, bench mark (Vandalla).....		46	40	
Effingham.....	13	30	30	14	Jackson.....	14	34	34	15
Eighteenth.....	13	30	30	13	Jasper.....	14	34	34	15
Eikhorn.....	10	21		11	Jefferson.....	14	34	34	15
Florida.....	10	22		11	Jersey.....	14	34	34	15
El Paso.....	15	40	40	18	Jim.....	17	45	45	20
Elwin.....	16	43	43	19	John.....	12	28	28	18
Emery.....	16	42	42	19	Johnson.....	14	34		15
F 7, bench mark (Mendota).....		35	35		Jones.....	12	27	27	12
F 8, bench mark (Pana).....		44	44		Joy.....	15	36	36	17
Fayette.....	13	31		14	K 7, bench mark (Lostant).....		38	38	
First.....	13	29	29	13	K 8, bench mark (Vandalla).....		46	40	
First Congregational Church, spire, Beloit.....	17			11	Kane.....	14	34	34	15, 16
Flat.....	11	24		12	Kankakee.....	14	35	35	18
Fond.....	10	22		11	Kansas.....	10	20		11
Ford.....	13	31	31	14	Kappa.....	16	40	40	18
Ford Roofing Products Co., water tank, final, Vandalla.....	18			20	Kondal.....	14	35	35	16
Forest (Walworth Co., Wis.).....	10	22		11	Konosha.....	10	21		11
Forest (Winnebago Co., Ill.).....	12	28	28	12, 13	Kerrick.....	16	40	40	18
Forsyth.....	16	42	42	19	Kings.....	13	32	32	14
Fourth.....	13	29	29	13	Knox.....	14	35	35	16
Franklin.....	13	31	31	14	L 7, bench mark (Rutland).....		39	39	
Fred.....	14	33	33	15	L 8, bench mark (Vandalla).....		46	40	
Fulton.....	13	31	31	14	Lake.....	14	35		16
G 7, bench mark (Mendota).....		35	35		Lang.....	10	21		11
G 8, bench mark (Vera).....		45	45		La Salle.....	15	37	37	17
G. S. 665, bench mark (Tonca).....		38	38		Latham.....	12	29	26	12
G. S. 720, bench mark (Rockford).....		29	29		Lawrence.....	14	36	36	16
G. S. 789, bench mark (Davis Junction).....		31	31		Loach.....	17	45	45	20
Gallatin.....	13	32	32	14	Leo.....	14	30	36	16
Garner.....	17	46	46	20	Limit.....	11	25		12
Genet.....	12	27	27	12	Little Rock Ferry.....	15	37		17
Gooding.....	15	36	36	17	Livingston.....	14	36	36	16
Grant.....	13	30	30	13, 14	Logan.....	15	36	36	16, 17
Gregory.....	13	29	29	13	Long.....	11	24		11
Green.....	13	32	32	14	Lost.....	17	45	45	20
Grundy.....	13	32	32	14	M 7, bench mark (Minonk).....		39	39	
Guard.....	12	28	28	13	McDonough.....	15	37	37	17
H 6, bench mark (Rockford).....		29	29		McHenry.....	15	38		17
H 7, bench mark (Wenona).....		33	39		McLean.....	15	38	38	17, 18
H 8, bench mark (Vandalla).....		46	46		Macon (Macon Co., Ill.).....	16	43	43	19, 20
Hamilton.....	13	32	32	14	Macon (La Salle Co., Ill.).....	15	38		17
Hancock.....	13	32	32	14	Macoupin.....	15	38		17
Hardin.....	14	32	32	14	Madison.....	15	38	38	18
Harlan.....	16	41	41	19	Marion.....	15	38	38	18
Harris.....	16	41	41	19	Maros.....	16	42	42	19
Henderson.....	14	33		14, 15	Marshal.....	16	40	40	18
Henry.....	14	33	33	14, 15	Mason.....	16	43	43	19
Heyworth.....	16	41		19	Mendota.....	14	35	35	16
Hickory.....	16	42	42	19	Menok.....	15	39	39	18
Hocomb.....	13	31	31	14	Midway.....	10	20		11
I 6, bench mark (Rockford).....		29	29		Minonk, Catholic Church, spire.....	18			18
I 7, bench mark (Wenona).....		39	39		Moore.....	17	45	45	20
Ingersoll's Milling Machine Co., stack, Rockford.....	17			12, 13	Morgan.....	11	24		11
					Moweaqua.....	16	43	43	20
					N 7, bench mark (Minonk).....		39	39	
					O 7, bench mark (El Paso).....	17	44	44	20

Station.	Position.	Description.	Elevation.	Sketch.	Station.	Position.	Description.	Elevation.	Sketch.
	Page.	Page.	Page.	No.		Page.	Page.	Page.	No.
Oconto.....	10	20	.....	11	Shaw.....	11	25	25	12
Oglesby.....	15	37	37	17	Short (Macon Co., Ill.)..	16	43	43	19, 20
Owelda.....	10	20	.....	11	Short (Rock Co., Wis.)..	11	24	.....	11, 12
Ospur.....	16	42	42	19	Simpson.....	14	35	35	16
P bench mark (Bloomington).....		40	40	.....	Slim.....	11	24	.....	11, 12
P 7 bench mark (El Paso).....		40	40	.....	State Line.....	11	24	.....	11, 12
P. B. M. 78, bench mark (Monroe Center).....		31	31	.....	Steward.....	14	33	33	19
Pana.....	17	44	44	20	Stines.....	16	41	41	19
Panola.....	15	39	39	18	Sturgess.....	17	46	46	20
Park.....	12	29	29	13	T 7, bench mark (Bloomington).....		40	40	.....
Peach.....	12	29	29	13	T. B. M. 340, bench mark (La Salle).....		37	37	.....
Permanent bench mark (Davis Junction).....		31	31	.....	Tonica.....	15	38	38	18
Pit.....	16	42	42	19	U 7, bench mark (Bloomington).....		40	40	.....
Q 7, bench mark (Heyworth).....		41	41	.....	V 7, bench mark (Clinton).....		41	41	.....
R 7, bench mark (Heyworth).....		41	41	.....	Vandalia, Ford Roofing Products Co., water tank, final.....	18	.....	.....	20
Railroad water tank, final, Vandalia.....	18	.....	.....	20	Vandalia, railroad water tank, final.....	18	.....	.....	20
Ramsay.....	17	45	45	20	Vera.....	17	45	45	20
Ray.....	16	43	43	20	Vermilion River.....	15	37	.....	17
Rockford, Catholic Church, spire.....	18	.....	.....	13	Vilas.....	10	20	.....	11
Rockford, Ingersoll's Milling Machine Co., stack.....	17	.....	.....	12, 13	Vinson.....	15	36	36	17
Rockton.....	11	25	25	12	W 7, bench mark (Emery).....		42	42	.....
Roscoe.....	11	25	25	12	Wapella.....	16	41	41	19
Roscoe siding, intersection of main track and east-west road.....	17	.....	.....	.....	Warren.....	17	44	44	20
Roxbury.....	14	34	34	15	Watson.....	17	44	44	20
Ruby.....	12	27	.....	12	Weld.....	16	41	41	19
Rut.....	15	39	39	18	Western.....	13	29	.....	13
S 7, bench mark (Bloomington).....		40	40	.....	Whistle.....	10	21	.....	11
Sanitary B. M., bench mark (La Salle).....		37	37	.....	Wilmont.....	10	20	.....	11
Santa Fee.....	15	39	39	18	Woodford.....	15	39	39	18
Scarboro.....	14	33	33	15	X 7, bench mark (Decatur).....		42	42	.....
					Z 7, bench mark (Assumption).....		44	44	.....

