

63501  
60w.

Serial No. 14

63

DEPARTMENT OF COMMERCE

U. S. COAST AND GEODETIC SURVEY

H. LESTER JONES  
SUPERINTENDENT

GEODESY

C. & G. SURVEY,  
LIBRARY AND ARCHIVES  
OCT 22 1915  
Acc. No. \_\_\_\_\_

TRIANGULATION IN WEST VIRGINIA, OHIO, KENTUCKY,  
INDIANA, ILLINOIS, AND MISSOURI

BY

A. L. BALDWIN

Assistant Inspector of Geodetic Work  
U. S. Coast and Geodetic Survey

SPECIAL PUBLICATION No. 30

MAY 24 1991  
U.S. Dept. of Commerce



QB  
275  
-435  
no. 30  
(1915)  
C.2

# 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](mailto:www.reference@nodc.noaa.gov).

LASON

Imaging Contractor

12200 Kiln Court

Beltsville, MD 20704-1387

January 1, 2006

C. & G. SURVEY,  
LIBRARY AND ARCHIVES  
OCT 22 1915  
Acc. No. \_\_\_\_\_

ADDITIONAL COPIES  
OF THIS PUBLICATION MAY BE PROCURED FROM  
THE SUPERINTENDENT OF DOCUMENTS  
GOVERNMENT PRINTING OFFICE  
WASHINGTON, D. C.  
AT  
20 CENTS PER COPY

## CONTENTS.

---

	Page.
General statement.....	5
Louisville base line.....	5
Instruments used on triangulation.....	6
Program of occupation of stations.....	7
Abstract of horizontal directions and elevations of telescope above the station mark.....	7
Condition equations.....	8
Accuracy as indicated by corrections to observed directions.....	8
Accuracy as indicated by corrections to angles and closures of triangles.....	9
Accord in azimuth and length.....	10
The North American Datum.....	10
Explanation of tables of positions.....	13
Geographic positions:	
Thirty-ninth parallel.....	18
Louisville connection.....	32
Descriptions of stations:	
Thirty-ninth parallel.....	34
Louisville connection.....	53
Computation, adjustment, and accuracy of the elevations.....	57
Table of elevations.....	61
Triangulation sketches.....	62
Index to positions, descriptions, elevations, and sketches.....	63

## ILLUSTRATIONS.

---

FIG. 1. Index map showing areas covered by published triangulation which has been rigidly computed on the North American Datum.....	62
FIG. 2. Index map showing the limits of each of the sketches Nos. 3 to 12.....	62
FIG. 3. Triangulation, thirty-ninth parallel, stations Briery and Keeney to St. Albans base net.....	62
FIG. 4. Triangulation, thirty-ninth parallel, stations Piney and Pigeon to Ash Ridge and Minerva.....	62
FIG. 5. Triangulation, thirty-ninth parallel, stations Ash Ridge and Minerva to Holton base net.....	62
FIG. 6. Triangulation, thirty-ninth parallel, city of Cincinnati.....	62
FIG. 7. Triangulation, thirty-ninth parallel, Holton base net to Vincennes.....	62
FIG. 8. Triangulation, Louisville connection.....	62
FIG. 9. Triangulation, thirty-ninth parallel, Vincennes to stations Sturgess and Hartlin.....	62
FIG. 10. Triangulation, thirty-ninth parallel, stations Sturgess and Hartlin to Tavern Rock and Lynch.....	62
FIG. 11. Triangulation, thirty-ninth parallel, stations Tavern Rock and Lynch to Christian, High Point, and Belshe.....	62
FIG. 12. Triangulation, thirty-ninth parallel, stations Christian, High Point, and Belshe to Kansas-Missouri boundary.....	62



# TRIANGULATION IN WEST VIRGINIA, OHIO, KENTUCKY, INDIANA, ILLINOIS, AND MISSOURI.

By A. L. BALDWIN, *Assistant Inspector of Geodetic Work, Coast and Geodetic Survey.*

## GENERAL STATEMENT.

This publication brings together in convenient form for the use of engineers information in regard to the triangulation by the United States Coast and Geodetic Survey in six of the central States, namely, West Virginia, Ohio, Kentucky, Indiana, Illinois, and Missouri. The principal portion of these results is that part of the Transcontinental Triangulation, extending from the Atlantic to the Pacific, which lies within the limits of these six States. The field work was commenced in 1871 and finished in 1893, having been in progress during the whole interval, except during the years 1875, 1876, 1877, and 1888. A full account of the Transcontinental Triangulation has been published in so far as the features of special interest to the scientists are concerned.<sup>1</sup> Only the positions for the primary stations were there published, and but a few descriptions of stations. The positions of all stations, primary, secondary, and tertiary, are published herein on the North American (formerly called the United States Standard) Datum, together with all available descriptions.

The occasion for this publication at the present time is the completion in 1914 of a new scheme of primary triangulation in Indiana which connected for the first time the detached triangulation in Indiana and Kentucky north and south of Louisville. There is included a full report on this section of primary triangulation and also the results with the details omitted for that portion of the old secondary scheme which was required to connect the primary work with the base line near Louisville, measured in 1879 by Assistant G. A. Fairfield.

The positions and descriptions in this report were prepared for publication by Mr. C. H. Swick.

There are included in this publication 26 new stations of the Cincinnati city survey made in 1912 by a former officer of this survey, Mr. H. C. Mitchell. This work is fully described on pages 63 to 78 of the "Report on a Plan of Sewerage, City of Cincinnati." This report is a detailed one and the geographic positions contained therein are reprinted here without any discussion.

### LOUISVILLE BASE LINE.

Prof. William Byrd Page selected the site for the Louisville base line, the northern end of which is about 4 miles southwest of Louisville, Ky. During July and August, 1879, Assistant G. A. Fairfield slightly modified the scheme and occupied both ends of the base line which was shortened to 5.09 miles. The first measurement of the base was begun on September 15, 1879, and completed in 10 consecutive working days. Six-meter contact slide rods Nos. 1 and 2 were used in making the measurement. A second measure was made early in October. A force of four officers and seven men was used on the second measurement.

The following table gives the result of the individual measures of the five sections into which the base was divided.

	Temperature first measure	Temperature second measure	First measure	Second measure	Difference
	° F.	° F.	<i>Meters.</i>	<i>Meters.</i>	<i>mm.</i>
North base to I.....	80.53	85.92	1559.9659	1559.9582	+ 7.7
I to II.....	74.03	89.83	1680.2916	1680.2995	- 7.9
II to III.....	78.00	94.60	1560.3807	1560.3992	-18.5
III to IV.....	82.98	91.91	1644.1502	1644.1704	-20.2
IV to South base.....	74.09	86.75	1743.4113	1743.4292	-17.0
Whole base.....	77.81	83.76	8188.1997	8188.2565	-56.8

<sup>1</sup> See The Transcontinental Triangulation, U. S. Coast and Geodetic Survey Special Publication No. 4.

There appears to be a tendency toward a greater length of measure for the higher temperature, which was undoubtedly due to a difference between the temperatures of the rods and of the thermometers.

The above results develop a probable error of  $\pm 11.65$  mm. for the mean of the two results for the measured length. To this probable error must be added the probable error of the apparatus for the temperature of measurement,  $\pm 10.5$  mm. The total probable error of the base is therefore  $\sqrt{(11.65)^2 + (10.5)^2} = \pm 15.7$  mm.

Since the thermometer during the measurement gives the temperature of the air rather than that of the rod, there is an uncertainty in the length which, assuming a half degree Fahrenheit as an average, would introduce an additional probable error of 26 mm.

The elevation of the surface of the ground at the northern end of the base was assumed to be 426.176 feet <sup>1</sup> above the mean sea level and from levels run over the base the corresponding elevation of the southern end of the base was found to be 452.075 feet above mean sea level. The base had never been connected with the precise levels and it was assumed that the height of the base as used might be in error by as much as 25 feet, which would introduce a fourth probable error of 10 mm.

The combination of these probable errors gives  $\pm 32$  mm. or 1 part in 256 000.

Length of base.....	= 8188.228 meters.
Reduction to sea level (430 feet).....	= -.171
Resulting length of base.....	= 8188.057 $\pm$ .032
Logarithm of length of base.....	= 3.9131808 $\pm$ 17 (in seventh place).

#### PROGRESS OF THE 1914 TRIANGULATION.

The actual work of reconnoissance for the Louisville connection was inaugurated on September 16, 1914, and three days later the signal building and marking of stations was begun. Signalman J. S. Bilby had charge of this portion of the work and, coming as it did at the close of a season in northern Alabama and Mississippi, the same party and outfit were used and the reconnoissance and building were easily completed on November 5, 1914. The three obstructed lines of the Transcontinental Triangulation, where the connection was made, were cleared by November 18.

Three stations established and occupied in the years 1884–1886 by Prof. J. I. Campbell were recovered and 5 new stations were selected, which, together with the 3 stations, Miller, Stout, and Tripp, make 11 stations in this scheme. The stations on the western side of the scheme are on high timbered knobs; on the eastern side they are on flat land, partly cultivated and partly timbered.

On October 22, 1914, Assistant E. H. Pagenhart, having moved his observing party from Huntsville, Ala., began the actual observing. Ten stations were occupied and, in spite of some delays, the observations were completed on November 19, 1914, in a period of but 28 days.

*Signals.*—The type of signal is that shown by illustrations and described in Appendix 4 of the Report of the United States Coast and Geodetic Survey for 1903. In that publication are also given detailed directions for its erection.

#### INSTRUMENTS USED ON TRIANGULATION.

*Theodolite.*—The type of instrument used for the horizontal measures is described in detail in Appendix 8 of the Report for 1894. In August, 1914, the red-metal circle with its graduation on coin silver was replaced by a new nickel-alloy circle. For the graduations on this new circle a strip of platinum was inserted in a groove in the plate and securely soldered and pinned in place. The same graduating engine which is briefly described in Appendix 8 of 1894 was used to make the graduations. The deviation of triangulation in azimuth, which is thought to be due to unequal temperature changes within the instrument itself, made this change

<sup>1</sup> In April, 1915, Assistant J. H. Peters connected North base with a bench mark of the U. S. Engineers and found the elevation assumed for it to be 21.8 feet too low (elevation of North Base, 136.579 meters or 448.093 feet). The base line was not recomputed as the change that would be necessary is less than one-third the probable error assigned for the base.

advisable. The coefficient of expansion of the nickel-alloy is 0.000004 per degree centigrade, in contrast to 0.000018 for the red metal which it replaced.

The vertical collimator used in centering the theodolite over the mark of a previously established station or in placing a mark under a new signal is fully described on pages 30 and 31 of Special Publication No. 19. In the succeeding pages of the same book the heliotropes and lamps are described and their use by the light keepers is explained in great detail.

PROGRAM OF OCCUPATION OF STATIONS.

In the following table the stations occupied during October and November, 1914, are arranged in the chronological order in which the observations were made. The second column indicates the days on which observations on the primary stations were taken and the third column gives the number of days at each station on which primary horizontal directions were observed.

Stations occupied.

[Assistant E. H. Pagenhart, chief of party and observer, season of 1914.]

Station	Days on which observations of primary horizontal directions were made	Total days	Station	Days on which observations of primary horizontal directions were made	Total days
Lutz.....	October 22.....	1	Summit.....	November 3.....	1
Six Mile.....	October 23.....	1	Finley.....	November 6, 7, 8.....	3
Popp.....	October 25, 26.....	2	Blocher.....	November 9.....	1
O. & M.....	October 27, 29.....	2	Stout.....	November 10, 11.....	2
Marysville.....	October 31, November 1.....	2	Miller.....	November 17.....	1

ABSTRACT OF HORIZONTAL DIRECTIONS AND ELEVATIONS OF TELESCOPE ABOVE THE STATION MARK.

All observed directions in the 1914 triangulation have been given equal or unit weight. Those directions were reduced to center where either the instrument or the object observed was not coincident with the center of the station mark.

The greatest elevation was at station Summit, 968 feet, and the corrections necessary to reduce the horizontal directions to sea level is less than one one-hundredth of a second in almost every case. The computation of these corrections was therefore omitted.

In the following table is also given the elevation of the telescope of the theodolite above the station mark at each of the stations. These elevations enable the reader to judge of the amount of building done and they permit the engineer or surveyor who uses the stations to form an estimate of the probable amount of building required to make any particular line clear.

Station occupied and elevation of instrument above station mark	Number of direction	Object observed	Observed direction	Final seconds after figure adjustment	Station occupied and elevation of instrument above station mark	Number of direction	Object observed	Observed direction	Final seconds after figure adjustment
Miller, 15.28 meters..	3	Finley.....	0 00 00.00	00.60	Marysville, 23.41 meters.	22	O. & M.....	00 00 00.00	00.88
	1	Stout.....	293 23 02.53	01.60		23	Popp.....	28 44 41.56	41.83
	2	Blocher.....	321 28 42.43	42.75		24	Summit.....	72 13 43.70	43.33
Stout, 23.47 meters..	4	Blocher.....	00 00 00.00	59.75		25	Finley.....	94 53 09.97	09.33
	5	Finley.....	22 29 41.44	41.81		26	Blocher.....	168 31 11.08	10.98
	6	Miller.....	63 28 39.74	39.50		Popp, 1.42 meters...	27	Summit.....	00 00 00.00
Finley, 11.54 meters.	7	Miller.....	00 00 00.00	59.71	28		Marysville.....	33 53 56.02	56.75
	8	Stout.....	77 24 05.34	05.33	29		O. & M.....	57 09 10.24	09.77
	9	Blocher.....	93 00 09.97	09.69	30		Lutz.....	91 23 39.61	40.58
	10	Marysville.....	134 05 03.65	03.89	31		Six Mile.....	174 03 31.59	31.00
Blocher, 23.42 meters	11	Summit.....	165 39 23.13	23.48	O. & M., 18.65 meters	32	Lutz.....	00 00 00.00	00.06
	12	Marysville.....	00 00 00.00	59.85		33	Six Mile.....	47 34 58.34	57.14
	13	Summit.....	38 55 42.19	42.66		34	Popp.....	62 03 00.93	00.91
	14	Finley.....	65 16 55.58	55.78		35	Summit.....	131 01 01.93	02.43
	15	Miller.....	113 45 29.96	29.45	36	Marysville.....	190 03 06.61	07.27	
Summit, 1.27 meters	16	Stout.....	207 11 09.89	09.87	Lutz, 15.59 meters..	38	Six Mile.....	00 00 00.00	58.48
	17	Finley.....	00 00 00.00	59.94		39	Popp.....	21 18 58.97	58.25
	18	Blocher.....	80 59 34.02	33.57		40	O. & M.....	105 01 27.20	26.88
	19	Marysville.....	125 46 23.05	23.63	Six Mile, 1.27 meters.	41	Popp.....	00 00 00.00	00.65
	20	O. & M.....	174 30 37.10	36.71		42	O. & M.....	48 37 34.20	35.81
	21	Popp.....	228 23 25.57	25.91		43	Lutz.....	76 01 09.33	10.60

## CONDITION EQUATIONS.

No.

1.  $0 = -1.84 - (1) + (2) - (4) + (6) - (15) + (16).$
2.  $0 = -1.26 - (1) + (3) - (5) + (6) - (7) + (8).$
3.  $0 = +0.42 - (2) + (3) - (7) + (9) - (14) + (15).$
4.  $0 = -1.41 - (9) + (10) - (12) + (14) - (25) + (26).$
5.  $0 = +0.03 - (9) + (11) - (13) + (14) - (17) + (18).$
6.  $0 = -1.92 - (12) + (13) - (18) + (19) - (24) + (26).$
7.  $0 = +2.04 - (19) + (20) - (22) + (24) - (35) + (36).$
8.  $0 = +0.72 - (19) + (21) - (23) + (24) - (27) + (28).$
9.  $0 = -0.81 - (20) + (21) - (27) + (29) - (34) + (35).$
10.  $0 = -1.74 - (29) + (30) - (32) + (34) - (39) + (40).$
11.  $0 = +0.12 - (30) + (31) - (38) + (39) - (41) + (43).$
12.  $0 = +0.40 - (32) + (33) - (38) + (40) - (42) + (43).$
13.  $0 = +10.02 - (37) + (38) - (43) + (44) - (49) + (50).$
14.  $0 = +2.66 - (44) + (45) - (47) + (49) - (60) + (61).$
15.  $0 = +2.77 - (44) + (46) - (48) + (49) - (50a) + (51).$
16.  $0 = +5.99 - (47) + (48) - (51) + (52) - (59) + (61).$
17.  $0 = -0.27 - (52) + (55) - (58) + (59) - (73) + (75).$
18.  $0 = -0.14 - (53) + (55) - (73) + (78) - (79) + (80).$
19.  $0 = -1.01 - (56) + (58) - (75) + (78) - (79) + (81).$
20.  $0 = -0.72 - (52) + (54) - (57) + (59) - (65) + (66).$
21.  $0 = -0.65 - (54) + (55) - (63) + (65) - (73) + (76).$
22.  $0 = +2.15 - (62) + (64) - (67) + (68) - (71) + (72).$
23.  $0 = +0.93 - (63) + (64) - (67) + (69) - (74) + (76).$
24.  $0 = +0.98 - (68) + (69) - (70) + (71) - (74) + (77).$
25.  $0 = -10.66 - 4.94(1) + 7.59(2) - 2.65(3) - 4.03(4) + 5.08(5) - 1.05(6) + 0.11(7) + 7.54(8) - 7.65(9).$
26.  $0 = -1.49 - 0.66(9) + 3.43(10) - 2.77(11) - 2.61(12) + 6.86(13) - 4.25(14) - 5.28(24) + 5.05(25) + 0.23(26).$
27.  $0 = +2.00 - 1.85(19) + 3.38(20) - 1.53(21) - 3.17(22) + 3.84(23) - 0.67(24) - 1.36(27) + 4.90(28) - 3.54(29).$
28.  $0 = +4.04 - 1.12(32) + 8.16(33) - 7.04(24) - 5.40(38) + 5.64(39) - 0.24(40) - 1.33(41) + 1.85(42) - 0.52(43).$
29.  $0 = +19.34 - 0.33(47) + 5.20(48) - 4.87(49) - 1.68(50a) + 1.71(51) - 0.03(52) - 4.61(59) + 5.92(60) - 1.31(61).$
30.  $0 = -0.88 - 2.72(52) + 3.30(53) - 0.58(55) - 2.08(73) + 3.54(75) - 1.46(78) - 1.09(79) + 4.42(80) - 3.33(81).$
31.  $0 = -2.31 - 2.81(52) + 5.52(54) - 2.71(55) - 3.02(57) + 2.76(58) + 0.27(59) - 0.30(73) + 2.86(75) - 2.56(76).$
32.  $0 = +1.96 - 6.58(62) + 7.66(63) - 1.08(64) - 2.92(67) + 4.67(68) - 1.75(69) - 1.35(74) + 10.84(76) - 9.49(77).$
33.  $0 = -0.73 + (4) - (6) + (12) - (16) + (22) - (26).$
34.  $0 = +4.97 - (1) + (3) - (7) + (11) - (17) + (21) - (27) + (31) - (41) + (46) - (50a) + (55) - (73) + (74).$
35.  $0 = -10.58 - 2.65(2) + 2.65(3) - 1.05(4) + 1.05(6) - 0.11(7) - 0.55(9) + 0.66(11) - 2.61(12) + 2.61(13) - 0.13(15) + 0.13(16) + 0.33(17) - 0.33(18) - 1.53(20) + 1.53(21) - 0.67(22) + 0.44(24) + 0.23(26) + 1.30(27) - 1.36(29) - 0.27(30) + 0.27(31) - 1.12(32) + 1.12(34) + 1.26(35) - 1.26(36) - 0.43(37) + 0.43(38) + 0.24(39) - 0.24(40) + 0.52(41) - 0.52(43) + 0.64(44) - 0.64(46) - 1.27(47) + 1.27(48) + 0.78(49) - 0.78(50) + 1.71(50a) - 1.71(51) - 2.71(54) + 2.71(55) - 1.22(58) + 1.49(59) - 0.27(61) - 0.73(63) + 1.93(64) - 1.20(65) + 0.14(67) - 0.14(69) + 0.67(70) - 0.67(71) + 2.08(73) - 1.35(74) - 2.08(75) + 1.35(77).$

## ACCURACY AS INDICATED BY CORRECTIONS TO OBSERVED DIRECTIONS.

The corrections to observed directions resulting from the figure adjustments indicated by the preceding observation equations are as follows:

Table of corrections to observed directions

Number of direction	Correction to direction						
1	-0.83	22	+0.86	42	+1.16	62	+0.42
2	+0.32	23	+0.27	43	+1.27	63	-0.40
3	+0.60	24	-0.37	44	-0.51	64	-0.47
4	-0.25	25	-0.64	45	-0.83	65	+0.77
5	+0.40	26	-0.10	46	-2.19	66	-0.34
6	-0.15	27	-0.03	47	+1.89	67	+0.73
7	-0.29	28	+0.13	48	-0.57	68	-0.04
8	-0.01	29	-0.47	49	+1.42	69	-0.69
9	-0.28	30	+0.95	50	-2.74	70	+0.49
10	+0.24	31	-0.59	50a	+2.59	71	-0.01
11	+0.35	32	+0.06	51	-0.49	72	-0.50
12	-0.15	33	-1.20	52	-0.82	73	+0.66
13	+0.47	34	-0.02	53	-0.40	74	-0.48
14	+0.20	35	+0.50	54	-0.47	75	-0.20
15	-0.51	36	+0.66	55	-0.41	76	+0.08
16	-0.02	37	+2.26	56	+0.14	77	-0.31
17	-0.06	38	-1.52	57	-0.16	78	+0.24
18	-0.45	39	-0.72	58	+0.60	79	-0.23
19	+0.58	40	-0.32	59	+1.32	80	+0.34
20	-0.39	41	+0.65	60	-0.01	81	-0.12
21	+0.34			61	-1.88		

The maximum correction to an observed direction of the primary work is to direction 38 between stations Lutz and Popp and is 1.''52.

The probable error of an observed direction is  $d = 0.674 \sqrt{\frac{\sum v^2}{c}}$ , in which  $\sum v^2$  is the sum of the squares of the corrections to directions and  $c$  is the number of conditions.

The probable error of an observed direction computed for this work is 0.''64.

ACCURACY AS INDICATED BY CORRECTIONS TO ANGLES AND CLOSURES OF TRIANGLES.

The correction to each angle is the algebraic difference of the corrections to the separate directions. They are shown in the following table for every triangle of the primary scheme. In the table are shown the corrections to the angles resulting from the figure adjustment, the errors of closure of the triangles, the corrected spherical angles and the spherical excess for each triangle. The plus sign prefixed to the error of closure of a triangle indicates that the sum of the angles is less than 180° plus the spherical excess. The spherical excess is a convenient indication of the size of the triangle, since it is proportional to the area.

Tables of triangles

Station	Correction to angles from figure adjustment	Error of closure of triangle	Corrected spherical angles	Spherical excess	Station	Correction to angles from figure adjustment	Error of closure of triangle	Corrected spherical angles	Spherical excess
Blocher.....	+0.49	+1.84	93 25 40.42	1.41	O. & M.....	+0.16	-2.04	59 02 04.84	0.39
Miller.....	+1.25		23 05 41.15		Summit.....	-0.97		48 44 13.08	
Stout.....	+0.10		63 28 39.84		Marysville.....	-1.23		72 13 42.47	
Finley.....	+0.28	+1.26	77 24 05.62	2.37	Popp.....	+0.16	-0.72	33 53 56.78	0.56
Miller.....	+1.53		61 36 59.00		Summit.....	-0.24		102 37 02.28	
Stout.....	-0.55		40 58 57.75		Marysville.....	-0.64		43 29 01.50	
Finley.....	+0.01	-0.42	93 00 09.98	1.50	Popp.....	-0.44	+0.81	57 09 09.80	0.52
Miller.....	+0.28		38 31 17.85		Summit.....	+0.73		53 52 49.20	
Blocher.....	-0.71		48 28 33.67		O. & M.....	+0.52		68 58 01.52	
Finley.....	-0.27	+0.16	15 36 04.36	0.54	Popp.....	-0.60	-0.51	23 15 13.02	0.35
Stout.....	+0.65		22 29 42.09		Marysville.....	-0.59		28 44 40.97	
Blocher.....	-0.22		141 54 14.09		O. & M.....	+0.68		128 00 06.36	
Summit.....	-0.39	-0.03	80 59 33.63	0.54	Lutz.....	+0.40	+1.74	83 42 28.63	0.27
Miller.....	+0.63		72 39 13.79		Popp.....	+1.42		34 14 30.79	
Blocher.....	-0.27		26 21 13.12		O. & M.....	-0.08		62 03 00.85	
Marysville.....	-0.27	+0.48	22 39 17.00	0.28	Six Mile.....	+0.96	+2.02	48 37 35.16	0.16
Summit.....	+0.64		125 46 23.69		Popp.....	-0.12		116 54 21.23	
Finley.....	+0.11		31 34 19.59		O. & M.....	+1.18		14 28 03.77	
Marysville.....	+0.27	+1.92	96 17 27.65	0.52	Six Mile.....	+0.62	-0.12	76 01 09.95	0.16
Summit.....	+1.03		44 46 50.06		Popp.....	-1.54		82 39 50.44	
Blocher.....	+0.62		38 55 42.81		Lutz.....	+0.80		21 18 59.77	
Marysville.....	+0.54	+1.41	73 38 10.05	0.78	Six Mile.....	-0.34	-0.40	27 23 34.79	0.27
Finley.....	+0.52		41 04 54.20		O. & M.....	-1.26		47 34 57.03	
Blocher.....	+0.35		65 10 55.93		Lutz.....	+1.20		105 01 28.40	

The maximum correction, 1.''54, to any angle is to the angle at Popp, between Lutz and Six Mile.

The average closing error of a triangle for the 16 triangles is 0.''99, which is exactly the same as that attained in the 186 triangles composing the one hundred and fourth meridian arc north of the thirty-ninth parallel, and is less than the average closure called for by the general instructions, viz., 1.''00.

The mean error of an angle  $a$  ( $= \sqrt{\frac{\sum \Delta^2}{3n}}$ , in which  $\sum \Delta^2$  is the sum of the squares of the closing errors of the triangles and  $n$  is the number of triangles in the season's work) was computed and found to be  $\pm 0.''71$ .

## ACCORD IN AZIMUTH AND IN LENGTH.

A Laplace azimuth computed at station O. & M. was introduced into the triangulation as this azimuth was undoubtedly more accurate than the geodetic azimuth computed through the triangulation. The geodetic azimuth in the transcontinental triangulation at the northern end of the Louisville connection may be assumed to be without twist as the Laplace correction at the nearest station, Parkersburg, is only  $-0.''53$ . In solving the normal equations of the figure adjustment, the azimuth equation to bring into accord the Laplace azimuth was placed at or near the last of the group, so that after the conditions relating to triangle closures and ratios of lengths had been satisfied the discrepancy in azimuth became known. The azimuth computed to O. & M. station through the triangulation from the North American Datum azimuth of the line Miller-Stout was found to be too small by  $2.''21$  when compared with the Laplace azimuth at O. & M.

Similarly the length of the Louisville base as computed from the line Miller-Stout was made to agree with the measured length of the base. This equation was assigned last place in the solution of the normal equations, so that after all the conditions relating to triangle closures and ratios of length had been satisfied the discrepancy in length became known. This discrepancy was 66 in the seventh place of logarithms or, expressed as a ratio, one part in 66 000, the measured length being longer than the computed.

## THE NORTH AMERICAN DATUM.

Early in the year 1913 the Superintendent of the United States Coast and Geodetic Survey was notified by the director of the Comisión Geodésica Mexicana and by the chief astronomer of the Dominion of Canada Astronomical Observatory that the 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 now adopted by the three countries, the Superintendent of the United States Coast and Geodetic Survey has 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.

The lengths, as already fully explained in connection with the adjustments, all depend upon the Kent Island, St. Albans, Holton, Olney, American Bottom, Versailles, Salina, Louisville, and Cincinnati bases. The lengths as given are all reduced to sea level. If the actual length of a line simply reduced to the horizontal is desired, it may be obtained with all the accuracy ordinarily needed by adding to the sea level length as given a correction = (length of line as given)  $\left[ \frac{\text{mean elevation of the two ends of the line in meters}}{6\,370\,000} \right]$ . The maximum value of this correction does not exceed  $\frac{1}{45\,000}$  of the length of any line of the triangulation here published. The maximum error made in the use of the above approximate formula for the correction does not exceed  $\frac{1}{200\,000}$  of the length of any line of this triangulation.

The positions—that is, the latitudes, longitudes, and azimuths—need special explanation.

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 United States 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 the selected station, together with the adopted standard azimuth of a line from that station, is called the geodetic datum.

The primary 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 or overlapped.

The Transcontinental Triangulation, of which the office computation was completed in 1899, joined all of the detached portions mentioned and made of them one continuous triangulation. As soon as this was accomplished 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 heavy 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 (see p. 10), 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 United States Coast and Geodetic Survey are, first, the control of the charts published by the Survey; second, the furnishing of geographic positions (latitudes and longitudes), of accurately determined elevations, and of distances and azimuths, to officers connected with the United States Coast and Geodetic 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 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 later 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 United States Standard (now 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 is 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 sums 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 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 registers 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 available in 1903 on the United States Standard Datum at 246 latitude stations, 76 longitude stations, and 152 azimuth stations, scattered widely over the United States from Maine to Louisiana and to California, indicated that this datum approaches closely the ideal datum for which the algebraic sum of the station errors of each class would be zero.<sup>1</sup>

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

$$\begin{aligned} \varphi &= 39 \quad 13 \quad 26.686 \\ \lambda &= 98 \quad 32 \quad 30.506 \\ \alpha \text{ to Waldo} &= 75 \quad 28 \quad 14.52 \end{aligned}$$

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.

The geographic positions on pages 856 to 861 in Special Publication No. 4 are on the Transcontinental Datum. The corrections required to reduce these positions to the North American Datum vary at different parts of the thirty-ninth parallel, and in general fall between the limits  $\Delta\varphi = +0.''8$  to  $+2.''2$ ,  $\Delta\lambda = +0.''5$  to  $-0.''6$ , and  $\Delta\alpha = -3''$  to  $+2''$ . In order to reduce to the North American Datum the positions of those points of the thirty-ninth parallel which are included in this publication, the latitude of *Briery* was corrected by  $+2.''085$ , the longitude by  $-0.''485$ , and the azimuth of the line *Briery-Keeney* by  $-1.''24$ . Using this corrected position of *Briery* and the corrected azimuth of the line *Briery-Keeney*, the positions of all the points of the thirty-ninth parallel from this line to Kansas City were computed, using the adjusted triangles appearing on pages 74, 75, 93-96, 144-146, 166-169, 240-243, 393, 394, 411-416, 430-433, 446-449, 473-479, and 505-508 of Special Publication No. 4, no change being made in the angles and lengths.

The principal lists of geographic positions heretofore published on the adopted datum throughout the whole United States are contained in the following publications of the United States Coast and Geodetic Survey and of other organizations:

- Appendix 8 of the Report for 1885, positions in Massachusetts and Rhode Island.
- Appendix 8 of the Report for 1888, positions in Connecticut.

<sup>1</sup> This is further borne out in the reduction of 765 astronomic stations in connection with the "Supplementary investigation in 1909 of the figure of the earth and isostasy," by J. F. Hayford, published by the United States Coast and Geodetic Survey.

Appendix 8 of the Report for 1893, positions in Pennsylvania, Delaware, and Maryland.  
 Appendix 10 of the Report for 1894, positions in Massachusetts.  
 Appendix 6 of the Report for 1901, positions in Kansas and Nebraska.  
 Appendix 3 of the Report for 1902, positions in Kansas, Missouri, Nebraska, and Colorado.  
 Appendix 4 of the Report for 1903, positions in Kansas, Oklahoma, and Texas.  
 Appendix 9 of the Report for 1904, positions in California.  
 Appendix 5 of the Report for 1905, positions in Texas.  
 Appendix 3 of the Report for 1907, positions in California.  
 Appendix 5 of the Report for 1910, positions in California.  
 Appendix 4 of the Report for 1911, positions in Nebraska, Minnesota, North Dakota, and South Dakota.  
 Appendix 5 of the Report for 1911, positions in Texas.  
 Appendix 6 of the Report for 1911, positions in Florida.  
 Special Publication No. 11, positions in Texas, New Mexico, Arizona, and California.  
 Special Publication No. 13, positions in California, Oregon, and Washington.  
 Special Publication No. 16, positions in Florida.  
 Special Publication No. 17, positions in Texas.  
 Special Publication No. 19, positions in Colorado, Utah, Nevada, Wyoming, Montana, South Dakota, and North Dakota.  
 Special Publication No. 24, positions in Alabama and Mississippi.  
 Triangulation in Greater New York.  
 Report on a Plan of Sewerage, Cincinnati.  
 Appendix EEE, pages 2905-3031, Annual Report of the Chief of Engineers, 1902, positions of points on and near the Great Lakes.  
 Publications of the Massachusetts Harbor and Land Commission.  
 Various bulletins of the United States Geological Survey.

#### EXPLANATION OF TABLE OF POSITIONS.

In the table of positions the latitude and longitude of each point are given on the North American Datum (see p. 10), also the length and azimuth of each line observed over, whether in one or both ways. With the latitude and longitude of each point are given the lengths and azimuths of lines from that point to other points of the triangulation. No lengths or azimuths are repeated, and for a given line the length and azimuth will generally be found opposite the position of the last mentioned of the two stations involved.

For the convenience of the draftsman a column of "seconds in meters" is given, in which is placed the length (in meters) of each small arc of a meridian or parallel corresponding to the seconds of the given latitude or longitude. To facilitate further the use of the tables, a column is given of the logarithms of the lengths. It must be remembered that it is the logarithm which is derived first from the computation, the lengths given in this table being then derived from the corresponding logarithms.

The rule followed in recent publications of this office has been to give latitudes and longitudes to thousandths of seconds for all points the positions of which are fixed by fully adjusted triangulation. Points, the positions of which are given to hundredths of seconds only, are marked by footnotes as being without check (observed from only two stations) or checked by verticals only.

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 figures 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.

These tables may be conveniently consulted by using as finders the sketches at the end of this publication and the index on pages 63 to 67. In the third column of the index will be found for each point a reference to the page on which its description is given, in the fourth column the page on which its elevation above sea level is shown, and in the fifth column the number of the sketch on which it appears.

The following conversion tables are inserted for the convenience of those who may wish to change the distances or elevations given in this publication from meters to feet or from feet to meters:

Lengths—Feet to meters (from 1 to 1,000 units).

[Reduction factor: 1 foot = 0.3048006096 meter.]

Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.		
0		100	30.48006	200	60.96012	300	91.44018	400	121.92024	500	152.40030	600	182.88037	700	213.36043	800	243.84049		
1	.30480	1	30.78486	1	61.26492	1	91.74498	1	122.22504	1	152.70511	1	183.18517	1	213.66523	1	244.14529		
2	.60960	2	31.08966	2	61.56972	2	92.04978	2	122.52966	2	153.00991	2	183.48977	2	213.97003	2	244.45009		
3	.91440	3	31.39446	3	61.87452	3	92.35458	3	122.83465	3	153.31471	3	183.79477	3	214.27483	3	244.75489		
4	1.21920	4	31.69926	4	62.17932	4	92.65939	4	123.13945	4	153.61951	4	184.09957	4	214.57963	4	245.05969		
5	1.52400	5	32.00406	5	62.48412	5	92.96419	5	123.44425	5	153.92431	5	184.40437	5	214.88443	5	245.36449		
6	1.82880	6	32.30886	6	62.78898	6	93.26899	6	123.74905	6	154.22911	6	184.70917	6	215.18923	6	245.66929		
7	2.13360	7	32.61367	7	63.09373	7	93.57379	7	124.05386	7	154.53391	7	185.01397	7	215.49403	7	245.97409		
8	2.43840	8	32.91847	8	63.39853	8	93.87859	8	124.35866	8	154.83871	8	185.31877	8	215.79883	8	246.27889		
9	2.74321	9	33.22327	9	63.70333	9	94.18339	9	124.66345	9	155.14351	9	185.62357	9	216.10363	9	246.58369		
10	3.04801	110	33.52807	210	64.00813	310	94.48819	410	124.96825	510	155.44831	610	185.92837	710	216.40843	810	246.88849	910	277.36855
1	3.35281	1	33.83287	1	64.31293	1	94.79299	1	125.27306	1	155.75311	1	186.23317	1	216.71323	1	247.19329	1	277.67336
2	3.65761	2	34.13767	2	64.61773	2	95.09779	2	125.57785	2	156.05791	2	186.53797	2	217.01803	2	247.49810	2	277.97818
3	3.96241	3	34.44247	3	64.92253	3	95.40259	3	125.88265	3	156.36271	3	186.84277	3	217.32283	3	247.80290	3	278.28296
4	4.26721	4	34.74727	4	65.22733	4	95.70739	4	126.18745	4	156.66751	4	187.14757	4	217.62764	4	248.10770	4	278.58776
5	4.57201	5	35.05207	5	65.53213	5	96.01219	5	126.49225	5	156.97231	5	187.45237	5	217.93244	5	248.41250	5	278.89256
6	4.87681	6	35.35687	6	65.83693	6	96.31699	6	126.79705	6	157.27711	6	187.75717	6	218.23724	6	248.71730	6	279.19736
7	5.18161	7	35.66167	7	66.14173	7	96.62179	7	127.10185	7	157.58191	7	188.06197	7	218.54204	7	249.02210	7	279.50216
8	5.48641	8	35.96647	8	66.44653	8	96.92659	8	127.40665	8	157.88671	8	188.36678	8	218.84684	8	249.32690	8	279.80696
9	5.79121	9	36.27127	9	66.75133	9	97.23139	9	127.71145	9	158.19151	9	188.67158	9	219.15164	9	249.63170	9	280.11176
20	6.09601	120	36.57607	220	67.05613	320	97.53620	420	128.01626	520	158.49632	620	188.97638	720	219.45644	820	249.93650	920	280.41656
1	6.40081	1	36.88087	1	67.36093	1	97.84100	1	128.32106	1	158.80112	1	189.28138	1	219.76124	1	250.24130	1	280.72136
2	6.70561	2	37.18567	2	67.66573	2	98.14580	2	128.62586	2	159.10592	2	189.58598	2	220.06604	2	250.54610	2	281.02616
3	7.01041	3	37.49047	3	67.97053	3	98.45060	3	128.93066	3	159.41072	3	189.89078	3	220.37084	3	250.85090	3	281.33096
4	7.31521	4	37.79528	4	68.27533	4	98.75540	4	129.23546	4	159.71552	4	190.19558	4	220.67564	4	251.15570	4	281.63576
5	7.62002	5	38.10008	5	68.58014	5	99.06020	5	129.54026	5	160.02032	5	190.50038	5	220.98044	5	251.46050	5	281.94056
6	7.92482	6	38.40488	6	68.88494	6	99.36500	6	129.84506	6	160.32512	6	190.80518	6	221.28524	6	251.76530	6	282.24536
7	8.22962	7	38.70968	7	69.18974	7	99.66980	7	130.14986	7	160.62992	7	191.10998	7	221.59004	7	252.07010	7	282.55016
8	8.53442	8	39.01448	8	69.49454	8	99.97460	8	130.45466	8	160.93472	8	191.41478	8	221.89484	8	252.37490	8	282.85496
9	8.83922	9	39.31928	9	69.79934	9	100.27940	9	130.75946	9	161.23952	9	191.71958	9	222.19964	9	252.67971	9	283.15977
80	9.14402	180	39.62408	280	70.10414	380	100.58420	480	131.06426	580	161.54432	680	192.02438	780	222.50445	880	252.98451	980	283.46457
1	9.44882	1	39.92888	1	70.40894	1	100.88900	1	131.36906	1	161.84912	1	192.32918	1	222.80925	1	253.28931	1	283.76937
2	9.75362	2	40.23368	2	70.71374	2	101.19380	2	131.67386	2	162.15392	2	192.63398	2	223.11405	2	253.59411	2	284.07417
3	10.05842	3	40.53848	3	71.01854	3	101.49860	3	131.97866	3	162.45872	3	192.93878	3	223.41885	3	253.89891	3	284.37897
4	10.36322	4	40.84328	4	71.32334	4	101.80340	4	132.28346	4	162.76352	4	193.24358	4	223.72365	4	254.20371	4	284.68377
5	10.66802	5	41.14808	5	71.62814	5	102.10820	5	132.58827	5	163.06833	5	193.54838	5	224.02845	5	254.50851	5	284.98857
6	10.97282	6	41.45288	6	71.93294	6	102.41300	6	132.89307	6	163.37313	6	193.85318	6	224.33325	6	254.81331	6	285.29337
7	11.27762	7	41.75768	7	72.23774	7	102.71780	7	133.19787	7	163.67793	7	194.15798	7	224.63805	7	255.11811	7	285.59817
8	11.58242	8	42.06248	8	72.54255	8	103.02260	8	133.50267	8	163.98273	8	194.46278	8	224.94285	8	255.42291	8	285.90297
9	11.88722	9	42.36728	9	72.84735	9	103.32740	9	133.80747	9	164.28753	9	194.76758	9	225.24765	9	255.72771	9	286.20777
40	12.19202	140	42.67209	240	73.15215	340	103.63220	440	134.11227	540	164.59233	640	195.07239	740	225.55245	840	256.03251	940	286.51257
1	12.49682	1	42.97689	1	73.45695	1	103.93700	1	134.41707	1	164.89713	1	195.37719	1	225.85725	1	256.33731	1	286.81737
2	12.80162	2	43.28169	2	73.76175	2	104.24180	2	134.72187	2	165.20193	2	195.68199	2	226.16205	2	256.64211	2	287.12217
3	13.10642	3	43.58649	3	74.06655	3	104.54660	3	135.02667	3	165.50673	3	195.98679	3	226.46685	3	256.94691	3	287.42697
4	13.41122	4	43.89129	4	74.37135	4	104.85140	4	135.33147	4	165.81153	4	196.29159	4	226.77165	4	257.25171	4	287.73177
5	13.71603	5	44.19609	5	74.67615	5	105.15620	5	135.63627	5	166.11633	5	196.59639	5	227.07645	5	257.55652	5	288.03658
6	14.02083	6	44.50089	6	74.98095	6	105.46100	6	135.94107	6	166.42113	6	196.90119	6	227.38125	6	257.86132	6	288.34138
7	14.32563	7	44.80569	7	75.28575	7	105.76580	7	136.24587	7	166.72593	7	197.20599	7	227.68605	7	258.16612	7	288.64618
8	14.63043	8	45.11049	8	75.59055	8	106.07060	8	136.55067	8	167.03073	8	197.51079	8	227.99085	8	258.47092	8	288.95098
9	14.93523	9	45.41529	9	75.89535	9	106.37540	9	136.85547	9	167.33553	9	197.81559	9	228.29566	9	258.77572	9	289.25578

<b>50</b> 15. 24003 1 15. 54483 2 15. 84963 3 16. 15443 4 16. 45923  5 16. 76403 6 17. 06883 7 17. 37363 8 17. 67844 9 17. 98324	<b>150</b> 45. 78009 1 46. 02489 2 46. 32969 3 46. 63449 4 46. 93929  5 47. 24409 6 47. 54889 7 47. 85370 8 48. 15850 9 48. 46330	<b>250</b> 76. 20015 1 76. 50495 2 76. 80975 3 77. 11455 4 77. 41935  5 77. 72415 6 78. 02895 7 78. 33375 8 78. 63855 9 78. 94335	<b>350</b> 106. 68021 1 106. 98501 2 107. 28981 3 107. 59462 4 107. 89942  5 108. 20422 6 108. 50902 7 108. 81382 8 109. 11862 9 109. 42342	<b>450</b> 137. 16027 1 137. 46507 2 137. 76987 3 138. 07468 4 138. 37948  5 138. 68428 6 138. 98908 7 139. 29388 8 139. 59868 9 139. 90348	<b>550</b> 167. 64034 1 167. 94514 2 168. 24994 3 168. 55474 4 168. 85954  5 169. 16434 6 169. 46914 7 169. 77394 8 170. 07874 9 170. 38354	<b>650</b> 188. 12040 1 188. 42520 2 188. 73000 3 189. 03480 4 189. 33960  5 189. 64440 6 189. 94920 7 200. 25400 8 200. 55880 9 200. 86360	<b>750</b> 228. 60046 1 228. 90526 2 229. 21006 3 229. 51486 4 229. 81966  5 230. 12446 6 230. 42926 7 230. 73406 8 231. 03886 9 231. 34366	<b>850</b> 259. 08052 1 259. 38532 2 259. 69012 3 259. 99492 4 260. 29972  5 260. 60452 6 260. 90932 7 261. 21412 8 261. 51892 9 261. 82372	<b>950</b> 289. 56058 1 289. 86538 2 290. 17018 3 290. 47498 4 290. 77978  5 291. 08458 6 291. 38938 7 291. 69418 8 291. 99898 9 292. 30378
<b>60</b> 18. 23804 1 18. 59234 2 18. 89764 3 19. 20244 4 19. 50724  5 19. 81204 6 20. 11684 7 20. 42164 8 20. 72644 9 21. 03124	<b>160</b> 48. 76810 1 49. 07290 2 49. 37770 3 49. 68250 4 49. 98730  5 50. 29210 6 50. 59690 7 50. 90170 8 51. 20650 9 51. 51130	<b>260</b> 79. 24816 1 79. 55296 2 79. 85776 3 80. 16256 4 80. 46736  5 80. 77216 6 81. 07696 7 81. 38176 8 81. 68656 9 81. 99136	<b>360</b> 109. 72822 1 110. 03302 2 110. 33782 3 110. 64262 4 110. 94742  5 111. 25222 6 111. 55702 7 111. 86182 8 112. 16662 9 112. 47142	<b>460</b> 140. 20828 1 140. 51308 2 140. 81788 3 141. 12268 4 141. 42748  5 141. 73228 6 142. 03708 7 142. 34188 8 142. 64668 9 142. 95148	<b>560</b> 170. 68834 1 170. 99314 2 171. 29794 3 171. 60274 4 171. 90754  5 172. 21234 6 172. 51714 7 172. 82194 8 173. 12674 9 173. 43154	<b>660</b> 201. 16840 1 201. 47320 2 201. 77800 3 202. 08280 4 202. 38760  5 202. 69240 6 202. 99720 7 203. 30200 8 203. 60680 9 203. 91160	<b>760</b> 231. 64846 1 231. 95326 2 232. 25806 3 232. 56286 4 232. 86766  5 233. 17246 6 233. 47726 7 233. 78206 8 234. 08686 9 234. 39166	<b>860</b> 262. 12852 1 262. 43332 2 262. 73812 3 263. 04292 4 263. 34772  5 263. 65252 6 263. 95732 7 264. 26212 8 264. 56692 9 264. 87172	<b>960</b> 292. 60858 1 292. 91338 2 293. 21818 3 293. 52298 4 293. 82778  5 294. 13258 6 294. 43738 7 294. 74218 8 295. 04698 9 295. 35178
<b>70</b> 21. 33604 1 21. 64084 2 21. 94564 3 22. 25044 4 22. 55524  5 22. 86004 6 23. 16484 7 23. 46964 8 23. 77444 9 24. 07924	<b>170</b> 51. 81610 1 52. 12090 2 52. 42570 3 52. 73050 4 53. 03530  5 53. 34010 6 53. 64490 7 53. 94970 8 54. 25450 9 54. 55930	<b>270</b> 82. 29616 1 82. 60096 2 82. 90576 3 83. 21056 4 83. 51536  5 83. 82016 6 84. 12496 7 84. 42976 8 84. 73456 9 85. 03936	<b>370</b> 112. 77622 1 113. 08102 2 113. 38582 3 113. 69062 4 113. 99542  5 114. 30022 6 114. 60502 7 114. 90982 8 115. 21462 9 115. 51942	<b>470</b> 143. 25628 1 143. 56108 2 143. 86588 3 144. 17068 4 144. 47548  5 144. 78028 6 145. 08508 7 145. 38988 8 145. 69468 9 145. 99948	<b>570</b> 173. 73635 1 174. 04115 2 174. 34595 3 174. 65075 4 174. 95555  5 175. 26035 6 175. 56515 7 175. 86995 8 176. 17475 9 176. 47955	<b>670</b> 204. 21641 1 204. 52121 2 204. 82601 3 205. 13081 4 205. 43561  5 205. 74041 6 206. 04521 7 206. 35001 8 206. 65481 9 206. 95961	<b>770</b> 234. 69647 1 235. 00127 2 235. 30607 3 235. 61087 4 235. 91567  5 236. 22047 6 236. 52527 7 236. 83007 8 237. 13487 9 237. 43967	<b>870</b> 265. 17653 1 265. 48133 2 265. 78613 3 266. 09093 4 266. 39573  5 266. 70053 6 267. 00533 7 267. 31013 8 267. 61493 9 267. 91973	<b>970</b> 295. 65659 1 295. 96139 2 296. 26619 3 296. 57099 4 296. 87579  5 297. 18059 6 297. 48539 7 297. 79019 8 298. 09499 9 298. 39979
<b>80</b> 24. 38405 1 24. 68885 2 24. 99365 3 25. 29845 4 25. 60325  5 25. 90805 6 26. 21285 7 26. 51765 8 26. 82245 9 27. 12725	<b>180</b> 54. 86411 1 55. 16891 2 55. 47371 3 55. 77851 4 56. 08331  5 56. 38811 6 56. 69291 7 56. 99771 8 57. 30251 9 57. 60732	<b>280</b> 85. 34417 1 85. 64897 2 85. 95377 3 86. 25857 4 86. 56337  5 86. 86817 6 87. 17297 7 87. 47777 8 87. 78257 9 88. 08738	<b>380</b> 115. 82423 1 116. 12903 2 116. 43383 3 116. 73863 4 117. 04343  5 117. 34823 6 117. 65303 7 117. 95783 8 118. 26263 9 118. 56743	<b>480</b> 146. 30429 1 146. 60909 2 146. 91389 3 147. 21869 4 147. 52349  5 147. 82829 6 148. 13309 7 148. 43789 8 148. 74269 9 149. 04750	<b>580</b> 176. 78435 1 177. 08915 2 177. 39395 3 177. 69875 4 178. 00355  5 178. 30835 6 178. 61315 7 178. 91795 8 179. 22275 9 179. 52755	<b>680</b> 207. 26441 1 207. 56921 2 207. 87402 3 208. 17882 4 208. 48362  5 208. 78842 6 209. 09322 7 209. 39802 8 209. 70282 9 210. 00762	<b>780</b> 237. 74448 1 238. 04928 2 238. 35408 3 238. 65888 4 238. 96368  5 239. 26848 6 239. 57328 7 239. 87808 8 240. 18288 9 240. 48768	<b>880</b> 268. 22454 1 268. 52934 2 268. 83414 3 269. 13894 4 269. 44374  5 269. 74854 6 270. 05334 7 270. 35814 8 270. 66294 9 270. 96774	<b>980</b> 298. 70460 1 299. 00940 2 299. 31420 3 299. 61900 4 299. 92380  5 300. 22860 6 300. 53340 7 300. 83820 8 301. 14300 9 301. 44780
<b>90</b> 27. 43205 1 27. 73685 2 28. 04165 3 28. 34645 4 28. 65125  5 28. 95605 6 29. 26085 7 29. 56565 8 29. 87045 9 30. 17525	<b>190</b> 57. 91212 1 58. 21692 2 58. 52172 3 58. 82652 4 59. 13132  5 59. 43612 6 59. 74092 7 60. 04572 8 60. 35052 9 60. 65532	<b>290</b> 88. 39218 1 88. 69698 2 89. 00178 3 89. 30658 4 89. 61138  5 89. 91618 6 90. 22098 7 90. 52578 8 90. 83058 9 91. 13538	<b>390</b> 118. 87224 1 119. 17704 2 119. 48184 3 119. 78664 4 120. 09144  5 120. 39624 6 120. 70104 7 121. 00584 8 121. 31064 9 121. 61544	<b>490</b> 149. 35230 1 149. 65710 2 149. 96190 3 150. 26670 4 150. 57150  5 150. 87630 6 151. 18110 7 151. 48590 8 151. 79070 9 152. 09550	<b>590</b> 179. 83236 1 180. 13716 2 180. 44196 3 180. 74676 4 181. 05156  5 181. 35636 6 181. 66116 7 181. 96596 8 182. 27076 9 182. 57557	<b>690</b> 210. 31242 1 210. 61722 2 210. 92202 3 211. 22682 4 211. 53162  5 211. 83642 6 212. 14122 7 212. 44602 8 212. 75082 9 213. 05562	<b>790</b> 240. 79248 1 241. 09728 2 241. 40208 3 241. 70688 4 242. 01168  5 242. 31648 6 242. 62128 7 242. 92608 8 243. 23088 9 243. 53568	<b>890</b> 271. 27254 1 271. 57734 2 271. 88214 3 272. 18694 4 272. 49174  5 272. 79655 6 273. 10135 7 273. 40615 8 273. 71095 9 274. 01575	<b>990</b> 301. 75260 1 302. 05740 2 302. 36220 3 302. 66700 4 302. 97180  5 303. 27661 6 303. 58141 7 303. 88621 8 304. 19101 9 304. 49581

1 inch = .02540 meter.	4 inches = .10160 meter.	7 inches = .17780 meter.	10 inches = .25400 meter.
2 inches = .05080 meter.	5 inches = .12700 meter.	8 inches = .20320 meter.	11 inches = .27940 meter.
3 inches = .07620 meter.	6 inches = .15240 meter.	9 inches = .22860 meter.	12 inches = .30480 meter.

Lengths—Meters to feet (from 1 to 1,000 units).

[Reduction factor: 1 meter = 3.28083333 feet.]

Meters.	Feet.																		
0		100	328.08333	200	656.16667	300	984.25000	400	1,312.33333	500	1,640.41667	600	1,968.50000	700	2,296.58333				
1	3.28083	1	331.36417	1	659.44750	1	987.53083	1	1,315.61417	1	1,643.69750	1	1,971.78083	1	2,299.86417	1	2,624.66667		
2	6.56167	2	334.64500	2	662.72833	2	990.81167	2	1,318.89500	2	1,646.97833	2	1,975.06167	2	2,303.14500	2	2,627.94750		
3	9.84250	3	337.92583	3	666.00917	3	994.09250	3	1,322.17583	3	1,650.25917	3	1,978.34250	3	2,306.42833	3	2,631.23233		
4	13.12333	4	341.20667	4	669.29000	4	997.37333	4	1,325.45667	4	1,653.54000	4	1,981.62333	4	2,309.70667	4	2,634.50917		
5	16.40417	5	344.48750	5	672.57083	5	1,000.65417	5	1,328.73750	5	1,656.82083	5	1,984.90417	5	2,312.98750	5	2,637.79000		
6	19.68500	6	347.76833	6	675.85167	6	1,003.93500	6	1,332.02500	6	1,660.10167	6	1,988.18500	6	2,316.26833	6	2,641.07083		
7	22.96583	7	351.04917	7	679.13250	7	1,007.21583	7	1,335.29177	7	1,663.38250	7	1,991.46583	7	2,319.54917	7	2,644.35167		
8	26.24667	8	354.33000	8	682.41333	8	1,010.49667	8	1,338.58000	8	1,666.66333	8	1,994.74667	8	2,322.83000	8	2,647.63250		
9	29.52750	9	357.61083	9	685.69417	9	1,013.77750	9	1,341.86083	9	1,669.94417	9	1,998.02750	9	2,326.11083	9	2,650.91333		
10	32.80833	110	360.89167	210	688.97500	310	1,017.05833	410	1,345.14167	510	1,673.22500	610	2,001.30833	710	2,329.39167	810	2,657.47500		
1	36.08917	1	364.17250	1	692.25583	1	1,020.33917	1	1,348.42250	1	1,676.50583	1	2,004.58917	1	2,332.67250	1	2,660.75833		
2	39.37000	2	367.45333	2	695.53667	2	1,023.62000	2	1,351.70333	2	1,679.78667	2	2,007.87000	2	2,335.95333	2	2,664.03667		
3	42.65083	3	370.73417	3	698.81750	3	1,026.90083	3	1,354.98417	3	1,683.06750	3	2,011.15083	3	2,339.23417	3	2,667.31750		
4	45.93167	4	374.01500	4	702.09833	4	1,030.18167	4	1,358.26500	4	1,686.34833	4	2,014.43167	4	2,342.51500	4	2,670.59833		
5	49.21250	5	377.29583	5	705.37917	5	1,033.46250	5	1,361.54583	5	1,689.62917	5	2,017.71250	5	2,345.79583	5	2,673.87917		
6	52.49333	6	380.57667	6	708.66000	6	1,036.74333	6	1,364.82667	6	1,692.91000	6	2,020.99333	6	2,349.07667	6	2,677.16000		
7	55.77417	7	383.85750	7	711.94083	7	1,040.02417	7	1,368.10750	7	1,696.19083	7	2,024.27417	7	2,352.35750	7	2,680.44083		
8	59.05500	8	387.13833	8	715.22167	8	1,043.30500	8	1,371.38833	8	1,699.47167	8	2,027.55500	8	2,355.63833	8	2,683.72167		
9	62.33583	9	390.41917	9	718.50250	9	1,046.58583	9	1,374.66917	9	1,702.75250	9	2,030.83583	9	2,358.91917	9	2,687.00250		
20	65.61667	120	393.70000	220	721.78333	320	1,049.86667	420	1,377.95000	520	1,706.03333	620	2,034.11667	720	2,362.20000	820	2,690.28333		
1	68.89750	1	396.98083	1	725.06417	1	1,053.14750	1	1,381.23083	1	1,709.31417	1	2,037.39750	1	2,365.48093	1	2,693.56417		
2	72.17833	2	400.26167	2	728.34500	2	1,056.42833	2	1,384.51167	2	1,712.59500	2	2,040.67833	2	2,368.76167	2	2,696.84500		
3	75.45917	3	403.54250	3	731.62583	3	1,059.70917	3	1,387.79250	3	1,715.87583	3	2,043.95917	3	2,372.04250	3	2,700.12583		
4	78.74000	4	406.82333	4	734.90667	4	1,062.99000	4	1,391.07333	4	1,719.15667	4	2,047.24000	4	2,375.32333	4	2,703.40667		
5	82.02083	5	410.10417	5	738.18750	5	1,066.27083	5	1,394.35417	5	1,722.43750	5	2,050.52083	5	2,378.60417	5	2,706.68750		
6	85.30167	6	413.38500	6	741.46833	6	1,069.55167	6	1,397.63500	6	1,725.71833	6	2,053.80167	6	2,381.88500	6	2,709.96833		
7	88.58250	7	416.66583	7	744.74917	7	1,072.83250	7	1,400.91683	7	1,728.99917	7	2,057.08250	7	2,385.16583	7	2,713.24917		
8	91.86333	8	419.94667	8	748.03000	8	1,076.11333	8	1,404.19667	8	1,732.28000	8	2,060.36333	8	2,388.44667	8	2,716.53000		
9	95.14417	9	423.22750	9	751.31083	9	1,079.39417	9	1,407.47750	9	1,735.56083	9	2,063.64417	9	2,391.72750	9	2,719.81083		
30	98.42500	130	426.50833	230	754.59167	330	1,082.67500	430	1,410.75833	530	1,738.84167	630	2,066.92500	730	2,395.00833	830	2,723.09167		
1	101.70583	1	429.78917	1	757.87250	1	1,085.95583	1	1,414.03917	1	1,742.12250	1	2,070.20583	1	2,398.28917	1	2,726.37250		
2	104.98667	2	433.07000	2	761.15333	2	1,089.23667	2	1,417.32000	2	1,745.40333	2	2,073.48667	2	2,401.57000	2	2,729.65333		
3	108.26750	3	436.35083	3	764.43417	3	1,092.51750	3	1,420.60083	3	1,748.68417	3	2,076.76750	3	2,404.85083	3	2,732.93417		
4	111.54833	4	439.63167	4	767.71500	4	1,095.79833	4	1,423.88167	4	1,751.96500	4	2,080.04833	4	2,408.13167	4	2,736.21500		
5	114.82917	5	442.91250	5	770.99583	5	1,099.07917	5	1,427.16250	5	1,755.24583	5	2,083.32917	5	2,411.41250	5	2,739.49583		
6	118.11000	6	446.19333	6	774.27667	6	1,102.36000	6	1,430.44333	6	1,758.52667	6	2,086.61000	6	2,414.69333	6	2,742.77667		
7	121.39083	7	449.47417	7	777.55750	7	1,105.64083	7	1,433.72417	7	1,761.80750	7	2,089.89083	7	2,417.97417	7	2,746.05750		
8	124.67167	8	452.75500	8	780.83833	8	1,108.92167	8	1,437.00500	8	1,765.08833	8	2,093.17167	8	2,421.25500	8	2,749.33833		
9	127.95250	9	456.03583	9	784.11917	9	1,112.20250	9	1,440.28583	9	1,768.36917	9	2,096.45250	9	2,424.53583	9	2,752.61917		
40	131.23333	140	459.31667	240	787.40000	340	1,115.48333	440	1,443.56667	540	1,771.65000	640	2,099.73333	740	2,427.81667	840	2,755.00000		
1	134.51417	1	462.59750	1	790.68083	1	1,118.76417	1	1,446.84750	1	1,774.93083	1	2,103.01417	1	2,431.09750	1	2,758.28083		
2	137.79500	2	465.87833	2	793.96167	2	1,122.04500	2	1,450.12833	2	1,778.21167	2	2,106.29500	2	2,434.37833	2	2,761.56167		
3	141.07583	3	469.15917	3	797.24250	3	1,125.32583	3	1,453.40917	3	1,781.49250	3	2,109.57583	3	2,437.65917	3	2,764.84250		
4	144.35667	4	472.44000	4	800.52333	4	1,128.60667	4	1,456.69000	4	1,784.77333	4	2,112.85667	4	2,440.94000	4	2,768.12333		
5	147.63750	5	475.72083	5	803.80417	5	1,131.88750	5	1,459.97083	5	1,788.05417	5	2,116.13750	5	2,444.22083	5	2,771.40417		
6	150.91833	6	479.00167	6	807.08500	6	1,135.16833	6	1,463.25167	6	1,791.33500	6	2,119.41833	6	2,447.50167	6	2,774.68500		
7	154.19917	7	482.28250	7	810.36583	7	1,138.44917	7	1,466.53250	7	1,794.61583	7	2,122.69917	7	2,450.78250	7	2,777.96583		
8	157.48000	8	485.56333	8	813.64667	8	1,141.73000	8	1,469.81333	8	1,797.89667	8	2,125.98000	8	2,454.06333	8	2,781.24667		
9	160.76083	9	488.84417	9	816.92750	9	1,145.01083	9	1,473.09417	9	1,801.17750	9	2,129.26083	9	2,457.34417	9	2,784.52750		
90	2,952.75000	910	2,985.55833	920	3,018.36667	930	3,051.17500	940	3,083.98333	950	3,116.79167	960	3,150.60000	970	3,184.40833	980	3,218.21667	990	3,251.02500
1	2,956.03083	1	2,988.83917	1	3,021.64750	1	3,054.45583	1	3,086.75000	1	3,120.55833	1	3,154.36667	1	3,188.17500	1	3,221.78333	1	3,254.59167
2	2,959.31167	2	2,992.12000	2	3,024.92833	2	3,057.73667	2	3,089.95833	2	3,123.86667	2	3,157.57500	2	3,191.38333	2	3,225.06167	2	3,257.87500
3	2,962.59250	3	2,995.40083	3	3,028.20917	3	3,060.94500	3	3,092.97500	3	3,127.99583	3	3,161.60417	3	3,195.39167	3	3,228.35417	3	3,260.15667
4	2,965.87333	4	2,998.68167	4	3,031.49000	4	3,063.75333	4	3,095.78333	4	3,131.0250								

99159°-15-2

<b>50</b>	164.04167
1	167.92250
2	170.60333
3	173.88417
4	177.16500
5	180.44583
6	183.72667
7	187.00750
8	190.28833
9	193.56917
<b>60</b>	196.85000
1	200.13083
2	203.41167
3	206.69250
4	209.97333
5	213.25417
6	216.53500
7	219.81583
8	223.09667
9	226.37750
<b>70</b>	229.65833
1	232.93917
2	236.22000
3	239.50083
4	242.78167
5	246.06250
6	249.34333
7	252.62417
8	255.90500
9	259.18583
<b>80</b>	262.46667
1	265.74750
2	269.02833
3	272.30917
4	275.59000
5	278.87083
6	282.15167
7	285.43250
8	288.71333
9	291.99417
<b>90</b>	295.27500
1	298.55583
2	301.83667
3	305.11750
4	308.39833
5	311.67917
6	314.96000
7	318.24083
8	321.52167
9	324.80250

<b>150</b>	492.12500
1	495.40583
2	498.68667
3	501.96750
4	505.24833
5	508.52917
6	511.81000
7	515.09083
8	518.37167
9	521.65250
<b>160</b>	524.93333
1	528.21417
2	531.49500
3	534.77583
4	538.05667
5	541.33750
6	544.61833
7	547.89917
8	551.18000
9	554.46083
<b>170</b>	557.74167
1	561.02250
2	564.30333
3	567.58417
4	570.86500
5	574.14583
6	577.42667
7	580.70750
8	583.98833
9	587.26917
<b>180</b>	590.55000
1	593.83083
2	597.11167
3	600.39250
4	603.67333
5	606.95417
6	610.23500
7	613.51583
8	616.79667
9	620.07750
<b>190</b>	623.35833
1	626.63917
2	629.92000
3	633.20083
4	636.48167
5	639.76250
6	643.04333
7	646.32417
8	649.60500
9	652.88583

<b>250</b>	820.20833
1	823.48917
2	826.77000
3	830.05083
4	833.33167
5	836.61250
6	839.89333
7	843.17417
8	846.45500
9	849.73583
<b>260</b>	853.01667
1	856.29750
2	859.57833
3	862.85917
4	866.14000
5	869.42083
6	872.70167
7	875.98250
8	879.26333
9	882.54417
<b>270</b>	885.82500
1	889.10583
2	892.38667
3	895.66750
4	898.94833
5	902.22917
6	905.51000
7	908.79083
8	912.07167
9	915.35250
<b>280</b>	918.63333
1	921.91417
2	925.19500
3	928.47583
4	931.75667
5	935.03750
6	938.31833
7	941.59917
8	944.88000
9	948.16083
<b>290</b>	951.44167
1	954.72250
2	958.00333
3	961.28417
4	964.56500
5	967.84583
6	971.12667
7	974.40750
8	977.68833
9	980.96917

<b>350</b>	1,148.29167
1	1,151.57250
2	1,154.85333
3	1,158.13417
4	1,161.41500
5	1,164.69583
6	1,167.97667
7	1,171.25750
8	1,174.53833
9	1,177.81917
<b>360</b>	1,181.10000
1	1,184.38083
2	1,187.66167
3	1,190.94250
4	1,194.22333
5	1,197.50417
6	1,200.78500
7	1,204.06583
8	1,207.34667
9	1,210.62750
<b>370</b>	1,213.90833
1	1,217.18917
2	1,220.47000
3	1,223.75083
4	1,227.03167
5	1,230.31250
6	1,233.59333
7	1,236.87417
8	1,240.15500
9	1,243.43583
<b>380</b>	1,246.71667
1	1,249.99750
2	1,253.27833
3	1,256.55917
4	1,259.84000
5	1,263.12083
6	1,266.40167
7	1,269.68250
8	1,272.96333
9	1,276.24417
<b>390</b>	1,279.52500
1	1,282.80583
2	1,286.08667
3	1,289.36750
4	1,292.64833
5	1,295.92917
6	1,299.21000
7	1,302.49083
8	1,305.77167
9	1,309.05250

<b>450</b>	1,476.37500
1	1,479.65583
2	1,482.93667
3	1,486.21750
4	1,489.49833
5	1,492.77917
6	1,496.06000
7	1,499.34083
8	1,502.62167
9	1,505.90250
<b>460</b>	1,509.18333
1	1,512.46417
2	1,515.74500
3	1,519.02583
4	1,522.30667
5	1,525.58750
6	1,528.86833
7	1,532.14917
8	1,535.43000
9	1,538.71083
<b>470</b>	1,541.99167
1	1,545.27250
2	1,548.55333
3	1,551.83417
4	1,555.11500
5	1,558.39583
6	1,561.67667
7	1,564.95750
8	1,568.23833
9	1,571.51917
<b>480</b>	1,574.80000
1	1,578.08083
2	1,581.36167
3	1,584.64250
4	1,587.92333
5	1,591.20417
6	1,594.48500
7	1,597.76583
8	1,601.04667
9	1,604.32750
<b>490</b>	1,607.60833
1	1,610.88917
2	1,614.17000
3	1,617.45083
4	1,620.73167
5	1,624.01250
6	1,627.29333
7	1,630.57417
8	1,633.85500
9	1,637.13583

<b>550</b>	1,804.45833
1	1,807.73917
2	1,811.02000
3	1,814.30083
4	1,817.58167
5	1,820.86250
6	1,824.14333
7	1,827.42417
8	1,830.70500
9	1,833.98583
<b>560</b>	1,837.26667
1	1,840.54750
2	1,843.82833
3	1,847.10917
4	1,850.39000
5	1,853.67083
6	1,856.95167
7	1,860.23250
8	1,863.51333
9	1,866.79417
<b>570</b>	1,870.07500
1	1,873.35583
2	1,876.63667
3	1,879.91750
4	1,883.19833
5	1,886.47917
6	1,889.76000
7	1,893.04083
8	1,896.32167
9	1,899.60250
<b>580</b>	1,902.88333
1	1,906.16417
2	1,909.44500
3	1,912.72583
4	1,916.00667
5	1,919.28750
6	1,922.56833
7	1,925.84917
8	1,929.13000
9	1,932.41083
<b>590</b>	1,935.69167
1	1,938.97250
2	1,942.25333
3	1,945.53417
4	1,948.81500
5	1,952.09583
6	1,955.37667
7	1,958.65750
8	1,961.93833
9	1,965.21917

<b>650</b>	2,132.54167
1	2,135.82250
2	2,139.10333
3	2,142.38417
4	2,145.66500
5	2,148.94583
6	2,152.22667
7	2,155.50750
8	2,158.78833
9	2,162.06917
<b>660</b>	2,165.35000
1	2,168.63083
2	2,171.91167
3	2,175.19250
4	2,178.47333
5	2,181.75417
6	2,185.03500
7	2,188.31583
8	2,191.59667
9	2,194.87750
<b>670</b>	2,198.15833
1	2,201.43917
2	2,204.72000
3	2,208.00083
4	2,211.28167
5	2,214.56250
6	2,217.84333
7	2,221.12417
8	2,224.40500
9	2,227.68583
<b>680</b>	2,230.96667
1	2,234.24750
2	2,237.52833
3	2,240.80917
4	2,244.09000
5	2,247.37083
6	2,250.65167
7	2,253.93250
8	2,257.21333
9	2,260.49417
<b>690</b>	2,263.77500
1	2,267.05583
2	2,270.33667
3	2,273.61750
4	2,276.89833
5	2,280.17917
6	2,283.46000
7	2,286.74083
8	2,290.02167
9	2,293.30250

<b>750</b>	2,460.62500
1	2,463.90583
2	2,467.18667
3	2,470.46750
4	2,473.74833
5	2,477.02917
6	2,480.31000
7	2,483.59083
8	2,486.87167
9	2,490.15250
<b>760</b>	2,493.43333
1	2,496.71417
2	2,499.99500
3	2,503.27583
4	2,506.55667
5	2,509.83750
6	2,513.11833
7	2,516.39917
8	2,519.68000
9	2,522.96083
<b>770</b>	2,526.24167
1	2,529.52250
2	2,532.80333
3	2,536.08417
4	2,539.36500
5	2,542.64583
6	2,545.92667
7	2,549.20750
8	2,552.48833
9	2,555.76917
<b>780</b>	2,559.05000
1	2,562.33083
2	2,565.61167
3	2,568.89250
4	2,572.17333
5	2,575.45417
6	2,578.73500
7	2,582.01583
8	2,585.29667
9	2,588.57750
<b>790</b>	2,591.85833
1	2,595.13917
2	2,598.42000
3	2,601.70083
4	2,604.98167
5	2,608.26250
6	2,611.54333
7	2,614.82417
8	2,618.10500
9	2,621.38583

<b>850</b>	2,788.70833
1	2,791.98917
2	2,795.27000
3	2,798.55083
4	2,801.83167
5	2,805.11250
6	2,808.39333
7	2,811.67417
8	2,814.95500
9	2,818.23583
<b>860</b>	2,821.51667
1	2,824.79750
2	2,828.07833
3	2,831.35917
4	2,834.64000
5	2,837.92083
6	2,841.20167
7	2,844.48250
8	2,847.76333
9	2,851.04417
<b>870</b>	2,854.32500
1	2,857.60583
2	2,860.88667
3	2,864.16750
4	2,867.44833
5	2,870.72917
6	2,874.01000
7	2,877.29083
8	2,880.57167
9	2,883.85250
<b>880</b>	2,887.13333
1	2,890.41417
2	2,893.69500
3	2,896.97583
4	2,900.25667
5	2,903.53750
6	2,906.81833
7	2,910.09917
8	2,913.38000
9	2,916.66083
<b>890</b>	2,919.94167
1	2,923.22250
2	2,926.50333
3	2,929.78417
4	2,933.06500
5</	

## GEOGRAPHIC POSITIONS.

Thirty-ninth parallel.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
<i>Principal points.</i>							
Briery 1880	38 08 39.590 80 20 40.462	1220.6 985.2	254 09 20.37 208 07 20.39 209 06 41.94	74 29 41.33 88 45 31.91 119 24 56.03	Paddy Elliott Knob Bald Knob	49886.53 90339.09 49638.59	4.6979833 4.9558757 4.6958194
Keeney 1880	37 46 24.843 80 42 19.179	765.9 469.4	217 30 01.78 235 20 09.01 257 04 32.52	37.43 20.62 55 53 44.90 77 35 58.98	Briery Paddy Bald Knob	51948.66 96733.39 77037.38	4.7155743 4.9855764 4.8867015
Beech 1880	38 06 44.564 80 36 18.956	1374.0 461.8	261 06 00.41 13 11 42.73	81 15 39.86 193 08 01.24	Briery Keeney	23131.38 38620.62	4.3642015 4.5868192
Summersville 1880	38 16 55.359 80 52 07.750	1707.0 188.3	288 15 06.66 309 07 23.15	108 34 34.13 129 17 09.86	Briery Beech	48301.04 29793.83	4.6847649 4.4741263
Ivy 1881	37 47 15.684 81 29 28.382	483.6 694.5	224 41 20.63 244 53 36.06 271 03 22.37	45 04 21.19 65 26 17.50 91 32 15.67	Summersville Beech Keeney	77437.03 85804.43 69251.00	4.8889487 4.9335097 4.8404260
Table Rock 1881	38 11 18.534 81 36 53.338	571.5 1298.0	260 44 04.63 346 14 43.14	81 11 46.73 166 19 17.01	Summersville Ivy	66134.76 45791.33	4.8204298 4.6607832
Holmes 1881	38 25 40.840 81 35 34.508	1259.3 836.9	284 08 02.85 352 48 54.75 4 07 36.98	104 34 59.93 172 52 40.70 184 06 48.11	Summersville Ivy Table Rock	65333.92 71630.68 26656.66	4.8151387 4.8550991 4.4258057
Piney 1883	38 26 39.588 82 03 28.996	1220.7 703.2	272 24 33.51 306 05 22.97 325 31 46.34	92 41 54.45 126 21 62.29 145 52 45.97	Holmes Table Rock Ivy	40652.19 48053.50 88221.92	4.6090839 4.6817250 4.9455765
Pigeon 1883	38 13 44.047 82 04 00.015	1358.1 0.4	181 48 06.28 276 19 40.94 313 55 13.01	1 48 25.52 96 36 27.09 134 16 28.69	Piney Table Rock Ivy	23924.49 39829.23 79373.36	4.3788426 4.6002019 4.8474083
Big Rocks 1891	38 20 51.152 81 55 29.367	1577.2 713.2	43 20 40.14 132 45 01.79 252 46 37.51 302 57 32.38	223 15 23.74 312 40 03.91 72 58 59.51 123 09 03.58	Pigeon Piney Holmes Table Rock	18065.11 15839.55 30343.10 32309.13	4.2575613 4.1907429 4.4820599 4.5101310
Simms 1891	38 27 11.408 81 50 26.619	351.7 645.4	277 16 39.70 32 05 44.80 87 06 25.74	97 25 54.34 212 02 36.75 266 58 19.25	Holmes Big Rocks Piney	21814.81 13836.07 18997.24	4.3387514 4.1410129 4.2789905
Coal 1893	38 21 26.581 81 49 30.578	819.6 742.4	82 53 02.06 115 27 06.28 172 43 01.00 248 48 06.07	262 49 19.42 295 18 25.49 352 42 26.19 68 56 45.31	Big Rocks Piney Simms Holmes	8780.07 22517.43 10718.95 21751.59	3.9434978 4.3525186 4.0301522 4.3374909
Rogers 1893	38 22 52.520 81 50 36.684	1619.4 890.3	62 15 04.87 181 45 04.53 328 47 40.02	242 12 03.20 1 45 10.78 148 48 21.05	Big Rocks Simms Coal	8030.73 7986.28 3097.87	3.9047549 3.9023445 3.4910626
Ryan 1892	38 23 45.155 81 47 37.571	1392.3 911.7	32 42 34.01 64 56 22.16 69 32 30.46 147 12 02.90	212 41 23.83 244 51 29.26 249 30 39.23 327 10 17.84	Coal Big Rocks Rogers Simms	5077.50 12647.18 4640.04 7566.99	3.7056499 4.1019936 3.6665218 3.8789231
St. Albans east base 1893	38 22 42.575 81 47 42.231	1312.8 1024.9	94 09 22.60 183 21 16.68	274 07 34.29 3 21 19.57	Rogers Ryan	4245.42 1932.87	3.6279206 3.2862037
St. Albans west base 1893	38 23 21.472 81 50 13.850	662.1 336.1	259 05 17.53 288 02 19.28 31 49 57.90	79 06 54.59 108 03 53.42 211 49 43.72	Ryan St. Albans east base Rogers	3862.22 3870.403 1050.79	3.5868366 3.5877562 3.0215162
Davis 1883	38 21 06.229 82 21 12.312	192.1 298.9	248 11 16.20 208 26 01.30	68 22 16.65 118 36 40.96	Piney Pigeon	27774.43 28552.31	4.4430451 4.4556412
Gebhardt 1883	38 31 45.656 82 15 11.048	1407.8 267.6	298 57 14.47 333 54 43.16 23 59 24.02	119 04 31.38 154 01 39.78 203 55 40.32	Piney Pigeon Davis	19457.13 37114.76 21575.11	4.2890788 4.5695467 4.3339531
Wray 1884	38 35 42.244 82 27 38.907	1302.6 941.6	291 52 47.43 340 49 57.64	112 00 33.64 160 53 58.18	Gebhardt Davis	19520.81 28590.74	4.2904979 4.4562253
Oakland 1884	38 21 46.466 82 38 52.881	1432.7 1283.8	212 18 47.31 241 41 35.15 272 40 01.16	32 25 46.67 61 56 19.22 92 50 59.31	Wray Gebhardt Davis	30512.31 39117.34 25780.11	4.4844751 4.5923693 4.4112848
Fradd 1884	38 35 46.927 82 33 06.031	1447.0 1454.9	271 00 59.69 285 51 33.48 18 00 13.70	91 04 23.75 106 02 43.00 197 56 37.88	Wray Gebhardt Oakland	7917.68 27068.65 27244.57	3.8985980 4.4324686 4.4352709
Buena Vista 1884	38 23 44.026 82 48 21.664	1357.5 525.7	224 47 25.11 284 39 44.46	44 56 55.06 104 45 37.63	Fradd Oakland	31451.43 14273.64	4.4976404 4.1545347
Gould 1885	38 38 27.582 82 49 56.728	850.5 1372.0	281 21 56.10 332 25 05.92 355 09 35.06	101 32 26.91 152 31 59.19 175 10 34.86	Fradd Oakland Buena Vista	24947.67 34808.56 27341.14	4.3970300 4.5418860 4.4368167

GEOGRAPHIC POSITIONS—Continued.

Thirty-ninth parallel—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
<i>Principal points—Continued.</i>							
Howland 1885	38 37 47.115	1452.8	264 43 17.96	84 49 09.90	Gould	13690.61	4.1364228
	82 59 20.415	493.7	328 23 44.36	148 30 34.56	Buena Vista	30504.44	4.4843631
Scioto 1885	38 45 47.719	1471.3	292 56 07.10	113 14 50.55	Fradd	47235.01	4.6742640
	83 03 03.622	87.4	305 26 57.47	125 35 09.49	Gould	23361.24	4.3684959
			339 58 48.81	160 01 08.36	Howland	15770.77	4.1978529
Cave 1885	38 32 39.734	1225.2	217 43 46.95	37 46 56.11	Howland	11988.06	4.0787487
	83 04 23.098	573.9	305 13 32.71	125 23 31.19	Buena Vista	28578.74	4.4560430
Round Top 1885	38 36 35.371	1090.7	219 07 22.42	39 13 21.31	Scioto	21969.63	4.3418228
	83 12 37.795	914.5	263 23 19.14	85 31 36.82	Howland	19416.44	4.2881097
			301 14 09.83	121 19 17.93	Cave	13994.19	4.1459478
Twin Creek 1886	38 42 08.710	268.3	251 18 44.51	71 27 23.87	Scioto	21155.86	4.3254307
	83 16 53.681	1297.1	328 55 54.36	148 58 34.20	Round Top	11997.12	4.0790769
Peach Mount 1886	38 53 43.525	1342.1	298 24 44.26	118 36 28.39	Scioto	30738.01	4.4876884
	83 21 43.441	1040.9	341 54 01.03	161 57 02.59	Twin Creek	22537.43	4.3529044
Cherry Ridge 1886	38 39 38.337	1182.1	201 55 26.06	21 59 58.74	Peach Mount	28101.29	4.4487263
	83 28 58.825	1422.3	255 07 09.25	75 14 42.46	Twin Creek	18130.39	4.2584071
			283 17 23.46	103 27 35.99	Round Top	24380.25	4.3871984
Cave Hill 1886	38 50 58.103	1791.6	255 56 14.99	76 05 08.08	Peach Mount	21102.41	4.3243321
	83 35 52.857	1274.6	334 27 55.00	154 32 14.18	Cherry Ridge	23223.12	4.3659205
Ash Ridge 1887	38 55 13.430	414.1	274 30 47.22	94 45 38.23	Peach Mount	34294.16	4.5352201
	83 45 22.093	532.2	299 48 01.26	119 53 58.59	Cave Hill	15318.55	4.1901666
			320 27 37.25	140 37 53.24	Cherry Ridge	37343.77	4.5722181
Minerva 1887	38 42 31.168	960.8	210 54 46.17	31 00 52.57	Ash Ridge	27411.80	4.4370375
	83 55 06.653	160.7	240 35 41.44	60 47 44.08	Cave Hill	31937.60	4.5043022
			277 52 07.49	98 08 27.44	Cherry Ridge	38267.15	4.5828261
Tate 1887	38 56 26.711	823.7	273 49 44.66	94 03 58.90	Ash Ridge	32822.68	4.5161741
	84 08 01.532	36.9	323 58 19.89	144 06 25.69	Minerva	31831.46	4.5028566
Flaughner 1887	38 43 50.435	1555.1	200 34 17.59	20 38 05.53	Tate	24914.15	4.3964461
	84 14 05.027	121.4	242 58 36.79	63 16 36.98	Ash Ridge	46593.01	4.6683208
			274 58 50.51	95 10 42.58	Minerva	27609.43	4.4410575
Stevens 1887	38 55 25.319	780.8	266 35 02.83	86 49 20.25	Tate	32919.04	4.5174471
	84 30 45.975	1107.4	311 30 01.83	131 40 29.40	Flaughner	32281.71	4.5089565
Dry Ridge 1889	38 40 41.112	1267.7	191 40 59.09	11 43 26.66	Stevens	27844.26	4.4447357
	84 34 40.043	967.9	258 49 26.75	79 02 19.01	Flaughner	30407.69	4.4829835
Tanner 1889	39 00 03.064	94.5	278 17 24.29	98 36 57.12	Tate	45385.76	4.6569196
	84 39 06.362	153.1	305 21 57.76	125 27 12.41	Stevens	14781.63	4.1697223
			349 48 49.21	169 51 36.23	Dry Ridge	36401.30	4.5611109
Stow 1890	38 51 07.065	217.9	241 01 19.70	61 14 21.67	Tanner	34233.46	4.5344508
	84 59 50.905	1227.5	297 45 15.25	118 01 01.25	Dry Ridge	41268.57	4.6156194
Reizin 1889	39 02 53.857	1660.8	276 56 47.50	97 15 14.26	Tanner	42609.07	4.6295020
	85 08 24.085	579.1	330 24 08.94	150 29 31.55	Stow	25054.71	4.3988894
Culbertson 1890	38 49 56.092	1729.7	190 51 41.94	10 53 42.22	Reizin	24422.58	4.3877916
	85 11 35.465	855.4	262 35 57.60	82 43 19.48	Stow	17132.16	4.2338121
			287 32 49.66	107 55 56.50	Dry Ridge	58164.60	4.7494627
Correct 1890	39 00 56.697	1748.4	253 42 58.06	73 48 22.83	Reizin	12919.76	4.1112545
	85 16 59.801	1438.8	338 59 16.56	159 02 40.34	Culbertson	21817.72	4.3388093
Glasgow 1890	39 06 18.567	572.6	294 51 37.97	114 57 34.44	Reizin	14987.66	4.1757338
	85 17 49.592	1191.6	353 07 06.37	173 07 37.75	Correct	9997.56	3.9998939
Green 1890	39 06 09.779	301.6	269 03 45.17	89 11 32.25	Glasgow	17796.00	4.2503224
	85 30 10.134	243.5	296 51 53.32	117 00 11.33	Correct	21314.30	4.3286711
Holton north base 1890	39 04 48.842	1506.3	102 20 14.07	282 24 17.96	Green	11580.75	4.0637368
	85 22 19.580	470.6	246 52 50.83	66 55 41.05	Glasgow	7053.71	3.8484174
			312 55 24.70	132 58 46.15	Correct	10306.18	4.0214449
Holton south base 1890	39 01 50.926	1570.6	124 19 56.39	304 14 49.52	Green	14168.78	4.1513323
	85 22 03.204	77.1	175 53 47.07	355 53 36.75	Holton north base	5300.570	3.7404077
			216 25 54.54	36 28 34.38	Glasgow	10261.14	4.0111953
			282 52 41.90	102 55 52.93	Correct	7487.66	3.8743460
Mud Lick 1890	38 50 52.126	1007.3	204 10 08.48	24 13 47.06	Correct	20439.04	4.3104605
	85 22 47.639	1148.8	276 01 31.05	96 08 32.60	Culbertson	16303.03	4.2122682
Stout 1890	38 51 12.501	385.5	193 17 18.47	13 20 09.56	Green	28433.30	4.4538273
	85 34 42.121	1015.8	234 45 33.44	54 56 41.04	Correct	31262.23	4.4954365
			272 01 34.23	92 09 02.42	Mud Lick	17240.48	4.2365493
Tripp 1890	38 59 58.155	1793.3	226 45 04.30	46 50 23.99	Green	16739.45	4.2237412
	85 38 37.560	903.8	340 41 43.98	160 44 11.01	Stout	17172.92	4.2348441
Miller 1889	38 50 36.473	1124.7	242 52 48.97	63 07 35.62	Tripp	38155.71	4.5815595
	86 02 08.848	213.3	268 15 14.43	88 32 27.36	Stout	39725.89	4.5990736

## GEOGRAPHIC POSITIONS—Continued.

Thirty-ninth parallel—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
<i>Principal points—Continued.</i>							
Weed Patch 1889	39 10 00.634	19.6	278 21 07.30	96 48 09.77	Green	Meters 62149.90	4.7934405
	86 13 00.771	18.5	290 21 27.79	110 43 08.55	Tripp	52955.87	4.7239141
			336 20 23.14	156 27 13.46	Müller	39176.81	4.5936291
Fountain 1887	38 56 36.824	1135.5	187 31 54.46	7 33 20.48	Weed Patch	25003.76	4.3980053
	86 15 17.290	416.4	300 15 02.24	120 23 17.28	Müller	22011.76	4.3426545
Rariden 1887	38 45 27.798	857.1	227 19 34.73	47 29 18.50	Fountain	30482.80	4.4840548
	86 30 47.909	1156.8	256 55 39.08	77 13 36.28	Miller	42560.43	4.6290060
Leonard 1887	39 06 28.225	870.4	258 49 32.83	79 04 14.18	Weed Patch	34169.73	4.5336416
	86 36 17.122	411.5	300 55 43.03	121 08 56.31	Fountain	35369.24	4.5486257
			348 26 25.03	168 29 51.91	Rariden	39667.94	4.5984396
Beard 1887	38 58 03.862	119.1	182 17 42.01	2 17 58.35	Leonard	15585.63	4.1921666
	86 36 43.065	1036.9	236 59 44.67	57 14 41.06	Weed Patch	40714.99	4.6067543
			274 50 32.87	85 04 01.26	Fountain	31075.66	4.4924204
			339 48 06.76	159 51 49.61	Rariden	24836.93	4.3950978
Calvary 1886	39 04 42.133	1299.3	259 43 22.62	79 51 19.21	Leonard	18455.40	4.2661235
	86 48 52.913	1271.9	304 54 35.17	125 02 14.71	Beard	21426.23	4.3309457
Osborn 1886	38 51 23.456	723.3	192 16 16.78	12 18 36.95	Calvary	25206.38	4.4015105
	86 52 35.794	863.1	241 38 27.97	61 48 26.41	Beard	26064.40	4.4160477
			289 02 58.99	109 16 38.67	Rariden	33408.89	4.5238621
Sisson 1885	38 58 11.846	365.3	253 25 33.12	73 43 21.71	Calvary	42561.74	4.6290193
	87 17 10.030	241.4	289 23 36.74	109 39 02.77	Osborn	37684.97	4.5761682
Wright 1886	39 07 13.640	420.6	277 57 37.40	98 12 01.11	Calvary	33238.72	4.5216442
	87 11 42.410	1018.7	25 16 32.45	205 13 06.07	Sisson	18471.95	4.2665127
Summit 1884	38 45 42.538	1311.7	197 37 21.29	17 40 32.63	Sisson	24247.15	4.3846606
	87 22 14.956	361.1	256 05 05.47	76 23 40.53	Osborn	41196.05	4.6453835
Merom College 1885	39 03 02.714	83.7	256 16 54.24	76 30 53.16	Wright	32903.23	4.5172386
	87 33 53.017	1274.8	290 18 06.40	110 28 37.74	Sisson	25744.85	4.4106903
			332 16 01.76	152 23 20.18	Summit	36217.90	4.5589233
Honey Creek 1884	38 55 28.776	887.3	221 57 30.82	42 03 00.35	Merom College	18837.48	4.2750220
	87 42 36.781	886.0	301 25 20.68	121 38 07.00	Summit	34569.36	4.5386913
Belle Air 1879	39 10 38.159	1115.1	297 52 55.69	118 04 26.90	Merom College	29806.31	4.4743082
	87 52 08.658	207.8	333 46 40.11	153 52 40.41	Honey Creek	31177.79	4.4938454
Hunt City 1879	39 03 58.583	1806.7	225 55 14.02	46 00 47.10	Belle Air	17638.84	4.2464700
	88 00 56.552	1359.6	300 36 51.41	120 48 23.45	Honey Creek	30783.08	4.4883121
Claremont 1879	38 45 28.551	880.4	176 57 28.28	356 56 40.75	Hunt City	34278.07	4.5350164
	87 59 40.884	987.1	233 03 48.88	53 14 31.16	Honey Creek	30863.04	4.4894513
			269 20 56.50	89 44 22.59	Summit	54228.69	4.7342291
Oblong 1879	38 59 54.394	1677.2	21 17 59.43	201 13 28.90	Claremont	28649.61	4.4571187
	87 52 29.872	718.8	121 45 19.86	301 40 00.78	Hunt City	14325.65	4.1561143
			181 28 25.92	1 28 39.29	Belle Air	19797.00	4.2985993
Buffalo Mound 1879	38 54 08.186	252.5	190 58 40.98	11 00 22.42	Hunt City	18546.39	4.2682505
	88 03 23.494	566.2	235 47 58.99	55 54 29.88	Oblong	19018.54	4.2791772
			341 27 15.54	161 29 35.12	Claremont	16809.25	4.2276975
Newton 1883	38 55 28.587	881.5	219 11 40.01	39 17 15.89	Hunt City	20305.89	4.3076221
	88 09 50.322	1212.2	321 29 04.59	141 35 26.81	Claremont	23630.13	4.3734661
Denver 1879	38 46 17.966	554.0	193 49 15.17	13 51 03.94	Newton	17486.49	4.2427027
	88 12 43.732	1055.7	222 55 55.36	43 01 46.69	Buffalo Mound	19819.76	4.2970984
			274 32 27.76	94 40 37.92	Claremont	18961.62	4.2778753
Onion Hill 1879	38 48 57.527	1773.8	226 48 44.68	46 53 10.58	Buffalo Mound	14006.85	4.1463405
	88 10 27.315	659.0	292 23 07.61	112 29 52.64	Claremont	16890.30	4.2273802
			33 47 56.33	213 46 30.85	Denver	5920.07	3.7723270
Olney west base 1879	38 51 38.566	1189.2	44 00 29.44	223 56 21.63	Denver	13737.21	4.1378986
	88 06 08.380	202.1	51 31 54.71	231 29 12.33	Onion Hill	7978.74	3.9019341
			220 43 40.98	40 45 24.48	Buffalo Mound	6039.47	3.7845792
			320 38 03.05	140 42 05.91	Claremont	14751.15	4.1688260
Olney check base 1879	38 48 20.534	633.2	95 20 38.86	275 15 19.44	Onion Hill	12350.09	4.0916702
	88 01 57.634	1390.8	135 17 53.51	315 15 16.28	Olney west base	8594.68	3.9342297
			169 04 36.90	349 03 43.05	Buffalo Mound	10918.37	4.0381580
			328 05 22.46	148 06 48.13	Claremont	6246.53	3.7956385
Olney east base 1879	38 51 44.093	1359.6	340 30 09.94	166 37 21.54	Claremont	11903.63	4.0756794
	88 01 35.112	846.6	4 56 52.82	184 56 33.70	Olney check base	6300.43	3.7993701
			68 14 14.26	248 08 40.61	Onion Hill	13825.11	4.1406685
			88 32 33.31	268 29 41.85	Olney west base	6590.760	3.8189368
			149 33 25.14	329 32 17.11	Buffalo Mound	5154.37	3.7121755
Olney middle base 1879	38 51 41.348	1274.9	88 31 10.50	268 29 44.85	Olney west base	3292.30	3.5174993
	88 03 51.876	1250.7	188 35 20.54	8 35 38.36	Buffalo Mound	4579.34	3.6608027
			268 31 04.50	68 32 30.31	Olney east base	3298.48	3.5183130

GEOGRAPHIC POSITIONS—Continued.

Thirty-ninth parallel—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
<i>Principal points—Continued.</i>							
Island Creek 1883	39 06 10.729	330.9	278 17 10.28	98 20 24.10	Hunt City	<i>Meters</i> 27930.46	4.4460780
	88 20 06.201	149.0	323 08 21.38	143 14 49.08	Newton	24731.82	4.3932561
			343 48 11.52	163 52 49.59	Denver	38293.58	4.5831260
Lucas 1883	38 56 14.702	453.3	204 28 32.28	24 32 11.56	Island Creek	20199.38	4.3053380
	88 25 54.482	1312.2	273 25 11.15	93 35 17.01	Newton	23267.07	4.3667417
			313 54 45.95	134 03 02.02	Denver	26498.20	4.4232163
Parkersburg 1879	38 34 51.518	1558.5	143 16 15.64	323 09 26.49	Denver	26429.43	4.4220878
	88 01 49.004	1186.1	188 56 53.53	8 58 18.58	Claremont	19885.80	4.2985430
Holtzhausen 1883	38 48 01.888	58.2	236 10 38.15	56 20 30.38	Lucas	27359.86	4.4371139
	88 41 38.218	922.2	274 13 35.10	94 31 41.01	Denver	41985.58	4.6231002
Mound 1883	39 04 05.433	167.0	264 03 07.41	84 19 43.59	Island Creek	38171.25	4.5817363
	88 46 26.231	630.6	295 59 09.29	116 12 04.51	Lucas	33002.76	4.5185503
			346 50 00.12	160 53 01.12	Holtzhausen	30511.56	4.4844644
Sturgess 1883	38 56 57.121	1761.3	244 52 53.50	65 05 13.95	Mound	31234.14	4.4946295
	89 06 02.602	62.7	294 55 50.59	115 11 09.67	Holtzhausen	38967.96	4.5907077
Hartlin 1882	38 42 28.166	868.5	150 52 17.47	330 45 48.49	Sturgess	30690.69	4.4870066
	88 55 42.219	1020.1	198 28 16.31	18 34 05.35	Mound	42187.73	4.6251861
			243 08 08.07	63 16 56.40	Holtzhausen	22830.40	4.3585135
Bording 1882	38 36 45.305	1397.0	209 03 46.13	29 12 46.66	Sturgess	42781.24	4.6312533
	89 20 25.603	619.4	253 26 50.20	73 42 16.87	Hartlin	37391.21	4.5727695
Holle 1882	38 53 43.065	1327.9	257 21 12.28	77 32 53.39	Sturgess	27540.83	4.4399770
	89 24 38.546	928.9	260 15 44.84	116 33 52.87	Hartlin	46782.30	4.6700816
			348 57 53.77	169 00 32.11	Bording	31972.12	4.5047714
Geoffrey 1881	38 32 58.184	1794.1	184 53 41.94	4 55 07.27	Holle	38527.75	4.5857737
	89 26 54.964	1330.9	233 21 01.30	53 25 04.11	Bording	11741.59	4.0697269
Parkinson 1881	38 43 26.882	828.9	233 57 06.20	54 08 26.07	Holle	32361.61	4.5100301
	89 42 44.281	1069.6	290 49 17.46	111 03 13.88	Bording	34051.14	4.5397175
			310 05 34.73	130 15 27.47	Geoffrey	30049.72	4.4778404
Berger 1881	38 36 40.158	1238.2	197 43 06.34	17 44 49.90	Parkinson	13167.04	4.1104880
	89 45 30.167	729.9	284 07 53.67	104 19 29.12	Geoffrey	27847.72	4.4447896
Turkey Hill 1880	38 28 32.971	1016.6	211 12 30.96	31 19 42.49	Parkinson	32247.81	4.5085002
	89 54 15.988	387.6	220 14 30.21	40 19 57.85	Berger	10693.19	4.2043160
			258 14 07.23	78 31 09.08	Geoffrey	40590.48	4.6084242
Clarks Mound 1871	38 34 45.727	1410.0	262 30 05.12	82 41 45.31	Berger	27391.01	4.4376081
	90 04 12.598	304.9	308 26 41.12	128 32 52.74	Turkey Hill	18464.86	4.2663450
Sugar Loaf Mound 1871	38 42 05.290	163.1	264 18 50.57	84 29 55.54	Parkinson	25811.64	4.4118157
	90 00 27.536	665.4	294 43 17.11	114 52 37.05	Berger	23902.10	4.3784360
			21 53 56.89	201 51 36.35	Clarks Mound	14606.10	4.1645343
Insane Asylum 1871	38 36 13.965	430.6	245 16 07.65	65 26 17.54	Sugar Loaf Mound	25977.70	4.4146007
	90 16 43.980	1064.2	278 26 40.35	98 34 29.04	Clarks Mound	18386.76	4.2645053
American Bottom upper base 1872	38 39 50.135	1545.9	20 44 34.01	206 42 32.07	Clarks Mound	10509.11	4.0215661
	90 00 57.230	1383.6	73 51 09.13	253 41 18.04	Insane Asylum	23849.45	4.3774783
American Bottom lower base 1872	38 36 15.956	492.0	89 53 39.06	269 45 06.56	Insane Asylum	19875.51	4.2983183
	90 03 02.580	62.4	199 10 35.71	119 12 12.56	Sugar Loaf Mound	11405.57	4.0571172
			204 38 51.94	24 40 10.20	American Bottom upper base	7266.884	3.8613482
Dreyer 1871	38 30 06.300	194.3	148 16 50.19	328 13 49.66	Insane Asylum	13331.10	4.1248661
	90 11 54.318	1316.2	232 20 42.66	52 25 30.34	Clarks Mound	14116.49	4.1407267
			276 18 36.07	96 29 34.73	Turkey Hill	25810.27	4.4117925
Minoma 1872	38 41 57.617	1776.6	260 20 27.41	89 30 38.32	Sugar Loaf Mound	23612.03	4.3731333
	90 16 44.019	1078.3	279 39 30.15	99 49 22.25	American Bottom upper base	23234.24	4.3661285
			297 51 08.07	117 59 41.50	American Bottom lower base	22496.04	4.3521235
			306 08 49.05	126 16 38.62	Clarks Mound	22542.10	4.3529044
Kleinschmidt 1871	38 30 10.817	611.0	230 09 29.05	20 11 12.31	Insane Asylum	11633.63	4.0657152
	90 19 29.663	718.7	219 39 27.09	69 48 58.53	Clarks Mound	23674.40	4.3742789
			272 07 26.56	92 12 10.04	Dreyer	11041.21	4.0430167
Morgan 1871	38 40 20.741	639.5	253 48 14.31	73 52 40.65	Minoma	10733.62	4.0307463
	90 23 51.171	1237.1	306 20 03.83	126 24 30.57	Insane Asylum	12831.60	4.1082807
			341 07 08.00	161 09 51.11	Kleinschmidt	19580.45	4.2918227
Patterson 1873	38 27 52.652	1623.5	207 08 32.46	27 13 37.50	Morgan	23931.53	4.4138282
	90 32 00.538	13.0	235 04 15.02	55 13 46.02	Insane Asylum	27051.02	4.4321837
			255 56 03.96	76 03 51.24	Kleinschmidt	18756.10	4.2731426
Kessler 1871	38 36 33.996	1048.2	244 45 36.95	64 52 00.82	Morgan	16429.20	4.2150164
	90 34 05.910	143.0	271 18 47.47	91 29 37.60	Insane Asylum	25218.26	4.4017151
		349 17 34.09	169 18 52.20	Patterson	16359.66	4.2137744	

## GEOGRAPHIC POSITIONS—Continued.

## Thirty-ninth parallel—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
<i>Principal points—Continued.</i>							
	° ' "		° ' "	° ' "		<i>Meters</i>	
Tavern Rock 1873	38 36 19.119 90 45 09.458	589.5 228.8	256 20 23.17 268 18 20.98 309 11 26.08	76 33 41.34 88 25 15.00 129 19 37.57	Morgan Kessler Patterson	31800.88 16061.73 24677.67	4.5024301 4.2057922 4.3923042
Lynch 1873	38 24 27.713 00 44 00.615	854.5 14.9	175 39 26.66 224 28 28.47 250 02 46.29	355 38 43.80 70 10 13.92	Tavern Rock Patterson	21999.09 18572.29	4.3424046 4.2688656
Halleck 1873	38 28 07.655 90 55 24.924	236.0 604.2	224 28 28.47 292 10 02.03	44 34 51.91 112 17 07.44	Tavern Rock Lynch	21256.58 17928.42	4.3274933 4.2535419
Dieckhaus 1873	38 35 16.610 90 56 40.055	512.2 969.4	263 21 40.00 317 19 37.21 352 09 33.47	83 28 50.82 137 27 29.95 172 10 20.29	Tavern Rock Lynch Halleck	16822.01 27184.75 13351.18	4.2250012 4.4343253 4.1255197
Peters 1874	38 27 46.555 91 03 46.186	1435.5 1119.7	216 36 22.64 239 36 16.57 266 53 31.25 281 56 02.87	36 40 48.06 59 47 52.27 86 58 45.07 102 08 19.86	Dieckhaus Tavern Rock Halleck Lynch	17205.30 31326.74 12160.68 29400.71	4.2379280 4.4959152 4.0852791 4.4683578
Enoch Knob 1874	38 34 43.772 91 08 10.082	1349.7 244.0	266 28 14.84 303 19 02.12 333 33 10.36	86 35 25.18 123 26 58.71 153 35 64.71	Dieckhaus Halleck Peters	16732.05 22197.60 14365.50	4.2235491 4.3463060 4.1573208
Berger 1874	38 35 58.120 91 17 27.984	1792.1 677.1	272 19 07.44 279 35 16.09 307 13 01.11	92 32 05.89 99 41 04.06 127 21 33.04	Dieckhaus Enoch Knob Peters	30227.62 13695.62 25019.10	4.4804039 4.1365818 4.3982716
Jacobs 1874	38 26 18.167 91 16 10.071	560.2 244.2	173 58 53.23 216 40 49.16 261 20 38.03	353 58 04.71 36 45 48.01 81 28 20.61	Berger Enoch Knob Peters	17981.88 19449.89 18242.79	4.2548351 4.2889171 4.2610912
Winter 1874	38 27 41.358 91 26 02.931	1275.2 71.1	219 06 40.55 280 03 56.18	39 12 01.33 100 10 04.84	Berger Jacobs	19753.39 14603.17	4.2950416 4.1644471
Gasconade 1874	38 35 33.323 91 28 03.935	1027.6 95.2	267 06 02.00 314 38 38.45 348 36 07.35	87 12 38.72 134 46 02.98 168 37 22.72	Berger Jacobs Winter	15408.81 24333.65 14845.02	4.1877693 4.3862072 4.1715807
Turnpike Bluff 1878	38 35 29.074 91 34 42.054	896.5 1017.7	269 11 11.27 318 52 08.22	89 15 19.59 138 57 31.55	Gasconade Winter	9635.82 19134.05	3.9838889 4.2818069
Geyer 1878	38 26 57.017 91 35 48.869	1758.1 1185.1	185 50 50.81 215 14 17.89 264 27 08.96	5 51 32.42 35 19 07.45 84 33 13.36	Turnpike Bluff Gasconade Winter	15871.74 19501.34 14272.82	4.2006245 4.2900644 4.1545098
Bradford 1879	38 33 57.210 91 46 42.138	1764.0 1020.2	260 42 25.26 263 39 16.24 291 00 00.10 309 14 44.86	80 49 54.30 83 50 53.55 111 12 51.75 129 21 31.60	Turnpike Bluff Gasconade Winter Geyer	17658.68 27228.27 32181.81 20454.89	4.2469583 4.4350200 4.5076104 4.3107972
Pilot Knob 1879	38 20 11.236 91 47 55.525	346.4 1348.6	183 59 26.15 214 08 12.12 234 34 52.43	4 00 11.79 34 16 25.69 54 42 23.72	Bradford Turnpike Bluff Geyer	25530.25 34219.73 4.3348973	4.4070550 4.5342766 4.3348973
McDaniel 1879	38 27 35.671 91 53 15.588	1099.9 377.4	218 58 52.00 330 25 52.49	39 02 56.98 150 29 11.28	Bradford Pilot Knob	15141.35 15751.26	4.1801645 4.1973153
Kennedy 1879	38 20 59.524 92 05 44.190	1835.4 1073.3	236 00 58.94 273 11 29.08	58 08 43.98 93 22 32.05	McDaniel Pilot Knob	21889.40 25994.53	4.3402338 4.4148810
Cedar 1879	38 36 03.897 92 08 39.616	120.2 958.7	276 52 11.77 304 55 04.80 351 18 52.18	97 05 53.44 125 04 40.42 171 20 41.33	Bradford McDaniel Kennedy	32126.51 27322.72 28208.01	4.5068636 4.4365240 4.4503725
Belshe 1879	38 22 30.363 92 24 18.292	936.2 444.0	222 07 27.26 275 48 57.70	42 17 11.45 96 00 29.15	Cedar Kennedy	33864.30 27192.71	4.5207421 4.4344525
Moreau 1879	38 31 36.904 92 25 27.361	1137.9 662.8	251 16 00.52 304 18 17.38 354 19 06.48	71 26 28.74 124 30 32.94 174 19 49.43	Cedar Kennedy Belshe	25749.52 34779.83 16035.12	4.4107692 4.5413275 4.2287882
Medlock 1879	38 38 13.256 92 20 13.462	408.7 325.6	283 18 26.24 11 33 12.94 31 53 43.27	103 25 39.29 191 30 40.51 211 50 27.51	Cedar Belshe Moreau	17252.96 29672.56 14390.59	4.2368036 4.4723551 4.1580786
Christian 1879	38 37 38.403 92 32 50.462	1184.1 1220.7	266 34 30.96 316 03 51.45 336 03 00.28	86 42 23.57 136 08 27.75 156 08 19.12	Medlock Moreau Belshe	18341.50 15469.03 30626.10	4.2634349 4.1894630 4.4860917
High Point 1880	38 29 29.396 92 34 59.741	906.4 1447.8	191 42 58.64 254 07 20.90 309 39 12.60	11 44 19.23 74 13 17.29 129 45 51.33	Christian Moreau Belshe	15399.80 14414.65 20223.41	4.1875152 4.1589042 4.3058543
Hunter 1880	38 25 45.210 92 46 24.373	1394.0 591.2	221 48 21.41 247 19 54.51 280 27 42.16	41 56 48.40 67 27 00.33 100 41 25.89	Christian High Point Belshe	29534.37 17980.88 32732.98	4.4703277 4.2548110 4.5149850
Cole 1880	38 38 06.770 92 43 39.538	208.8 956.3	273 07 57.44 321 41 12.08 9 55 07.28	83 14 42.66 141 46 36.10 189 53 24.58	Christian High Point Hunter	15724.12 20319.26 23211.58	4.1965664 4.3079078 4.3657048

GEOGRAPHIC POSITIONS—Continued.

Thirty-ninth parallel—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
<i>Principal points—Continued.</i>							
Versailles north base 1880	38 29 34.790	1072.7	203 29 41.99	23 32 38.92	Cole	17217.07	4.2359593
	92 48 23.327	565.3	236 29 07.89	56 38 49.38	Christian	27064.93	4.4324069
			270 25 11.24	90 33 31.40	High Point	19475.24	4.2894828
			290 21 02.32	110 36 00.58	Bolsho	37411.46	4.5730046
			337 49 23.03	157 50 37.02	Hunter	7643.852	3.8833123
Hubbard 1880	38 40 28.145	867.8	280 41 08.94	100 52 58.67	Christian	27972.26	4.4467275
	92 51 40.805	1131.4	290 15 42.80	110 20 47.18	Cole	12562.69	4.0990827
			309 43 04.80	129 53 32.85	High Point	31729.06	4.5014572
			346 14 42.79	166 16 49.69	Versailles north base	20739.29	4.3167939
Hughes 1880	38 25 56.501	1742.2	192 26 23.24	12 28 56.11	Hubbard	27525.23	4.4397310
	92 55 52.086	1263.3	218 10 23.32	38 17 59.70	Cole	28007.82	4.4573946
			236 59 20.72	57 13 41.37	Christian	39854.17	4.6004737
			238 13 06.61	58 17 45.74	Versailles north base	12793.58	4.1069919
			271 23 57.04	91 29 40.91	Hunter	13774.33	4.1390705
Schnackenberg 1882	38 29 51.828	1598.1	235 25 37.06	55 37 53.53	Hubbard	34666.37	4.5390083
	03 11 27.625	669.4	287 39 35.04	107 49 16.98	Hughes	23813.29	4.3768194
Heard 1880	38 42 56.400	1739.0	278 34 10.24	98 47 05.16	Hubbard	30301.50	4.4814642
	93 12 26.321	635.9	322 29 12.53	142 39 32.47	Hughes	39601.01	4.5977031
			356 38 06.90	176 38 43.52	Schnackenberg	24233.87	4.3844228
Kendrick 1882	38 39 38.948	1200.9	252 42 52.63	72 51 20.86	Heard	20572.36	4.3132840
	93 25 59.385	1435.8	310 33 08.03	130 42 11.66	Schnackenberg	27803.00	4.4440917
High Point Tobo 1882	38 34 34.278	1057.0	232 09 58.69	52 15 11.26	Kendrick	15331.10	4.1855733
	93 34 20.189	488.7	284 33 43.35	104 47 58.48	Schnackenberg	34364.78	4.5301135
Knob Noster 1882	38 46 35.456	1093.3	282 35 45.69	102 48 42.25	Heard	30715.57	4.4873586
	93 33 07.090	171.1	321 08 43.31	141 13 10.84	Kendrick	16483.73	4.2170555
			4 32 58.41	184 32 12.73	High Point Tobo	22307.84	4.3484575
Normal 1883	38 45 32.997	1017.4	263 08 42.12	83 15 41.25	Knob Noster	16273.83	4.2114898
	93 44 16.442	397.0	324 35 08.84	144 41 21.38	High Point Tobo	24906.91	4.3963198
Caldwell 1882	38 34 05.336	164.5	184 17 51.90	4 18 33.13	Normal	21204.12	4.3276475
	93 45 22.440	543.3	217 28 47.79	37 36 27.28	Knob Noster	29171.98	4.4649659
			266 45 23.66	86 52 16.57	High Point Tobo	16056.41	4.2056485
Baker 1883	38 45 37.030	1141.8	270 08 33.28	90 21 02.45	Normal	28892.94	4.4607917
	94 04 13.090	316.0	307 51 53.81	128 03 40.19	Caldwell	34671.82	4.5399766
Hutton Mound 1883	38 32 51.375	1584.1	202 05 37.22	22 09 45.21	Baker	25486.34	4.4063074
	94 10 50.114	1213.6	266 20 22.62	86 36 14.82	Caldwell	37059.07	4.5688945
Chapel Hill 1883	38 54 47.232	1456.4	301 29 31.35	121 41 33.85	Normal	32623.27	4.5135275
	94 03 28.583	688.6	3 37 26.88	183 36 58.97	Baker	17000.05	4.2304502
Thornton 1883	38 50 05.360	165.3	241 57 17.53	62 04 23.38	Chapel Hill	18522.78	4.2677062
	94 14 47.115	1136.4	298 20 55.73	118 27 32.99	Baker	17394.24	4.2404055
			349 47 41.95	169 50 10.10	Hutton Mound	32393.71	4.5104607
Fulton 1883	38 38 43.589	1344.0	104 36 38.04	14 39 00.24	Thornton	21727.32	4.3370063
	94 18 34.346	830.6	238 26 03.29	58 35 01.82	Baker	24405.63	4.3874900
			313 59 26.65	134 04 16.25	Hutton Mound	15625.53	4.1938346
Bowler 1884	38 53 16.076	495.7	204 23 32.05	84 36 12.51	Chapel Hill	29316.26	4.4671085
	94 23 39.564	953.6	294 33 59.38	114 39 33.46	Thornton	14120.50	4.1498502
			344 39 22.96	104 42 34.07	Fulton	27894.67	4.4455213
Berry 1884	38 49 13.996	431.6	242 25 32.30	62 31 45.02	Bowler	16154.20	4.2082854
	94 33 33.088	812.7	311 44 47.07	131 54 10.38	Fulton	20150.23	4.4046420
Marty 1884	38 59 22.786	702.6	295 09 51.59	115 20 17.24	Bowler	26508.27	4.4233814
	94 40 15.041	362.0	332 42 35.51	152 40 47.57	Berry	21117.51	4.3246428
Haskin 1885	38 44 23.610	728.0	182 23 56.07	2 34 28.46	Marty	27755.18	4.4433441
	94 41 06.663	160.9	230 38 40.88	50 43 24.59	Berry	14132.49	4.1502186
			287 40 09.79	107 54 15.18	Fulton	34322.37	4.5355773
<i>Supplementary points.</i>							
Cold Knob <sup>1</sup> 1880	38 03 58.98	1818.5	32 48	212 39	Keeney	38635	4.58698
	80 28 03.92	95.6	112 59	292 54	Beech	13099	4.11725
			231 16	51 21	Briery	13841	4.14118
Grassy Knob <sup>1</sup> 1880	38 03 55.81	1720.7	29 34	209 26	Keeney	37231	4.57090
	80 20 48.48	1181.7	71 53	250 10	Ivy	92709	4.96712
			236 43	56 49	Briery	15963	4.20312
Jobs Knob <sup>1</sup> 1880	38 04 46.049	1438.3	69 03 45.04	248 28 45.27	Ivy	89483.3	4.9517419
	80 32 32.756	798.3	123 25 42.54	303 23 22.98	Beech	6602.8	3.8197268
			247 27 16.28	67 34 35.91	Briery	19780.0	4.2736967
Big Clear Creek Mountain <sup>1</sup> 1880	37 57 52.07	1805.4	23 22	203 18	Keeney	23074	4.36313
	80 36 05.27	128.6	228 24	48 33	Briery	30115	4.47879
Big Sewall Mountain <sup>1</sup> 1880	37 54 30.54	941.6	74 52	254 31	Ivy	50769	4.70560
	80 56 05.52	134.8	306 28	126 37	Keeney	25148	4.40051

<sup>1</sup> Checked by vertical angles only.

GEOGRAPHIC POSITIONS—Continued.

Thirty-ninth parallel—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
<i>Supplementary points—Contd.</i>							
Townsend Mountain <sup>1</sup> 1880	37 56 30.01	925.2	45 18	225 11	Ivy Summersville Keeney	<i>Meters</i> 24273 53164 55173	4.38513 4.72562 4.74173
	81 17 43.19	1054.6	224 35 289 35	44 51 109 57			
Paint Creek, east tree 1880	37 56 51.054	1574.0	42 15 51.64	222 09 07.57	Ivy Table Rock Summersville Beech Keeney	23948.9 37928.1 53522.1 64386.3 56470.5	4.3792862 4.5789811 4.7285329 4.8087936 4.7518220
	81 18 30.116	735.3	134 56 18.68 225 56 10.11 253 16 19.98 289 48 24.16	314 44 58.43 46 12 26.80 73 42 19.37 110 10 36.56			
Coal River Mountain, long flat <sup>1</sup> 1880	37 53 15.47	477.0	25 56	205 54	Ivy Table Rock Keeney	12332 37127 65040	4.09105 4.56969 4.81318
	81 25 47.96	1172.0	154 08 281 00	334 02 101 27			
Coal River Mountain <sup>1</sup> 1881	37 53 39.84	1228.3	27 51	207 48	Ivy Table Rock	13393 36843.	4.12687 4.56635
	81 25 12.70	310.3	152 26	332 19			
Creed 1881	38 24 16.751	516.5	11 20 20.9	191 18 18.3	Table Rock Holmes	24471.2 3878.1	4.388856 3.586024
	81 33 35.629	864.5	131 58 00.3	311 56 46.4			
Elk 1881	38 22 20.653	636.8	187 54 06.4	17 54 57.5	Holmes Creed	6486.9 6052.3	3.812034 3.781921
	81 36 56.713	1376.7	233 43 17.1	53 45 22.0			
Martin 1881	38 21 25.278	779.4	187 40 20.8	7 40 48.0	Holmes Creed Elk	7951.2 6598.3 1945.8	3.900434 3.819435 3.289101
	81 36 18.273	443.7	216 43 58.0 151 20 38.0	36 45 39.0 331 20 14.1			
Ferguson 1881	38 20 37.875	1167.8	210 58 23.4	30 59 15.0	Elk Martin	3696.4 3190.8	3.567774 3.503893
	81 38 15.080	366.2	242 43 36.5	62 44 49.0			
Fort Scammon 1881	38 21 06.240	192.4	236 02 20.4	56 03 47.5	Elk Martin Ferguson	4108.6 4381.4 1741.5	3.613691 3.641615 3.240913
	81 39 17.096	415.1	262 17 05.7 300 08 29.0	82 18 56.7 120 09 07.5			
Charleston astronomic <sup>2</sup> 1881	38 21 02.287	70.5	27 08 14.0	207 08 04.1	Ferguson Fort Scammon	845.8 1895.5	2.927268 3.277726
	81 37 59.193	1437.3	93 41 36.6	273 40 48.2			
Charleston Catholic Church 1881	38 20 49.640	1530.6	45 05 02.9	225 04 53.6	Ferguson Fort Scammon Elk	513.8 1938.5 3200.5	2.710774 3.287458 3.505221
	81 38 00.098	2.4	105 18 58.0 208 44 03.0	285 18 10.2 28 44 42.3			
Second Presbyterian Church <sup>2</sup> 1881	38 20 55.812	1720.9	18 35 21.2	198 35 16.5	Ferguson Fort Scammon	583.5 1722.1	2.766040 3.236006
	81 38 07.420	180.2	100 45 59.3	280 45 16.1			
Colored Baptist Church 1881	38 20 59.437	1832.6	40 32 32.6	220 32 18.1	Ferguson Fort Scammon Elk	874.8 2085.0 2837.4	2.941928 3.319111 3.452921
	81 37 51.663	1254.5	95 46 52.0 208 02 29.4	275 45 59.0 28 03 03.5			
South Methodist Church 1881	38 21 00.949	29.3	36 12 34.2	216 12 20.9	Ferguson Fort Scammon Elk	881.7 203.3.2 2819.5	2.945328 3.308182 3.450166
	81 37 53.631	1302.3	94 36 34.7 209 20 37.1	274 35 42.9 29 21 12.4			
Old Capitol, top of belfry 1881	38 21 02.213	68.2	29 55 52.7	209 55 41.7	Ferguson Fort Scammon Elk	865.9 1941.8 2830.7	2.937463 3.288208 3.451886
	81 37 57.289	1391.1	93 40 23.8 211 17 49.0	273 39 34.3 31 18 26.6			
Courthouse spire <sup>2</sup> 1881	38 21 03.198	98.0	93 56 56.8	273 56 22.1	Fort Scammon Elk	1363.5 3146.2	3.134650 3.497789
	81 38 21.075	511.7	220 36 33.6	40 37 26.0			
North Methodist Church spire 1881	38 21 11.442	352.8	11 08 58.9	191 08 53.7	Ferguson Fort Scammon Elk	1054.9 1717.3 2727.5	3.023211 3.234842 3.435772
	81 38 06.680	162.2	84 38 47.4 218 30 46.1	264 38 03.7 38 31 29.5			
First Baptist Church spire 1881	38 21 12.298	379.2	23 50 27.1	203 50 15.1	Ferguson Fort Scammon Elk	1160.4 1983.6 2549.1	3.064596 3.297451 3.406379
	81 37 55.766	1354.1	84 36 13.7 214 13 09.4	264 35 23.2 34 13 46.0			
Ironton, Kelly's house, cupola <sup>2</sup> 1885	38 31 59.67	1839.9	235 39 56	55 44 20	Fradd Oakland	12435.5 19000.8	4.094663 4.278771
	82 40 10.36	250.9	354 19 06	174 19 54			
Springville 1885	38 43 22.216	685.1	55 27 42.82	235 19 52.92	Round Top Scioto Gould	22090.8 6212.5 17297.1	4.3442118 3.7932694 4.2379744
	83 00 05.688	137.4	136 15 04.19 301 37 53.59	316 13 12.83 121 44 14.17			
Portsmouth North meridian 1885	38 44 38.845	1197.8	40 47 18.42	220 46 25.62	Springville Scioto	3120.4 6680.7	3.4942173 3.8248232
	82 38 41.303	997.4	108 33 31.80	288 30 47.50			
Scioto County court- house <sup>2</sup> 1885	38 44 06.18	190.6	4 01 28.2	184 01 25.7	Springville Scioto	1358.8 5394.0	3.133157 3.731911
	83 00 01.74	42.0	125 30 04.2	305 28 10.4			
Sixth Street Methodist Church spire <sup>2</sup> 1885	38 44 05.65	174.2	18 43 41.2	198 43 29.4	Springville Scioto	1414.0 5698.7	3.150443 3.755778
	82 59 46.89	1132.5	123 32 36.3	303 30 33.2			
German Catholic Church west gable of tower <sup>2</sup> 1885	38 44 03.50	109.8	355 31 16.0	175 31 18.6	Springville Scioto	1278.7 5285.0	3.106771 3.723041
	83 00 09.82	237.2	127 26 26.9	307 24 38.1			

<sup>1</sup> Checked by vertical angles only.

<sup>2</sup> No check on this position.

GEOGRAPHIC POSITIONS—Continued.

Thirty-ninth parallel—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
<i>Supplementary points—Contd.</i>							
Portsmouth—Continued.						<i>Meters</i>	
First Presbyterian Church, corner Third and Court Streets <sup>1</sup> 1885	38 43 56.21 83 00 03.98	1733.2 96.1	2 15 37.6 128 25 00.9	182 15 36.5 308 23 08.5	Springville Scioto	1048.9 5535.7	3.020714 3.743170
Davis Steel Works, chimney <sup>1</sup> 1885	38 43 57.46 83 00 30.14	1771.7 728.0	331 28 34 132 32 34	151 28 49 312 30 58	Springville Scioto	1237.0 5029.6	3.09237 3.70153
Davis Distillery, chimney <sup>1</sup> 1885	38 45 05.17 83 01 37.50	159.4 907.7	325 01 52 112 16 59	145 02 49 302 16 05	Springville Scioto	3873.8 2456.8	3.58814 3.39037
South meridian <sup>1</sup> 1885	38 44 33.4 82 58 41.3	1030.8 997.4	170 59 57	359 59 57	North meridian	167 <sup>2</sup>	2.2227
West Union courthouse 1888	38 47 42.978 83 32 46.122	1325.3 1113.0	143 11 41.0 235 06 58.9 339 48 25.5	323 09 43.9 55 13 54.5 159 50 47.7	Cave Hill Peach Mount Cherry Ridge	7516.3 19468.0 15920.9	3.8760066 4.2893215 4.2019667
West Union Children's Home 1880	38 47 42.631 83 32 08.862	1314.6 213.9	138 08 39.20 233 31 26.24 342 53 47.20	318 06 18.78 53 37 58.53 162 55 46.09	Cave Hill Peach Mount Cherry Ridge	8095.1 18743.8 15623.1	3.9082209 4.2728575 4.1937670
Unity Church spire <sup>1</sup> 1886	38 53 30.09 83 31 18.12	927.8 430.7	268 14 12.7 54 44 20.7	88 20 13.5 234 41 28.3	Peach Mount Cave Hill	13855.7 8113.7	4.141629 3.909220
Eckmansville Church spire <sup>1</sup> 1886	38 51 50.03 83 38 34.03	1542.7 835.0	261 44 27.6 328 18 35.2	81 55 02.3 148 24 35.7	Peach Mount Cherry Ridge	24624.0 26501.5	4.391358 4.423271
Georgetown courthouse, dome 1887	38 51 56.326 83 54 14.766	1736.9 356.0	244 37 03.53 4 06 52.91 62 33 20.02	64 42 37.97 184 06 20.41 242 20 54.23	Ash Ridge Minerva Flaughter	14203.4 17472.4 32306.0	4.1523032 4.2423524 4.5104910
Felicity town hall 1887	38 50 25.130 84 05 48.208	774.9 1162.7	44 37 02.79 163 56 08.62 313 17 07.88	224 31 51.58 343 54 44.92 133 23 49.66	Flaughter Tate Minerva	17055.5 11603.6 21204.4	4.2326288 4.0645943 4.3282857
Alexandria Courthouse 1889	38 57 34.911 84 23 12.143	1076.6 292.4	89 57 21.50 101 19 59.44 130 57 22.29 275 23 55.92	249 52 36.25 281 09 59.18 310 51 37.41 95 33 28.36	Stevens Tanner Lookout House Tate	11637.4 23415.2 17442.4 22028.5	4.0658553 4.3695530 4.2416051 4.3429844
Lookout House 1889	39 03 45.313 84 32 20.038	1397.3 481.8	351 38 21.50 54 59 42.62	171 39 20.69 234 55 26.74	Stevens Tanner	15583.6 11936.8	4.1926681 4.0768871
Cold Spring larger spire 1880	39 01 35.269 84 26 51.356	1087.6 1235.4	26 21 31.86 80 55 47.45 116 55 46.45	206 19 04.29 260 48 04.76 296 52 19.40	Stevens Tanner Lookout House	12729.6 17910.6 8803.4	4.1048134 4.2531091 3.9475999
Observatory, Cincinnati 1889	39 08 20.787 84 25 21.540	641.0 517.3	351 06 33.55 9 48 08.19 49 50 50.64	171 07 55.08 189 47 11.57 229.46 26.70	Alexandria Courthouse Cold Spring larger spire Lookout House	21158.7 12690.1 13164.0	4.3044618 4.1034577 4.1193886
Price Hill 1889	39 06 19.806 84 33 23.702	610.8 569.5	312 53 44.23 342 11 18.02 349 20 16.16 35 22 29.12	132.57 51.50 162 11 58.16 169 21 55.46 215 18 53.23	Cold Spring larger spire Lookout House Stevens Tanner	12882.6 5003.9 20536.1 14242.9	4.1100029 3.6993050 4.3125182 4.1535973
Mount Lookout transit pier 1881	39 08 21.872 84 25 21.929	674.5 526.6	344 23 05	164 23 05	Observatory	34.75	1.540955
Mount Adams Convent 1889	39 06 27.655 84 29 56.350	852.8 1353.9	34 36 43.81 48 09 49.14 87 14 12.11	214 35 13.22 228 04 02.60 267 12 01.32	Lookout House Tanner Price Hill	6081.8 17763.9 4988.0	3.7840351 4.2465390 3.6970260
Williamstown Courthouse <sup>1</sup> 1887	38 38 12.52 84 33 39.37	386.0 952.2	162 15 06.0 249 44 24.1	342 14 28.1 69 56 38.1	Dry Ridge Flaughter	4811.0 30236.2	3.682239 4.480527
Cold Spring Church spire <sup>3</sup> 1912	39 01 35.272 84 26 51.345	1087.7 1235.0	26 21 34.66 116 55 37.91	206 19 07.08 296 52 10.85	Stevens Lookout House	12729.75 8863.61	4.1048193 3.9476194
Fort Thomas <sup>3</sup> 1912	39 04 03.300 84 26 49.103	101.8 1180.4	0 40 37.65 86 02 24.33	180 40 36.24 205 58 55.77	Cold Spring Church spire Lookout House	4565.11 7075.60	3.6504515 3.9017633
Cincinnati Brothers' Protective <sup>3</sup> 1912	39 05 14.757 84 30 31.014	455.1 767.0	21 08 29.44 294 28 16.17	201 06 52.15 114 30 54.93	Tanner Lookout House	10304.42 6653.21	4.0130234 3.8230311
Warsaw School <sup>3</sup> 1912	39 06 46.734 84 35 10.057	1441.2 241.7	34 44 52.83 292 40 16.09 323 50 33.70	214 44 01.20 112 45 31.97 143 52 20.85	Brothers' Protective Fort Thomas Lookout House	3451.67 13051.70 6927.95	3.5380287 4.1156670 3.8406046
Eden Park water tower spire <sup>3</sup> 1912	39 07 02.207 84 29 24.852	68.1 597.0	34 45 13.42 72 08 31.03 86 44 14.71 325 40 54.20	214 43 22.95 252 04 02.54 266 40 36.89 145 51 32.41	Lookout House Brothers' Protective Warsaw School Fort Thomas	7388.80 10783.48 8307.07 6666.91	3.8685741 4.0327588 3.9194476 3.8239245

<sup>1</sup> No check on this position.

<sup>2</sup> Approximate.

<sup>3</sup> Copied from "Report on a plan of sewerage, city of Cincinnati." See p. 5.

GEOGRAPHIC POSITIONS—Continued.

Thirty-ninth parallel—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
<i>Supplementary points—Contd.</i>							
<i>Cincinnati—Continued.</i>							
Hughes High School <sup>1</sup> 1912	39 07 43.101	1329.1	11 41 29.78	191 40 49.98	Lookout House	7488.13	3.8743735
	84 31 16.928	406.6	58 52 35.29	238 49 16.60	Brothers' Protectory	8843.26	3.9466125
			72 46 37.77	252 44 10.66	Warsaw School	5863.89	3.7681858
			295 05 20.11	115 06 30.83	Eden Park water tower	2972.98	3.4731922
			316 27 36.06	136 30 24.98	Fort Thomas	9346.86	3.9706656
Westwood School <sup>1</sup> 1912	39 08 51.848	1599.0	7 21 29.68	187 21 06.98	Brothers' Protectory	6750.14	3.8293129
	84 35 55.943	1343.3	287 31 53.11	107 34 49.22	Hughes High School	7028.36	3.8468538
			344 03 11.59	164 03 40.53	Warsaw School	4012.57	3.6034227
Stross <sup>1</sup> 1912	39 09 18.729	577.6	76 20 05.88	256 18 36.32	Westwood School	3505.64	3.5447678
	84 33 34.088	818.4	311 49 28.95	131 50 55.53	Hughes High School	4421.12	3.6455327
Clifton School <sup>1</sup> 1912	39 09 00.729	22.5	4 37 16.78	184 37 11.69	Hughes High School	2401.69	3.3805173
	84 31 08.872	213.0	99 03 26.29	279 01 54.60	Stross	3530.79	3.5478716
College Hill Methodist Home <sup>1</sup> 1912	39 11 13.312	410.5	17 22 09.49	197 21 40.41	Stross	3702.23	3.5684640
	84 32 48.058	1153.4	22 32 24.36	202 30 54.69	Warsaw School	8890.76	3.9493781
			45 58 21.29	225 56 22.62	Westwood School	6274.98	3.7976123
			329 46 32.31	149 47 34.96	Clifton School	4731.36	3.6749859
			341 20 27.03	161 21 24.57	Hughes High School	6841.74	3.8351664
Observatory <sup>1</sup> 1912	39 08 20.648	636.7	14 13 44.48	194 12 51.71	Fort Thomas	8186.89	3.9131189
	84 25 25.398	609.9	67 12 40.51	247 10 09.41	Eden Park water tower	6239.66	3.7951611
			82 13 19.62	262 09 37.76	Hughes High School	8522.12	3.9305476
			98 33 09.05	278 29 32.23	Clifton School	8340.44	3.9211889
Norwood <sup>1</sup> 1912	39 10 02.597	80.1	34 17 19.66	214 15 40.01	Eden Park water tower	6731.82	3.8281328
	84 26 46.989	1128.1	56 27 15.43	236 24 25.01	Hughes High School	7779.65	3.8909600
			73 08 38.19	253 05 52.83	Clifton School	6570.79	3.8176178
			328 03 48.31	148 04 39.82	Observatory	3704.33	3.5687094
Longview <sup>1</sup> 1912	39 11 23.951	738.6	28 11 51.50	208 10 15.52	Hughes High School	7726.65	3.8879915
	84 28 44.931	1078.3	86 48 10.84	266 45 37.22	College Hill Methodist Home	5844.16	3.7667217
			311 32 13.83	131 33 28.34	Norwood	3782.64	2.5777947
Mount Washington School <sup>1</sup> 1912	39 05 28.615	882.4	35 57 51.76	215 55 35.03	Cold Springs Church spire	8888.23	3.9488153
	84 23 14.343	344.7	63 00 45.09	242 58 30.31	Fort Thomas	5793.86	3.7629682
			107 59 40.21	287 55 46.52	Eden Park water tower	9358.78	3.9712193
			149 19 21.93	329 17 59.22	Observatory	6169.03	3.7902167
			165 19 36.07	345 18 32.39	Kennedy	9558.34	3.9808227
			177 06 46.07	357 06 36.72	Madisonville School	7505.38	3.8753727
Madisonville School <sup>1</sup> 1912	39 09 31.690	977.2	51 39 32.82	231 38 20.02	Observatory	3530.79	3.5478717
	84 23 30.088	722.4	101 40 02.39	281 37 58.15	Norwood water tower	4822.27	3.6832517
			130 35 23.49	310 34 29.73	Kennedy	2090.67	3.4298611
Kennedy <sup>1</sup> 1912	39 10 28.451	877.4	10 25 25.84	100 25 06.77	Observatory	4007.27	3.6028485
	84 24 55.209	1325.2	73 50 37.40	253 49 26.90	Norwood water tower	2789.33	3.4455005
Norwood water tower <sup>1</sup> 1912	39 10 03.267	100.7	11 42 50.28	191 42 50.17	Norwood	21.13	1.3249365
	84 26 46.810	1123.7	56 20 41.93	236 17 51.39	Hughes High School	7794.67	3.8917980
			131 16 46.19	311 15 31.56	Longview	3772.17	3.5765907
			328 17 17.28	148 18 08.68	Observatory	3719.65	3.5705017
St. Joe - 1912	39 05 50.314	1551.5	2 49 10.38	182 48 56.57	Tanner	10721.20	4.0302432
	84 38 44.446	1068.1	215 51 15.74	35 53 02.08	Westwood School	6908.18	3.8393635
			231 19 07.42	71 21 22.66	Warsaw School	5437.18	3.7353740
			288 59 07.42	109 00 30.99	Brothers' Protectory	3368.49	3.5274350
			292 36 44.93	112 40 47.26	Lookout House	10011.54	4.0005007
Reading <sup>1</sup> 1912	39 12 48.360	1491.3	4 28 15.31	184 28 04.84	Norwood water tower	5106.65	3.7081359
	84 20 30.228	725.3	51 09 57.70	231 08 32.56	Longview	4150.03	3.6180515
			72 07 01.89	252 03 03.09	College Hill Methodist Home	9528.27	3.9790142
Madisonville water tower <sup>1</sup> 1912	39 09 18.598	573.5	47 21 08.3	227 20 17.4	Observatory	2637.37	3.4211716
	84 24 04.625	111.0	150 35 31.7	330 34 59.7	Kennedy	2472.87	3.3932014
			244 02 09.3	64 02 31.1	Madisonville School	922.30	2.9648715
			350 19 49.5	170 20 21.1	Mount Washington School	7194.22	3.8569836
St. Francis de Sales Church spire <sup>1</sup> 1912	39 07 47.125	1453.2	40 28 47.9	220 28 16.8	Eden Park water tower	1820.94	3.2602048
	84 28 35.646	856.2	88 10 46.0	268 09 05.1	Hughes High School	3875.94	3.5833765
			178 05 28.8	358 05 22.9	Longview	6090.17	3.8254370
			211 58 39.9	31 59 48.4	Norwood	4925.52	3.6924516
			257 14 06.5	77 16 06.5	Observatory	4684.85	3.6706957

<sup>1</sup> Copied from "Report on a plan of sewerage, city of Cincinnati." See p. 5.

GEOGRAPHIC POSITIONS—Continued.

Thirty-ninth parallel—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
<i>Supplementary points—Contd.</i>							
<i>Cincinnati—Continued.</i>							
St. Clemon's Church spire <sup>1</sup> 1912	39 09 57.065	1759.7	23 50 29.0	203 49 41.0	Hughes High School	4516.33	3.6547859
	84 30 00.927	22.2	43 12 17.7	223 11 34.8	Clifton School	2383.15	3.3771513
Westwood Methodist Church spire <sup>1</sup> 1912	39 09 02.071 84 35 57.938	82.4 1391.2	120 23 20.9	300 21 35.3	College Hill Methodist Home	4650.01	3.6674537
			214 14 27.3	34 15 15.3	Longview	3241.38	3.5107303
			267 53 05.5	87 55 07.9	Norwood	4659.00	3.6682928
			270 28 08.2	90 31 10.7	College Hill Methodist Home	6083.44	3.7841492
			289 57 21.6	110 00 18.9	Clifton School	6941.44	3.8414498
			344 39 15.8	164 39 46.0	Hughes High School	7181.01	3.8561855
St. Lawrence Church spire <sup>1</sup> 1912	39 06 40.437 84 34 22.820	1247.0 548.3	351 49 51.9	171 49 53.1	Warsaw School	4346.89	3.6381789
			49 35 20.2	229 33 58.8	Westwood School	337.18	2.5278676
			99 42 52.0	279 42 22.2	Brothers' Protectorsy	4074.80	3.6101060
			151 06 41.0	331 05 42.3	Warsaw School	1151.36	3.0612128
			193 28 46.9	13 29 17.7	Westwood School	4628.75	3.6654635
Whittier's School flag-staff <sup>1</sup> 1912	39 06 30.941 84 34 00.831	954.1 20.0	227 06 00.9	47 08 03.3	Stross	5019.73	3.7006803
			240 35 02.8	66 37 00.1	Clifton School	6357.55	3.8032896
			331 20 13.0	151 21 30.4	Hughes High School	4865.84	3.6871579
			57 06 23.8	237 04 48.0	Lookout House	6154.09	3.7891036
			106 19 42.1	286 18 58.4	Brothers' Protectorsy	4324.37	3.6358228
St. Mary Seminary flag-staff <sup>1</sup> 1912	39 06 39.899 84 33 41.297	1230.4 992.2	147 32 26.5	327 31 13.9	Warsaw School	1733.06	3.2388135
			187 04 26.9	7 04 43.8	Westwood School	5150.41	3.7118422
			334 37 03.5	154 38 07.0	Stross	5213.94	3.7171660
			57 22 46.0	237 20 58.4	Lookout House	5652.95	3.7522751
			95 39 10.1	275 38 14.1	Brothers' Protectorsy	4868.56	3.6874006
Cedar Grove Academy cupola <sup>1</sup> 1912	39 06 46.953 84 34 41.171	1447.9 989.2	182 01 25.4	2 01 30.0	Warsaw School	2142.30	3.3310024
			240 39 03.3	60 40 39.5	Stross	4901.01	3.6902856
			340 03 22.1	160 04 13.3	Hughes High School	3978.27	3.5996944
			43 06 56.9	223 05 47.0	Lookout House	5727.13	3.7579371
Wolf Hill 1885	38 47 56.220 87 29 03.558	1733.0 85.9	89 26 44.5	269 26 26.3	Brothers' Protectorsy	3894.19	3.5904175
			250 32 38.6	70 34 47.5	Warsaw School	694.03	2.8413754
			328 47 20.6	148 48 58.5	Hughes High School	5202.98	3.7162520
Vincennes courthouse center cupola 1885	38 40 35.216 87 31 37.354	1085.9 902.9	195 15 51.8	15 17 28.0	Lookout House	6548.33	3.8161303
			235 03 21.8	55 09 13.6	Summit	10689.5	4.028958
Vincennes latitude and longitude 1881	38 40 35.70 87 31 35.05	1100.8 847.3	166 01 08.4	345 58 06.5	Merom College	28809.8	4.459540
			39 15 29.0	219 14 17.8	Wolf Hill	14096.8	4.149121
St. Marie Catholic Church white spire 1879	38 55 56.50 88 01 30.23	1742.2 728.0	40 08 49.1	220 05 54.4	Summit	16565.0	4.219101
			151 06 14.8	331 05 33.8	Buffalo Mound	4313.1	3.634786
Dundas Baptist Church tower 1879	38 50 05.93 88 05 02.98	182.9 72.0	238 51 23.9	58 63 34.3	Olney west base	10401.6	4.017102
			112 30 13.4	292 25 28.2	Olney east base	3262.9	3.513610
Olney Courthouse dome 1879	38 43 50.42 88 05 08.07	1554.8 194.9	249 01 02.0	69 04 26.8	Claremont	5855.8	3.767585
			112 53 47.7	292 48 53.0	Denver	11906.6	4.075790
Olney Evangelical Church spire 1879	38 43 42.54 88 04 52.87	1311.6 1277.1	246 31 07.0	66 34 22.2	Claremont	8461.1	3.927425
			113 51 31.2	203 46 48.4	Denver	12339.2	4.091286
Olney schoolhouse tower 1879	38 43 41.77 88 05 11.93	1288.1 288.3	187 42 14.0	7 43 22.0	Claremont	8213.1	3.914507
			7 43 22.0	7 43 22.0	Buffalo Mound	11925.8	4.076489
Flora schoolhouse spire <sup>2</sup> 1879	38 40 17.44 88 28 40.31	537.8 974.7	127 23 01.9	307 14 55.2	Holtzhausen	19492.5	4.289867
			244 13 32.9	64 23 31.3	Denver	23624.5	4.373362
Flora tall spire <sup>2</sup> 1879	38 40 12.01 88 29 16.36	398.1 395.6	128 58 13.4	308 50 29.2	Holtzhausen	25643.5	4.408977
			244 46 02.7	64 66 23.6	Denver	23025.6	4.362211
Effingham Catholic Church spire <sup>2</sup> 1883	39 07 29.49 88 32 27.57	909.4 662.2	277 42 02.1	97 49 49.8	Island Creek Mound	26490.1	4.423084
			72 43 50.3	252 35 10.4	Island Creek Mound	17976.1	4.254695
Farina Baptist Church <sup>2</sup> 1883	38 50 10.55 88 46 25.04	325.3 604.0	179 56 09.8	359 56 09.1	Mound	21113.2	4.324555
			299 48 14.5	119 51 14.3	Holtzhausen	25745.1	4.410094
Hill 1883	39 03 13.389 89 06 15.609	412.9 375.3	358 27 13.3	178 27 21.5	Holtzhausen	7076.2	3.901796
			178 27 21.5	178 27 21.5	Sturgess	11607.2	4.064728
Henderson 1883	39 03 25.943 89 09 43.428	800.0 1044.2	274 24 42.4	94 26 53.3	Hill	5011.9	3.700005
			336 04 45.7	156 07 04.7	Sturgess	13114.8	4.117761
North base 1883	39 04 35.082 89 08 19.711	1081.8 473.8	310 09 54.8	130 11 13.0	Hill	3904.9	3.591611
			43 21 23.1	223 20 30.4	Henderson	2032.0	3.467159

<sup>1</sup> Copied from "Report on a plan of sewerage, city of Cincinnati." See p. 5.

<sup>2</sup> No check on the position.

GEOGRAPHIC POSITIONS—Continued.

Thirty-ninth parallel—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
<i>Supplementary points—Contd.</i>							
South base, stone A, on third principal meridian (U. S. L. S.) 1883	39 03 26.875	828.7	89 11 44.6	269 10 51.5	Henderson North base Hill	<i>Meters</i> 2029.3	3.307347
	89 08 19.037	457.7	179 33 31.0	359 33 30.6		2103.4	3.322922
Carlyle Catholic Church spire 1884	38 36 44.202	1363.0	43 37 24.3	223 34 33.3	Geoffrey Parkinson Holle Bording	9623.7	3.983342
	89 22 20.778	502.7	112 52 40.9	292 39 56.4		32079.3	4.506225
			173 58 03.6	353 56 37.4		31592.9	4.490590
			269 17 27.7	89 18 39.6		2786.8	3.445101
Breesee Catholic Church spire 1881-2	38 36 31.990	986.4	90 47 37.6	270 39 02.3	Berger Parkinson Holle Bording Geoffrey	19982.2	4.3006430
	89 31 44.353	1073.1	128 46 55.5	308 40 03.2		20450.3	4.3106989
			107 53 02.7	17 57 29.3		33415.1	4.5239432
			268 30 32.4	88 37 36.0		16427.3	4.2155673
Hanover Catholic Church spire 1880-1	38 33 13.106	404.1	74 59 56.7	254 46 14.6	Turkey Hill Berger Parkinson Geoffrey	33125.5	4.5201626
	89 32 15.994	387.3	108 26 30.6	238 18 15.3		20254.9	4.3065306
			141 17 38.0	321 11 05.6		24271.1	4.3850892
			273 21 35.1	93 24 55.1		7787.2	3.8913825
Damiansville Church spire 1880-1	38 30 35.809	1104.2	81 18 16.3	261 07 46.6	Turkey Hill Berger Geoffrey	24805.6	4.3945501
	89 37 24.416	591.5	133 43 52.2	313 38 49.4		16264.5	4.2112398
			253 52 56.8	73 59 28.9		15866.0	4.2004681
Venedy Church tall brown tower, white spire 1880	38 23 48.126	1483.9	111 24 42.5	291 15 06.0	Turkey Hill Berger Geoffrey	24144.2	4.382813
	89 38 48.686	1181.3	157 48 25.0	337 44 15.1		25710.2	4.410206
			225 30 29.4	45 37 53.4		24228.0	4.384317
Trenton Lutheran Church spire <sup>1</sup> 1881	38 36 29.24	901.6	285 47 12	105 57 02	Geoffrey Berger	23800.6	4.376588
	89 42 40.76	986.2	94 42 40	274 40 54		4112.5	3.614109
Lebanon Methodist Church spire 1880-1	38 36 14.731	454.2	213 32 45.6	33 36 34.2	Parkinson Berger Turkey Hill Clarks Mound	15994.3	4.2039665
	89 48 50.167	1213.9	260 46 46.3	80 48 51.1		4902.3	3.6903966
			29 01 25.7	208 58 02.7		16278.6	4.2116166
			83 04 16.6	262 54 41.2		22492.0	4.3520273
Lebanon College chapel spire 1880-1	38 36 23.145	713.7	214 34 55.7	34 38 48.8	Parkinson Berger Turkey Hill Clarks Mound	15876.3	4.2007480
	89 48 57.311	1386.7	264 00 24.0	84 02 33.2		5039.3	3.7023712
			28 03 22.0	208 00 03.4		16423.9	4.2154766
			82 21 23.3	262 11 52.3		22353.4	4.3493435
Shiloh Church spire 1880-1	38 33 34.120	1052.1	148 50 13.1	328 46 06.7	Sugar Loaf Mound Parkinson Berger Turkey Hill	18426.7	4.2654474
	89 53 52.932	1281.6	221 26 31.1	41 33 28.6		24404.5	4.3874692
			244 42 59.4	64 48 12.9		13452.9	4.1288165
Belleville Catholic Church spire <sup>1</sup> 1871	38 30 38.04	1172.9	297 51 24.4	117 54 31.6	Turkey Hill Dreyer	8245.9	3.916238
	89 59 16.75	405.8	86 00 49.9	266 52 58.3		18382.0	4.264392
Collinsville Baptist Church spire <sup>1</sup> 1871	38 40 11.45	353.0	34 33 30.6	214 30 32.3	Clarks Mound Sugar Loaf Mound	12191.9	4.086070
	89 59 26.88	649.8	157 20 24.2	337 19 46.3		3804.2	3.580267
Centerville Church spire 1871	38 27 35.514	1095.0	116 56 36.1	296 52 41.0	Dreyer Clarks Mound Turkey Hill	10272.5	4.011676
	90 05 36.401	882.7	188 41 38.3	8 42 30.5		13410.8	4.127747
			263 48 39.5	83 55 42.8		16589.9	4.210944
Forder <sup>1</sup> 1873	38 30 39.614	1221.5	77 58 53.6	257 57 40.0	Kleinschmidt Insane Asylum	2929.1	3.466734
	90 17 31.425	761.4	186 21 15.4	6 21 45.0		10373.4	4.015921
St. Louis: Standpipe 1871	38 40 13.571	418.5	29 02 39.06	208 58 17.42	Kleinschmidt Insane Asylum Morgan Minoma Sugar Loaf Mound American Bottom upper base American Bottom lower base Clarks Mound Dreyer	20034.45	4.3208615
	90 12 30.214	730.4	39 44 20.30	219 41 41.85		9605.04	3.9824991
			90 49 42.59	270 42 37.08		16463.22	4.2165148
			117 34 33.28	297 31 54.27		6935.01	3.8410844
			258 46 48.68	78 54 20.38		17803.20	4.2504982
			272 24 35.44	92 31 48.41		16769.02	4.2245078
			298 02 21.40	118 08 15.82		15561.49	4.1920511
			309 58 50.82	130 04 01.43		15719.13	4.1964284
			357 20 25.95	177 20 48.33		18745.25	4.2728911
Courthouse 1871	38 37 32.394	998.8	41 36 44.7	221 31 40.2	Kleinschmidt Insane Asylum Standpipe American Bottom upper base American Bottom lower base Clarks Mound	17828.6	4.2511167
	90 11 21.026	508.6	72 49 47.8	252 46 26.2		8179.1	3.9127038
			161 24 01.6	341 23 18.4		5244.0	3.7196642
			254 13 17.5	74 19 47.0		15672.0	4.1951240
			281 00 56.9	101 06 08.1		12287.3	4.0894540
		296 19 54.0	116 24 21.3	11570.8	4.0633635		

<sup>1</sup> No check on this position.

GEOGRAPHIC POSITIONS—Continued.

Thirty-ninth parallel—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
<i>Supplementary points—Contd.</i>							
St. Louis—Continued. Second Presbyterian Church spire 1871	° ' '' 38 37 56.190 90 12 14.534	1732.6 351.6	° ' '' 36 51 19.0 64 13 00.7 104 52 52.3 138 46 08.3 174 53 12.4 257 50 01.8	° ' '' 210 46 47.6 244 10 12.6 284 45 37.6 318 43 19.6 354 53 02.6 77 57 04.7	Kleinschmidt Insane Asylum Morgan Minoma Standpipe American Bottom upper base American Bottom lower base Clarks Mound	Meters 17578.1 7240.6 17425.0 9902.4 4253.1 16751.3 13706.0 13056.5	4.2449718 3.8597775 4.2411723 3.9957385 3.6287093 4.2240495 4.1369112 4.1158273
St. John's Church 1871	38 38 08.461 90 13 11.005	260.9 266.2	295 35 16.7 352 52 32.6 32 25 18.8 55 35 53.4	115 40 52.6 172 53 20.4 212 21 22.7 235 33 40.4	Clarks Mound Dreyer Kleinschmidt Insane Asylum	14440.5 14982.8 17112.7 6245.8	4.1598516 4.1755919 4.2333188 3.7955874
Sacred Heart Convent 1871	38 34 43.886 90 14 11.288	1353.2 273.2	43 27 59.1 126 56 37.7 193 30 52.9 269 43 24.6 338 48 13.9	223 24 40.8 306 55 02.5 13 31 56.0 89 49 38.0 158 49 39.3	Kleinschmidt Insane Asylum Standpipe Clarks Mound Dreyer	11213.8 4622.8 10455.8 14491.7 9179.5	4.0497509 3.6049080 4.0193575 4.1611181 3.9628202
Marine Hospital 1871	38 35 13.007 90 13 11.400	401.1 275.9	45 24 36.1 110 05 21.9 273 38 37.7 348 49 39.7	225 20 40.4 290 03 09.4 93 44 13.7 168 50 27.9	Kleinschmidt Insane Asylum Clarks Mound Dreyer	12870.0 5477.1 13068.3 9639.6	4.1065797 3.7385473 4.1162184 3.9846066
Bohemian Church 1871	38 36 44.602 90 12 18.710	1375.3 452.6	81 39 00.6 177 31 43.3 287 15 51.7 357 14 41.6	261 36 15.0 357 31 36.1 107 20 54.9 177 14 56.9	Insane Asylum Standpipe Clarks Mound Dreyer	6487.5 6449.6 12321.6 12295.7	3.8120801 3.8065341 4.0906680 4.0897525
First Presbyterian Church 1871	38 37 53.156 90 12 00.020	1639.0 0.5	37 50 51.7 68 01 29.6 170 25 51.2 297 01 34.5	217 52 11.4 245 58 32.4 350 24 32.3 117 06 26.1	Kleinschmidt Insane Asylum Standpipe Clarks Mound	17717.0 7519.8 4390.9 12701.1	4.2483904 3.8762066 3.6425513 4.1038400
St. Francis Church 1871	38 34 48.784 90 14 22.041	1504.2 533.4	41 57 34.3 127 24 52.4 195 06 20.3 270 18 48.0 337 39 28.6	221 54 22.5 307 23 23.8 15 07 30.1 90 25 08.0 157 41 00.6	Kleinschmidt Insane Asylum Standpipe Clarks Mound Dreyer	11148.2 4324.2 10373.7 14752.0 9416.4	4.0472052 3.6359040 4.0159350 4.1688497 3.9738828
Holy Cross Church 1871	38 35 22.875 90 13 40.490	705.3 979.8	274 42 52.6 345 14 04.3 42 10 14.9	94 48 46.7 165 15 10.5 222 06 37.3	Clarks Mound Dreyer Kleinschmidt	13792.7 10094.4 12602.4	4.1396400 4.0049806 4.1004519
Centenary Methodist Church 1871	38 38 11.688 90 12 40.785	360.4 986.4	58 20 46.9 183 53 23.8 355 41 52.3	238 18 15.1 3 53 30.4 175 42 21.2	Insane Asylum Standpipe Dreyer	6913.0 3767.0 15009.0	3.8396685 3.5759914 4.1763526
Church, corner Manchester and Ballas Roads 1871	38 36 13.312 90 26 36.969	410.5 894.6	207 42 40.6 250 02 21.0 269 52 05.7	27 44 24.1 70 11 09.7 89 58 15.7	Morgan Standpipe Insane Asylum	8619.1 21778.4 14348.6	3.9354617 4.3380256 4.1568108
Church, corner Smith Street and Ballas Road 1871	38 37 57.634 90 26 35.565	1777.1 860.2	221 59 58.6 258 20 18.6 282 32 22.2	42 01 41.2 78 29 06.6 102 38 31.5	Morgan Standpipe Insane Asylum	5939.2 20860.8 14664.4	3.7737279 4.3194568 4.1662653
Tower, corner Grand Street and La Fayette Avenue 1871	38 36 58.897 90 14 18.667	1816.1 451.6	285 35 10.1 344 37 35.7 68 30 17.6	105 41 37.2 164 39 05.8 248 28 47.0	Clarks Mound Dreyer Insane Asylum	15230.3 13193.6 3779.0	4.1827089 4.1203638 3.5773760
Northwest corner <sup>1</sup> 1874	38 36 28.476 90 45 03.939	878.1 95.3	24 50 29	204 50 26	Tavern Rock	317.91	2.502310
Poleman's House <sup>1</sup> 1874	38 28 33.20 90 68 05.78	1023.8 140.2	189 28 11.0 281 24 27.2	9 29 04.4 101 26 07.3	Dieckhaus Halleck	12610.9 3978.2	4.100747 3.599687
Corner fifth meridian <sup>1</sup> 1874	38 28 37.95 90 57 54.92	1170.3 1331.2	60 55 10	240 55 03	Poleman's House	301.31	2.47902
Dutzow Catholic Church, east gable <sup>1</sup> 1874	38 35 33.08 90 59 03.32	1019.9 80.2	278 19 06.7 25 29 38.7	98 20 36.1 205 26 42.5	Dieckhaus Peters	3504.1 15933.4	3.544577 4.202309
St. Gertrude's Church 1874	38 29 50.196 91 02 59.627	1547.7 1449.8	71 13 32.5 118 25 40.8 140 19 53.2	251 05 20.9 298 16 39.8 320 16 39.9	Jacobs Berger Enoch Knob	20242.5 23888.8 11764.6	4.306264 4.378194 4.070578
Doermann Hill 1878	38 30 19.368 91 27 55.953	597.2 1355.8	61 28 55.1 134 11 40.5 178 51 24.7 235 27 34.1 330 38 35.7	241 24 00.9 314 07 27.4 358 51 19.7 55 34 05.5 150 39 46.0	Geyer Turnpike Bluff Gasconade Berger Winter	13051.3 13707.8 9682.6 18447.9 5589.4	4.115654 4.136908 3.985992 4.265946 3.747367

<sup>1</sup>No check on this position.

## GEOGRAPHIC POSITIONS—Continued.

## Thirty-ninth parallel—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
<i>Supplementary points—Contd.</i>							
L'Ours Creek spire <sup>1</sup> 1879	38 30 35.10 91 56 55.54	1082.3 1345.8	35 53 38.5 112 46 48.1	215 48 09.9 292 32 16.5	Kennedy Medlock	<i>Meters</i> 21894.9 36670.3	4.340342 4.564314
Koeltztown spire 1879	38 19 31.445 92 02 29.450	969.5 715.4	99 57 36.75 119 52 56.03 163 41 14.40 221 56 53.15 266 36 59.89	279 44 04.66 299 50 55.24 343 37 24.16 42 02 37.13 86 46 01.00	Belshe Kennedy Cedar McDaniel Pilot Knob	32256.5 5453.8 31890.2 20089.7 21281.7	4.5086177 3.7366965 4.5036576 4.3029735 4.3275985
Jefferson City capitol, rod on dome 1879	38 34 46.970 92 10 20.392	1448.3 493.6	113 57 27.72 225 47 19.19	293 51 17.65 45 48 22.05	Medlock Cedar	15696.2 3402.2	4.1957965 3.5317576
Jefferson City, astronomic 1879	38 33 41.161 92 09 45.553	1269.2 1103.1	157 26 01.53 199 55 34.35	337 25 39.81 19 56 15.47	Jefferson City capitol Cedar	2197.5 4681.7	3.3419289 3.6703979
California Church spire 1879	38 38 00.610 92 33 58.858	18.8 1423.7	5 20 51.53 38 35 45.87 90 49 30.46 292 28 46.73 313 39 21.83 333 49 29.67	185 20 13.59 218 28 01.46 270 43 27.91 112 29 29.43 133 44 40.81 153 55 31.12	High Point Hunter Cole Christian Moreau Belshe	15831.89 28987.21 14046.11 1790.48 17125.08 31947.44	4.1995327 4.4622065 4.1475560 3.2529707 4.2330326 4.5044361
Tipton Church spire 1879	38 39 17.953 92 46 39.559	553.6 956.6	278 37 54.79 296 44 26.67 316 54 35.60 359 09 28.68	98 46 32.51 116 40 19.09 137 01 51.95 179 09 38.15	Christian Cole High Point Hunter	20284.95 4875.51 24826.14 25063.29	4.3071739 3.6880204 4.3949093 4.3990381
Hunter latitude 1880	38 25 45.210 92 46 24.637	1394.0 597.6	270	90	Hunter	6.43	0.80828
Sedalia Church spire 1880	38 42 21.887 93 13 37.428	674.9 904.3	238 13 05.62 276 12 16.51 319 34 56.82	58 13 50.09 96 25 55.79 139 46 01.02	Heard Hubbard Hughes	2020.96 31868.80 39854.03	3.3055567 4.5033657 4.6004722
Green Ridge Congregational Church chimney <sup>1</sup> 1882	38 37 04.13 93 24 32.53	127.3 787.0	72 03 02.7 156 15 27.3	251 56 56.1 336 14 33.1	High Point Tebo Kendrick	14952.7 5215.5	4.174721 3.717294
Lamont Campbellite Church spire <sup>1</sup> 1882	38 46 39.36 93 25 24.39	1213.6 588.7	3 44 03.8 89 25 23.1	183 43 41.9 269 20 33.3	Kendrick Knob Noster	12991.1 11169.7	4.113646 4.048041
Tomlin's house, southeast chimney <sup>1</sup> 1882	38 37 55.14 93 28 04.59	1700.2 111.2	55 45 33.8 223 23 44.2	235 41 39.4 43 25 02.4	High Point Tebo Kendrick	10998.2 4406.0	4.041321 3.644048
Shoemaker's house, cupola, lightning rod <sup>1</sup> 1882	38 44 19.27 93 31 15.36	594.2 371.1	147 17 33.1 318 31 01.5	327 16 23.2 138 34 19.1	Knob Noster Kendrick	4991.1 11533.5	3.698200 4.061959
Windsor public school flag-staff <sup>1</sup> 1882	38 31 44.13 93 31 30.87	1360.7 747.7	102 16 20.4 142 00 24.7	282 07 42.2 321 68 39.2	Caldwell High Point Tebo	20602.4 6658.4	4.313918 3.823370
Cooks Knob, ice house <sup>1</sup> 1882	38 51 57.15 93 31 31.86	1762.2 768.2	13 02 51.5 57 21 35.2	193 01 51.8 237 13 36.0	Knob Noster Normal	10182.4 21922.9	4.007852 4.340899
Warrensburg Presbyterian Church spire 1883	38 45 52.680 93 44 16.769	1624.4 404.8	4 10 08.44 89 08 48.68 120 47 02.33 265 16 38.57 359 15 13.82	184 09 27.41 268 56 19.67 300 34 59.99 85 23 37.92 179 15 14.03	Caldwell Baker Chapel Hill Knob Noster Normal	21868.83 28887.70 32301.75 16220.47 606.99	4.3398255 4.4607129 4.5092260 4.2100634 2.7831833
Hazel Hill <sup>1</sup> 1882	38 53 42.09 93 45 06.94	1297.8 167.2	307 05 20.5 355 22 38.7	127 12 51.9 175 23 10.4	Knob Noster Normal	21783.4 15130.7	4.338126 4.179860
Centerview Cumberland Presbyterian Church, cupola <sup>1</sup> 1883	38 44 32.64 93 50 41.34	1006.4 998.4	95 51 15.7 135 44 46.5	275 42 47.6 315 36 45.5	Baker Chapel Hill	19702.1 26489.3	4.294513 4.423071
Holden Methodist Church spire 1883	38 42 56.102 93 59 23.318	1729.9 563.4	41 45 24.47 125 21 48.76 164 55 11.69 257 27 56.67 308 45 13.43	221 38 15.70 305 18 47.43 344 52 37.96 77 37 24.15 128 53 58.52	Hutton Mound Baker Chapel Hill Normal Caldwell	24973.27 8579.30 22712.79 22431.00 26103.81	4.3974754 3.9334521 4.3562705 4.3508486 4.4167040
Kingsville public school, cupola 1883	38 44 36.602 94 04 24.185	1128.6 584.1	23 15 42.39 62 09 30.87 188 10 51.69	203 11 41.38 242 00 39.38 8 10 58.64	Hutton Mound Fulton Baker	23663.98 23251.00 1882.49	4.3740878 4.364416 3.2747316
Hicks City Christian Union Church spire <sup>1</sup> 1883	38 53 30.97 94 07 10.64	954.9 256.4	60 05 35.0 246 15 22.5	240 00 48.5 66 17 41.9	Thornton Chapel Hill	12701.2 5844.8	4.103844 3.766768

<sup>1</sup> No check on this position.

GEOGRAPHIC POSITIONS—Continued.

Thirty-ninth parallel—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
<i>Supplementary points—Contd.</i>							
Gunn City flouring mill, iron chimney <sup>1</sup> 1883	38 39 58.34 94 09 55.15	1798.0 1333.3	79 38 27.1 218 19 31.8	259 33 02.8 38 23 05.7	Fulton Baker	<i>Meters</i> 12763.9 13317.9	4.105984 4.124436
Staley Mound, Staley's house chimney 1883	38 42 15.301 94 12 07.268	474.6 175.6	55 07 09.32 165 06 10.84 241 27 44.74 353 52 05.65	235 03 07.43 345 04 30.73 61 32 41.42 173 52 53.79	Fulton Thornton Baker Hutton Mound	11410.8 14996.8 13032.1 17401.3	4.0573153 4.1759090 4.1150152 4.2428222
Austin Methodist Church spire <sup>1</sup> 1883	38 30 08.99 94 17 53.58	277.2 1298.4	176 26 41.5 243 56 45.2	356 26 16.1 64 01 09.0	Fulton Hutton Mound	15898.1 11414.6	4.201345 4.057461
Harrisonville, Cumberland Presbyterian Church spire 1883	38 39 14.918 94 21 00.613	460.0 14.8	108 11 29.0 135 30 36.2 171 35 54.9 285 15 49.6	287 58 55.0 315 22 45.0 351 34 15.4 105 17 21.0	Haskin Berry Bowler Fulton	30660.1 25924.2 26220.0 3666.5	4.486573 4.413706 4.418633 3.564256
Lees Summit South Methodist Church cupola <sup>1</sup> 1883	38 54 43.58 94 22 31.89	1343.8 768.4	307 24 05.7 31 09 18.2	127 28 57.4 211 08 35.7	Thornton Bowler	14111.4 3152.7	4.149569 3.498682
Raymore Hill, Butler's barn cupola <sup>1</sup> 1883	38 46 47.53 94 26 01.11	1465.6 26.8	105 51 12.9 249 17 05.2	15 52 41.7 69 24 07.6	Bowler Thornton	12487.7 17370.8	4.096484 4.240046
Independence courthouse high cupola or tower 1884	39 05 32.741 94 24 57.613	1009.7 1384.6	355 15 58.35 22 25 22.42 62 44 18.46	175 16 47.46 202 19 57.94 242 34 40.59	Bowler Berry Marty	22794.0 32639.3 24838.7	4.3578212 4.5137405 4.3951281
Kansas City: Catholic Cathedral, Eleventh Street between Broadway and Washington Streets 1884	39 06 03.118 94 35 20.437	96.2 491.1	273 31 36.5 324 26 47.9 355 16 08.7 29 52 35.9 79 49 21.0	93 38 09.4 144 34 08.9 175 17 16.1 209 49 30.3 259 33 44.4	Independence court- house Bowler Berry Marty Eckman	14996.2 29051.1 31224.1 14233.6 36306.0	4.175980 4.463162 4.494490 4.153315 4.559978
Second Presbyterian Church spire 1884	39 05 55.813 94 35 13.448	1721.2 323.2	272 41 54.75 30 55 25.85 80 13 08.76	92 48 23.10 210 52 15.87 259 57 27.81	Independence court- house Marty Eckman	14816.3 14124.3 36432.3	4.1707387 4.1499661 4.5614668
Astronomic 1882	39 05 50.40 94 35 22.16	1554.1 532.7					
Westport, College of the Redemptionist Fathers 1884	39 04 01.546 94 35 19.549	47.7 470.0	319 41 24.6 354 40 08.6 39 36 41.0	139 48 44.9 174 41 15.2 219 33 34.9	Bowler Berry Marty	26078.4 27487.7 11154.1	4.416281 4.439138 4.047434
State line 3, stake 1885	38 46 20.761 94 36 30.102	640.2 726.7	61 36 44.4 167 20 53.5 218 32 17.7	241 33 51.4 347 18 32.3 38 34 08.4	Haskin Marty Berry	7592.3 24716.8 6830.8	3.880372 4.392933 3.834472
Belton South Methodist Church spire 1884	38 48 32.756 94 31 49.882	1010.0 1203.5	60 17 46.1 116 55 47.0 148 46 25.9 233 29 49.6 313 19 22.9	240 11 57.4 296 54 41.9 328 41 08.7 53 34 57.2 133 27 40.6	Haskin Berry Marty Bowler Fulton	15481.2 2808.8 23451.5 14701.4 26444.8	4.189908 3.448518 4.370170 4.167359 4.422341
Missouri and Kansas State line 3, stone 1885	38 46 02.85 94 36 30.10	87.9 726.7	179 59 23.0	359 59 23.0	State line 3, stake	552.2	2.74207
State line 1 1885	38 53 01.80 94 36 28.69	55.5 691.6	328 59 26.0 22 47 35.0	149 01 16.0 202 44 41.0	Berry Haskin	8194.7 17329.3	3.913532 4.238782
Missouri and Kansas State line 1, Missouri stone <sup>1</sup> 1885	38 53 01.56 94 30 28.11	48.1 677.6	117 32 54.0	297 32 54.0	State line 1	15.8	1.19931
Base 1 <sup>1</sup> 1885	38 59 27.48 94 30 56.18	847.3 1352.1	345 31 14.0 88 17 00.0	165 33 20.9 268 14 55.0	Berry Marty	19536.9 4788.2	4.290856 3.680172
Base 2 <sup>1</sup> 1885	38 59 19.15 94 36 59.80	590.5 1439.3	108 43 06.0	18 43 08.0	Base 1	271.2	2.43336
State line 2 1885	38 59 10.30 94 36 29.52	317.6 710.5	110 31 44.0 129 32 31.0	290 31 25.0 309 32 14.0	Base 2 Base 1	778.2 832.2	2.89111 2.92022
Missouri and Kansas State line 2, stone 1885	38 59 10.39 94 36 29.49	320.4 709.8	11 08 31.0	191 08 31.0	State line 2	2.9	0.4617

<sup>1</sup> No check on this position.

## GEOGRAPHIC POSITIONS—Continued.

Louisville connection.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
<i>Principal points.</i>							
Blocher 1914	38 43 33.837	1043.4	111 35 15.60	291 20 55.58	Miller	35608.84	4.5515578
	85 39 15.877	383.5	205 00 56.02	25 03 47.52	Stout	15610.45	4.1934153
Finley 1914	38 38 07.321	225.7	149 58 00.14	329 52 13.43	Miller	26696.15	4.4264487
	85 52 54.807	1325.6	227 22 05.76	47 33 29.61	Stout	35812.44	4.5540339
			242 58 10.12	63 06 41.93	Blocher	22207.96	4.3465698
Summit 1886	38 34 15.852	488.8	135 40 23.82	315 37 23.91	Finley	9981.41	3.9991921
	85 48 06.444	156.0	216 39 57.45	36 45 28.81	Blocher	21462.02	4.3316828
Marysville 1914	38 35 20.932	645.4	81 32 33.22	261 26 47.51	Summit	13567.75	4.1325077
	85 38 52.075	1260.3	104 11 50.22	284 03 04.32	Finley	21024.89	4.3227337
			177 50 00.87	357 49 46.00	Blocher	15209.71	4.1821210
O. & M. 1884	38 29 00.278	8.6	130 15 56.43	310 11 00.59	Summit	15067.79	4.1780496
	85 40 11.497	278.7	189 18 01.27	9 18 50.75	Marysville	11893.86	4.0753229
Popp 1914	38 25 14.301	441.0	184 03 19.35	4 03 49.79	Summit	16740.35	4.2237646
	85 48 55.348	1342.7	217 57 16.13	38 03 31.72	Marysville	23739.21	4.3754662
			241 12 29.15	61 17 54.91	O. & M.	14487.91	4.1610058
Lutz 1884	38 24 34.310	1057.9	95 32 28.19	275 26 59.94	Popp	12875.57	4.1097669
	85 40 07.062	171.3	179 14 56.82	359 14 54.00	O. & M.	8201.37	3.9138971
Six Mile 1884	38 22 37.953	1170.2	178 06 54.44	358 06 50.38	Popp	4823.43	3.6833556
	85 48 48.808	1184.7	220 44 29.60	46 49 51.14	O. & M.	17216.50	4.2359474
			254 08 04.39	74 13 28.42	Lutz	13160.02	4.1192566
Sims 1884	38 20 35.973	1109.2	105 55 13.62	285 49 35.53	Six Mile	13750.91	4.1383314
	85 39 44.027	1069.2	175 39 03.70	355 38 49.40	Lutz	7370.05	3.8674702
Bangs 1879	38 19 36.717	1132.1	212 47 08.86	32 48 40.88	Six Mile	6647.95	3.8226878
	85 51 17.115	415.8	263 44 44.40	83 51 54.29	Sims	10931.95	4.2287069
Blind Asylum 1879	38 15 24.227	747.0	122 11 06.35	302 05 50.40	Bangs	14633.41	4.1653456
	85 42 47.242	1148.6	146 44 02.92	326 40 18.74	Six Mile	15999.81	4.2041149
			204 50 08.28	24 52 01.83	Sims	10593.06	4.0250216
Williams 1879	38 10 24.695	761.4	196 44 43.75	16 46 54.29	Bangs	17775.95	4.2498327
	85 54 47.969	1167.6	242 09 37.93	62 17 03.78	Blind Asylum	19816.79	4.2970333
Cox 1879	38 09 24.220	746.8	98 35 57.29	278 30 42.69	Williams	12533.44	4.0980701
	85 46 18.845	458.8	159 00 53.52	338 57 48.90	Bangs	20230.13	4.3059988
			204 51 50.71	24 54 01.59	Blind Asylum	12235.80	4.0876324
Louisville north base 1879	38 13 29.002	894.3	326 05 53.97	146 08 02.74	Cox	9091.26	3.9586240
	85 49 47.122	1146.2	52 12 14.05	292 09 08.01	Williams	9267.16	3.9669467
Louisville south base 1879	38 09 03.583	110.5	109 32 49.77	289 29 50.75	Williams	7483.76	3.8741201
	85 49 58.232	1417.9	181 53 28.93	1 53 35.80	Louisville north base	8188.057	3.9131808
			263 11 16.62	83 13 32.15	Cox	5379.29	3.7307253
Riley 1879	38 05 30.379	936.7	117 28 28.99	297 21 05.38	Williams	19709.80	4.2946821
	85 42 49.556	1207.6	154 43 10.61	334 37 56.67	Bangs	28869.19	4.4604346
			180 10 33.87	0 10 35.30	Blind Asylum	18309.97	4.2626876
Potts 1880	38 05 23.771	732.9	191 48 02.82	11 48 52.00	Williams	9478.78	3.9767523
	85 56 07.608	185.4	269 19 52.86	89 28 05.19	Riley	19448.31	4.2888818
Mountain Top 1880	37 55 23.277	717.7	144 15 53.64	324 10 16.84	Potts	22821.02	4.3583522
	85 47 00.641	15.7	157 44 48.80	337 40 00.78	Williams	30037.61	4.4776654
			198 05 57.36	18 08 31.97	Riley	19694.81	4.2943519
Dobbins 1883	37 52 45.983	1417.7	113 13 30.78	293 08 46.08	Mountain Top	12317.53	4.0965236
	85 39 17.189	420.1	167 36 58.78	347 34 48.08	Riley	24130.66	4.3825691
Keith 1883	37 48 01.841	56.8	152 03 08.18	332 00 06.69	Mountain Top	15410.29	4.1878107
	85 42 04.037	120.8	205 04 30.72	25 06 13.63	Dobbins	9673.01	3.9855618
Jackson 1883	37 56 43.903	1353.6	31 38 32.68	211 36 39.05	Dobbins	8614.80	3.9352454
	85 36 12.256	299.3	149 11 44.26	329 07 39.50	Riley	18905.07	4.2765783
White Lick 1882	37 51 41.882	1291.3	64 07 34.52	244 01 44.46	Keith	15518.66	4.1908542
	85 32 34.189	835.8	101 22 46.87	181 18 39.48	Dobbins	10040.17	4.0020004
			150 14 36.60	330 12 22.63	Jackson	10727.95	4.0365169
Willett 1883	37 41 37.409	1153.3	128 17 43.34	308 11 27.31	Keith	19147.30	4.2821074
	85 31 50.687	1241.8	176 44 03.29	356 43 36.64	White Lick	18666.59	4.2710651
Thompson 1883	37 37 36.327	1120.0	148 04 32.63	327 59 32.06	Keith	22731.70	4.3566318
	85 33 53.594	1314.2	202 03 10.88	22 04 25.97	Willett	8019.84	3.9041659
Burkett 1883	37 46 36.074	1112.2	57 00 23.11	236 54 29.29	Willett	16887.06	4.2275540
	85 22 12.568	307.6	121 51 25.54	301 45 04.38	White Lick	17889.90	4.2526079
Rohan 1883	37 41 09.220	284.2	97 02 21.75	276 59 25.51	Willett	7116.10	3.8522422
	85 27 02.419	59.3	120 00 22.01	299 51 09.56	Keith	25496.91	4.4064876
			157 25 39.37	337 22 16.15	White Lick	21127.76	4.3248535
			215 08 02.72	35 11 00.10	Burkett	12325.68	4.0908110

GEOGRAPHIC POSITIONS—Continued.

Louisville connection—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
<i>Principal points—Continued.</i>							
Ferryell 1883	37 37 25.342	781.3	91 46 09.30	271 41 30.24	Thompson	11214.32	4.0497730
	85 26 16.488	404.4	133 31 10.98	313 27 46.80	Willet	11291.31	4.0527442
			170 44 21.83	330 43 53.77	Rohan	6993.34	3.8446848
Penick 1883	37 33 18.697	576.4	105 58 06.79	285 47 02.04	Ferryell	27796.15	4.4438847
	85 08 06.736	165.3	117 36 31.10	297 24 57.84	Rohan	31402.38	4.4969626
			133 32 28.39	313 17 30.83	White Lick	49485.30	4.6944768
			139 55 53.72	319 47 16.87	Burkett	32156.95	4.5072748
<i>Supplementary points.</i>							
Haystack 1884	38 25 14.272	440.1	184 03 53.56	4 04 24.07	Summit	10741.46	4.2237934
	85 48 55.466	1345.5	241 12 37.27	61 18 03.10	O. & M.	14490.85	4.1610939
Bartle 1886	38 30 21.028	648.4	217 06 17.15	37 08 38.15	Summit	9081.20	3.9581434
	85 51 52.750	1278.1	278 16 20.06	98 23 45.55	O. & M.	17175.42	4.2349073
			335 32 48.69	155 34 38.96	Haystack	10389.34	4.0165881
Anchorage <sup>1</sup> 1880	38 16 40.379	1245.1	80 25 32.0	260 19 39.2	Blind Asylum	14045.5	4.147537
	85 33 17.599	427.8	127 45 49.5	307 41 49.9	Sims	11870.5	4.074470
Jeffersonville, Government tower <sup>1</sup> 1880	38 17 00.199	6.1	115 50 53.3	295 46 38.8	Bangs	11083.1	4.044063
	85 44 26.478	043.5	148 33 47.0	328 31 04.3	Six Mfle	12208.7	4.086668
New Albany Second Presbyterian Church <sup>1</sup> 1880	38 17 03.779	116.5	146 53 55.9	326 52 37.4	Bangs	5629.9	3.750498
	85 49 10.536	256.1	182 55 48.8	2 56 02.3	Six Mfle	10317.2	4.013563
New Albany waterworks tower <sup>1</sup> 1880	38 16 53.922	1662.6	165 01 00.6	345 00 26.3	Bangs	5196.3	3.715693
	85 50 21.807	530.0	192 00 48.0	12 01 45.7	Six Mfle	10845.5	4.035249
Louisville: St. Martin's Church <sup>1</sup> 1880	38 14 43.761	1349.3	241 19 09.1	61 20 07.2	Blind Asylum	2600.4	3.415042
	85 44 21.074	512.5	16 13 38.3	196 12 25.5	Cox	10260.6	4.011172
Cave Hill Cemetery <sup>1</sup> 1880	38 14 37.221	1147.7	218 35 57.9	38 36 27.4	Blind Asylum	1854.6	3.268244
	85 43 34.830	847.0	22 28 49.8	202 27 08.4	Cox	10443.3	4.018837
Bonifacius Church <sup>1</sup> 1880	38 15 04.125	127.2	256 54 49.5	76 55 57.5	Blind Asylum	2739.3	3.437644
	85 44 36.984	899.3	18 18 48.9	193 17 45.9	Cox	10769.3	4.032186
Christ Church <sup>1</sup> 1880	38 15 07.345	226.5	261 40 17.3	81 41 48.0	Blind Asylum	3598.9	3.556108
	85 45 13.703	333.2	8 31 33.3	188 30 53.0	Cox	10907.6	4.029284
St. Paul's Church 1880	38 15 06.651	205.1	5 12 49.7	185 12 25.2	Cox	10601.9	4.025383
	85 45 39.274	955.0	63 28 44.0	243 26 10.6	Louisville north base	6737.6	3.828507
			135 26 00.1	315 22 30.7	Bangs	11694.0	4.067962
			262 36 11.2	82 37 57.7	Blind Asylum	4217.7	3.625080
Catholic Cathedral 1880	38 15 06.791	209.4	6 11 09.7	186 10 40.6	Cox	10624.2	4.026206
	85 45 31.823	773.8	64 07 10.6	244 04 32.6	Louisville north base	6902.1	3.838983
			134 47 39.1	314 44 05.1	Bangs	11818.8	4.072572
			262 20 03.0	82 21 44.9	Blind Asylum	4037.6	3.606120
Baptist Church 1880	38 15 04.837	149.2	6 45 27.7	186 44 56.1	Cox	10575.5	4.024302
	85 45 27.732	674.3	64 55 22.8	244 52 42.3	Louisville north base	6966.0	3.842984
			134 39 49.1	314 36 12.6	Bangs	11931.8	4.076707
			261 16 32.5	81 18 11.9	Blind Asylum	3947.7	3.598343
Second Presbyterian Church <sup>1</sup> 1880	38 14 41.085	1266.8	249 56 48.6	69 58 21.5	Blind Asylum	3881.8	3.589029
	85 45 17.219	418.7	8 43 51.5	188 43 13.4	Cox	9894.2	3.994942
Broadway Baptist Church 1880	38 14 45.102	1390.7	9 52 22.7	189 51 39.0	Cox	10042.2	4.001829
	85 45 08.121	197.5	135 06 26.1	315 02 37.4	Bangs	12699.1	4.103773
			250 35 14.3	70 36 41.5	Blind Asylum	3631.7	3.560109
German Methodist Church 1880	38 15 12.198	376.1	13 44 53.5	193 43 46.8	Cox	11045.1	4.043171
	85 44 31.029	754.5	129 30 24.8	309 32 13.2	Bangs	12902.8	4.107305
			261 37 47.0	81 38 51.3	Blind Asylum	2550.6	3.406638
Waterworks tower 1880	38 16 49.856	1537.2	21 34 01.2	201 33 34.6	Blind Asylum	2838.9	3.453154
	85 42 04.320	105.0	111 00 23.7	290 54 41.2	Bangs	14383.2	4.157856
			206 02 27.1	26 03 54.1	Sims	7760.5	3.890889
Courier-Journal office, pole <sup>1</sup> 1880	38 15 10.430	321.6	6 58 00.9	186 57 27.7	Cox	10753.9	4.031567
	85 45 25.268	614.4	63 52 01.2	243 49 19.1	Louisville north base	7094.6	3.850925
Malt House elevator <sup>1</sup> 1880	38 14 43.406	1338.4	56 28 50.0	76 31 03.5	Blind Asylum	5391.1	3.731678
	85 46 22.833	555.2	359 26 04.8	179 26 07.3	Cox	9841.9	3.993077
City Hall <sup>1</sup> 1880	38 15 15.808	487.4	266 24 12.5	86 25 58.1	Blind Asylum	4154.7	3.618541
	85 45 37.788	918.8	5 16 05.9	185 15 40.5	Cox	10886.4	4.036883

<sup>1</sup> No check on this position.

## GEOGRAPHIC POSITIONS—Continued.

## Louisville connection—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
<i>Supplementary points—Contd.</i>							
<i>Louisville—Continued.</i>							
Church of the Messiah <sup>1</sup> 1880	38 14 38.523 85 45 29.777	1187.8 724.1	250 21 41.9 7 01 39.8	70 23 22.5 187 01 09.4	Blind Asylum Cox	4195.8 9764.1	3.622816 3.989632
Stuart Robinson Church, highest spire <sup>1</sup> 1880	38 14 43.905 85 45 17.627	1353.8 428.7	251 12 33.9 8 35 55.2	71 14 07.0 188 35 17.3	Blind Asylum Cox	3862.2 9968.7	3.586834 3.998638
Cedar Glade 1883	37 59 58.167 85 31 03.952	1793.4 96.4	8 12 11.9 51 30 30.6	188 11 16.4 231 27 20.9	White Lick Jackson	15459.0 9617.6	4.189181 3.983068
Mount Washington Church spire 1883	38 02 58.581 85 32 42.550	1806.3 1037.5	336 36 41.6 359 26 19.8 23 54 28.4 107 36 19.0	156 37 42.3 179 26 24.9 203 52 19.3 287 30 04.7	Cedar Glade White Lick Jackson Riley	6060.1 20864.6 12634.4 15518.4	3.782480 4.319411 4.101556 4.190847
Bardstown Junction Metho- dist Church spire <sup>1</sup> 1883	37 56 25.450 85 41 58.470	784.9 1427.7	331 49 50.7 26 39 10.7	151 50 50.3 206 38 40.6	Britts Knob Indian Knob	5019.5 2669.5	3.700659 3.426426
Dry Knob 1883	37 55 52.731 85 36 10.251	1625.6 250.3	151 21 29.6 173 13 20.8 325 39 54.7	331 17 23.7 358 13 19.6 145 42 07.4	Riley Jackson White Lick	20299.7 1578.5 9363.9	4.307490 3.198237 3.971455
Indian Knob 1883	37 55 08.073 85 42 47.497	248.9 1160.1	299 44 47.1 310 25 57.1 94 21 26.8	119 46 16.9 130 28 06.3 274 18 51.2	Britts Knob Dobbins Mountain Top	4108.8 6752.2 6200.7	3.013714 3.829447 3.792442
Britts Knob 1883	37 54 01.925 85 40 21.481	59.3 524.8	326 08 03.7 104 27 35.3	146 08 43.2 284 23 30.0	Dobbins Mountain Top	2819.6 10068.0	3.450185 4.002944
Lebanon Junction Knob <sup>1</sup> 1883	37 50 14.155 85 43 13.860	436.7 338.9	250 08 04.4 337 32 35.6	80 14 36.9 157 33 17.9	White Lick Keith	15871.0 4414.2	4.200604 3.644855
Bardstown Catholic Church spire 1883	37 48 37.814 85 28 17.091	1165.8 418.0	292 47 31.5 352 27 50.1 21 59 19.3	112 51 14.9 172 23 35.8 201 57 08.6	Burkett Rohan Willett	9676.3 13950.6 13976.2	3.985709 4.144593 4.145390
Loretto Convent spire <sup>1</sup> 1883	37 39 51.206 85 23 54.384	1578.6 1332.9	37 46 38.5 117 34 43.4	217 45 11.7 297 32 48.5	Ferriell Rohan	5688.6 5197.9	3.755003 3.715627
Gethsemane La Trappe Mon- astery spire 1883	37 39 53.475 85 31 44.488	1648.6 1090.3	177 17 10.9 251 18 33.3 299 33 57.5	357 17 07.1 71 21 25.7 119 37 17.8	Willett Rohan Ferriell	3207.9 7296.1 9247.6	3.506220 3.863061 3.966028
Buzzards Roost <sup>1</sup> 1883	37 39 29.648 85 36 56.491	914.0 1384.6	283 40 15.0 307 54 29.4	103 46 45.8 127 58 21.1	Ferriell Thompson	16152.1 5684.4	4.208230 3.754081
New Hope Distillery smoke- stack <sup>1</sup> 1883	37 38 02.631 85 30 24.103	81.1 591.0	220 39 25.4 280 42 01.2	40 41 28.6 100 44 32.4	Rohan Ferriell	7584.8 6179.6	3.879943 3.790962
Chicago Catholic Church spire <sup>1</sup> 1883	37 37 33.339 85 25 50.024	1027.8 1226.7	69 11 59.5 130 26 04.7 165 04 36.1	249 11 43.3 310 22 24.3 345 03 51.9	Ferriell Willett Rohan	694.2 11609.0 6888.1	2.841511 4.064794 3.838099
St. Charles Catholic Church spire <sup>1</sup> 1883	37 35 38.915 85 20 38.696	1199.7 949.3	111 37 59.3 137 17 56.4	291 34 33.1 317 14 02.1	Ferriell Rohan	8911.2 13863.8	3.949938 4.141883
Lebanon Catholic Church spire <sup>1</sup> 1883	37 34 05.711 85 15 05.625	176.1 138.0	110 33 39.0 126 40 00.3	290 26 49.7 306 32 42.7	Ferriell Rohan	17570.6 21895.7	4.244787 4.340359

<sup>1</sup> No check on this position.

## DESCRIPTIONS OF STATIONS.

This list may be conveniently consulted by reference to the illustrations at the end of this publication or to the index. All azimuths given in these descriptions are reckoned continuously from true south around by west to 360°, south being 0°, west 90°, north 180°, and east 270°. Where magnetic directions are given they are indicated as such.

In general the surface and underground marks 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 dates and initials given in each description immediately after the county refer to the date of establishment of the station, the man by whom it was established, and the date when the station was last visited.

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 Superintendent, Coast and Geodetic Survey, Washington, D. C.

*Marking of stations.*—The standard triangulation disk station mark referred to in note 8 consists of a disk and shank, as shown in illustration No. 4 of Special Publication No. 19, made of brass and cast in one piece. The disk is 90 millimeters in diameter, with a small 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 Superintendent, Washington, D. C. \$250 fine or imprisonment for disturbing this mark." The shank is 25 millimeters in diameter and 80 millimeters long, with a slit at the lower end into which a wedge is inserted so that when it is driven into a drill hole in the rock it will bulge at the bottom and hold the mark securely in place.

The standard disk reference mark referred to in note 8 is similar to the standard disk triangulation station mark described above, except that the center of the disk is inscribed with an arrow instead of with the triangle and that the words "reference mark" replace the words "triangulation station" in the legend. A short perpendicular groove across the shank of the arrow indicates the point to which the measurements are made. The mark is set so that the arrow points toward the station.

#### NOTES REGARDING STATION AND REFERENCE MARKS.

NOTE 1.—The station is marked by a cross in the top of a sandstone or limestone post about 6 inches square and 30 inches long projecting 4 to 6 inches above the ground. The letters U S are inscribed in the face of the post. The underground mark is the apex of an earthenware pyramid about 30 inches below the ground. The pyramid is about 10 inches on an edge and has on one face the raised letters U. S. C. S.

NOTE 2.—Same as note 1 except that the underground pyramid is 6 inches on an edge and that the post of the surface mark is of white marble inscribed with the letters U S C & G S. In addition there are two or three reference posts also of white marble but slightly smaller than the post marking the station with an arrow in the top of each pointing toward the station. The distance and azimuth to each of these reference posts are given in the description.

NOTE 3.—Same as note 1 except that the post is marked with the letters U. S. C. S. and the underground mark is a bottle filled with ashes instead of the earthenware pyramid. Two other stone posts, slightly smaller than the one marking the station, are respectively 5 feet north and 5 feet south of the station and in the top of each there is an inscribed diagonal cross with an arrowhead at the end of one diagonal pointing toward the station.

NOTE 4.—The station is marked by two stone posts, one at the surface of the ground and the other 3 feet deep directly below the surface mark. Both posts are in an upright position. This type of marking was employed by the United States Engineers.

NOTE 5.—The station is marked by a pine stub about 4 inches square surrounded by a small mound of earth. The underground mark is an earthenware pyramid, measuring 10 inches on each of its edges and having on one face the raised letters U. S. C. S., set about 2½ feet below the surface of the ground.

NOTE 6.—The station is marked by a cross in the top of a stone post 6 inches square and 30 inches long inscribed with the letters U. S. C. & G. S. It is also marked by a bottle set in cement about 2½ feet below the ground. Four other stone posts 6 inches square and 30 inches long are respectively north, east, south, and west from the station at distances given in the description. The top of each of the reference posts is marked with a diagonal cross with an arrowhead at the end of one diagonal pointing toward the station.

NOTE 7.—The station is marked by a nail set in concrete at the center of the top of a tile 6 inches in diameter and 2 feet long. The tile is filled with concrete and is set flush with the surface of the ground. The underground mark is an earthenware pyramid set about 2½ or 3 feet below the surface. There are four reference marks similar to the surface mark at the station, except the tiles are only 4 inches in diameter. They are north, east, south, and west from the station at distances given in the description.

NOTE 8.—The station is marked by a standard disk station mark set in the top of a block of concrete 16 inches square at the bottom, 14 inches square at the top, and 2 feet long, projecting about 6 inches above the ground. The underground mark is similar to the surface mark except that the block of concrete is only 10 inches square and 10 inches deep. It is about 2 feet below the surface of the ground and about 6 inches of soil separates it from the surface mark. Each of the two reference marks consists of a standard disk reference mark set in the top of a block of concrete 6 inches square and 2 feet long set flush with the surface of the ground. The arrow on the disk of each reference mark points toward the station.

NOTE 9.—The marking of the station is the same as described in note 6 except that the underground mark is an earthenware pyramid with edges about 6 inches long marked with the raised letters U. S. C. S. The reference marks are the same as described in note 6 but there are only three of them instead of four.

NOTE 10.—The station is marked by a limestone post 2 feet in length and dressed to 5 inches square at the top inscribed with a cross and the letters U. S. C. & G. S. It is also marked 2 feet below the surface of the ground by a copper wire set in cement in the mouth of a black bottle which in turn is set at the center of a 10-inch tile filled with concrete. There are three reference marks each consisting of a stone similar to the one marking the station, except that the top is inscribed with a diagonal arrow pointing toward the station.

NOTE 11.—The station is marked by a half-inch drill hole in the upper surface of a small bowlder which projects slightly above the surface of the ground. The underground mark is the center of the mouth of a stone jug 5 inches in diameter and 11 inches high 1 foot below the ground. There is a pile of stones over the station mark.

### THIRTY-NINTH PARALLEL.

#### PRINCIPAL POINTS.

*Briery* (Pocahontas County, W. Va., A. T. M., 1880).—In the southwestern part of the county about 4 miles west of Hillsboro on the highest part of a peak known locally as Briery Knob, a part of the large dividing ridge between the Greenbrier and Gauley Rivers. The station is at the eastern end of the knob about 50 meters west of a clump of pines. It is marked by a cross in the top of a copper bolt set in solid bedrock about 2 feet below the surface of the ground and by a cross in the top of a marble post 6 inches square and 30 inches long which projects a few inches above the ground. The top of the post is inscribed with the letters U. S. C. S. There are four reference marks near the station at the following distances and directions: 2.14 meters north, 2.13 meters east, 2.15 meters south, and 2.14 meters west. The north and south marks consist of iron bolts set in drill holes in bedrock about 18 inches below the ground. A large bowlder with a drill hole in its upper surface is directly above each bolt. The east and west reference marks consist of marble posts 6 inches square and 30 inches long each marked with a diagonal cross and an arrow head pointing toward the station.

*Keeney* (Summers County, W. Va., A. T. M., 1880).—About 4 miles northwest of Alderson station on the Chesapeake & Ohio Railway, on the extreme northern and highest part of Keeney Mountain. The station is marked according to note 6.<sup>1</sup> The reference marks are located as follows: 2.15 meters north, 2.17 meters east, 2.11 meters south, and 2.15 meters west.

*Beech* (Greenbrier County, W. Va., A. T. M., 1880).—About 11 miles northeast of Snow Hill post office and 4 miles north of the house of Albert G. Williams, on the highest point of Beech Knob. The station is marked by a cross in the top of a rough sandstone post 6 inches square and 2 feet long. There are four reference marks, each consisting of a rough sandstone post marked with a drill hole, at the following distances and directions from the station: 2.10 meters north, 2.08 meters east, 2.13 meters south, and 2.16 meters west.

*Summersville* (Nicholas County, W. Va., A. T. M., 1880).—On a ridge about 1 mile west of Summersville and very nearly in the prolongation of the main street of the town. The station is marked according to note 6,<sup>1</sup> except that there are no letters cut in the top of the post. The reference marks are at the following distances and directions from the station: 2.14 meters north, 2.22 meters east, 2.13 meters south, and 2.10 meters west. A large lone tree, visible for 40 miles, is 4.69 meters from the station in azimuth  $174^{\circ} 40'$  and is marked with a spike. Two stumps marked with spikes are respectively 4.27 meters from the station in azimuth  $330^{\circ} 17'$  and 6.34 meters in azimuth  $141^{\circ} 51'$ .

*Ivy* (Raleigh County, W. Va., A. T. M., 1881).—On the highest point of Ivy Knob, one of the peaks of the Cherry Pond Mountains, near the corner of Wyoming and Boone Counties. The station is marked according to note 6<sup>1</sup> with the exception that the underground mark is an iron spike set with cement in a drill hole in solid bedrock 18 inches below the surface of the ground. The reference marks are at the following distances and directions from the station: 2.15 meters north, 2.13 meters east, 2.12 meters south, and 2.12 meters west. There is a drill hole 4 inches deep in bedrock directly under both the east and south reference posts.

*Table rock* (Kanawha County, W. Va., A. T. M., 1881).—On the range of hills near the headwaters and between the two forks of Lens Creek which flows into the Kanawha River at Brownstown. The station is on a long ridge, very narrow and steep, and is just above Tea Table Rock. It is marked according to note 6.<sup>1</sup> The reference marks are at the following distances and directions from the station: 2.14 meters north, 2.15 meters east, 2.12 meters south, and 2.13 meters west.

*Holmes* (Kanawha County, W. Va., A. T. M., 1881).—About  $8\frac{1}{2}$  miles by road from Charleston on top of a hill of the ridge forming the divide between Coopers Creek which flows into Elk River and Two Mile Creek which flows into the Kanawha River. The station is on land belonging to S. W. Gibson near the property lines of Marshall P. Holmes and Mason Guthrie. Holmes's house is about one-half mile southwest of the station at the head of the left fork of Two Mile Creek. The station is marked according to note 6.<sup>1</sup> The reference marks are at the following distances and directions from the station: 2.12 meters north, 2.12 meters east, 2.01 meters south, and 2.04 meters west.

*Piney* (Cabell County, W. Va., A. T. M. 1883; 1891).—On a ridge near Putnam County line about 2 miles northwest of Hurricane Station on the Chesapeake & Ohio Railway. The station was marked originally by an earthenware pyramid 2 feet below the ground with a hexagonal concrete pier built over it. As the pier was built a spike was inserted in the concrete about every 12 inches in height directly above the apex of the pyramid. The pier was found broken off at the surface of the ground in 1891 but by digging down about 6 inches one of the spikes at the center of the pier was found. The station was then re-marked by building a dome of concrete 2 feet in diameter and about 1 foot high on the old foundation and inserting a spike at the center directly above the old spike. The letters U. S. C. & G. S. were

<sup>1</sup> See p. 25.

inscribed in the dome. Four reference marks, consisting of concrete blocks 8 inches square and about 2 feet long, are at the following distances and directions from the station: 1.90 meters north, 1.80 meters east, 1.81 meters south, and 1.84 meters west. A concrete pier used in making time observations in 1883 is 13.64 meters north of the station.

*Pigeon* (Lincoln County, W. Va., A. T. M., 1883).—On a high ridge at the head of Middle Creek which flows into Mud River about  $3\frac{1}{2}$  miles from Hamlin. The station is about 7 miles by road from Hamlin and is on land belonging to Tom Huffman. It is marked according to note 6.<sup>1</sup> The reference marks are at the following distances and directions from the station: 2.76 meters north, 2.76 meters east, 2.76 meters south, and 2.75 meters west.

*Big Rocks* (Kanawha County, W. Va., A. T. M., 1881; 1891).—On the highest point of Big Rocks Hill, about  $5\frac{1}{2}$  miles in a southwesterly direction from St. Albans. The station is marked according to note 7.<sup>1</sup> The reference marks are at the following distances and directions from the station: 1.86 meters north, 1.50 meters east, 1.88 meters south, and 1.79 meters west.

*Simms* (Putnam County, W. Va., W. B. F., 1891).—On the west side of the Kanawha River on the highest point of the first river hill about 2 miles north or down the river from Scary. The station is on land belonging to Robert Simms and is marked according to note 7.<sup>1</sup> The reference marks are at the following distances and directions from the station: 1.78 meters north, 2.29 meters east, 1.81 meters south, and 2.09 meters west.

*Coal* (Kanawha County, W. Va., W. B. F., 1893).—On a sharp rocky point, the highest point of the ridge known as Indian Creek Hills, about 2 miles south of St. Albans. The station is on land belonging to Mr. Vickers and is marked according to note 7,<sup>1</sup> with the exception of the reference marks. There are only three reference marks, each consisting of a 1-inch drill hole 6 inches deep in solid bedrock, and they are at the following distances and azimuths from the station: 5.35 meters,  $3^{\circ} 38'$ , 2.93 meters,  $163^{\circ} 34'$ , and 3.96 meters,  $212^{\circ} 20'$ .

*Rogers* (Kanawha County, W. Va., W. B. F., 1893).—On a sharp rocky peak with a small top, on land belonging to L. R. Rogers on the west side of the Coal River about one-half mile from St. Albans. The station is marked by a nail set in concrete at the center of the top of a tile 6 inches in diameter, which is filled with concrete. The underground mark is a cross in the top of a copper bolt set in bedrock 15 inches below the surface of the ground. In each of the directions north, east, and south there is a drill hole in bedrock and west of the station there is a 4-inch tile filled with concrete. They are at the following distances from the station: 3.96 meters north, 3.41 meters east, 1.70 meters south, 2.02 meters west.

*Ryan* (Kanawha County, W. Va., W. B. F., 1892).—On a small rounded hill on the land of Pat Ryan, the highest point of his farm on the north side of the Kanawha River about 2 miles northeast of the town of St. Albans. The station is marked according to note 7.<sup>1</sup> The reference marks are at the following distances and directions from the station: 1.81 meters north, 1.83 meters east, 1.84 meters south, and 1.83 meters west.

*St. Albans east base* (Kanawha County, W. Va., W. B. F., 1893).—About 2 miles east of the railway station at St. Albans in the southeast corner of a large field belonging to Samuel Shrewsbury about 50 meters west of the west bank of Swindlers Creek and 18.3 meters north of the north rail of the main line of the Chesapeake & Ohio Railway. The station is marked by a small hole in the top of a copper bolt set in the top of a limestone block or post 18 inches square and 4 feet long. The upper end of the block, which projects 1 foot above the ground is cut in a conical form. The block rests on a concrete foundation 4 feet square and 1 foot thick with a hole 9 inches square at the center to give access to the underground mark which consists of a copper bolt marked with a cross and small drill hole set in the top of another limestone post 6 inches square and 2 feet long, 4 feet below the surface of the ground.

*St. Albans west base* (Kanawha County, W. Va., W. B. F., 1893).—In the fence line on the west side of First Street, St. Albans, 17.85 meters in a northerly direction from the north rail of the Chesapeake & Ohio Railway at a point 268 meters east of the west face of the eastern abutment of the railway bridge over the Coal River. Daniel J. Lewis owns the property just west of First Street and the station is on his east property line. The station is marked the same as *St. Albans east base* described above.

*Davis* (Cabell County, W. Va., A. T. M., 1883).—About 9 miles by road from Huntington on the ridge forming the divide between Davis Creek and Four Mile Creek. The station is marked by a spike in the top of a concrete post 1 foot square and about 3 feet long which projects 10 inches above the surface of the ground. It is also marked by an earthenware pyramid 3 feet below the ground. The reference marks are four concrete piers at the following distances and directions from the station: 1.86 meters north, 1.86 meters east, 1.88 meters south, and 1.88 meters west. A large pine tree marked with a cross and a spike is 7.97 meters nearly north of the station and an oak tree marked with a spike is 4.75 meters northwest. The marked pine tree, the north and south reference marks, and the station are in range.

*Gebhardt* (Cabell County, W. Va., A. T. M., 1883).—On Union Ridge about 4 miles from La Sage's Landing on the Ohio River and about 150 meters south of the house of John Gebhardt. The station is marked according to note 7.<sup>1</sup> The reference marks are at the following distances and directions from the station: 1.81 meters north, 1.81 meters east, 1.85 meters south, and 1.80 meters west.

*Wray* (Lawrence County, Ohio, A. T. M., 1884).—About 16 miles from Huntington, W. Va., and  $2\frac{1}{2}$  miles east of Marion post office, on Johnsons Ridge about 250 meters west of the old John Johnson house, which is owned by W. C. Wray. The station is on the highest part of the hill about 50 yards north of the road along the top of the ridge. It is marked according to note 7,<sup>1</sup> except that the tile of the station mark is only 4 inches in diameter. The reference marks are at the following distances and directions from the station: 1.81 meters north, 1.82 meters east, 1.83 meters south, and 1.80 meters west.

<sup>1</sup> See p. 35.

*Oakland* (Boyd County, Ky., A. T. M., 1884).—On the highest part of the wooded hill at the headwaters of Chadwicks Creek, on land belonging to Thomas Galligher and only a few feet from the line fence between his property and that of James L. Rucker. The station is marked according to note 7,<sup>1</sup> except that the tile of the station mark is only 4 inches in diameter. The reference marks are at the following distances and directions from the station: 1.82 meters north, 1.83 meters east, 1.53 meters south, and 1.85 meters west.

*Fradd* (Lawrence County, Ohio, A. T. M., 1884).—On a hill bare of trees near the line between Lawrence and Aid Townships about 3 miles from Marion and about 1 mile west of a schoolhouse on the hill. The station is about 100 meters south of the road from Marion to Vesuvius Furnace, on land belonging to Charles Fradd who lives in a hollow about one-third of a mile southwest of the station. It is marked according to note 7.<sup>1</sup> The reference marks are at the following distances and directions from the station: 2.33 meters north, 1.83 meters east, 1.98 meters south, and 1.83 meters west.

*Buena Vista* (Greenup County, Ky., A. T. M., 1884).—On the highest point of a narrow ridge, known locally as High Knob, about 2½ miles east of Hunnewell furnace and just to the left of the county road to the old Buena Vista furnace at the point where the road crosses the ridge. The station is marked by a spike in the top of a concrete pier which extends about 4½ feet above the surface of the ground. As the pier was built a spike was inserted at the center at the following heights: Six inches below the ground and 6 and 15 inches below the top of the pier. Any one of these spikes will give the true location of the station. The underground mark is an earthenware pyramid 3 feet below the surface. There are four reference marks as follows: A nail in the top of a concrete pier 6 inches square and 2 feet long set flush with the surface of the ground 2.18 meters east and a similar mark 2.13 meters west, and a nail in the top of an oak stub 2.38 meters north, and a similar mark 2.45 meters south. A blazed stump marked with a triangle of nails is 5.88 meters from the station.

*Gould* (Scioto County, Ohio, A. T. M., 1885).—On a wooded hill east of the Ohio River about 1½ miles from Franklin furnace landing, three-fourths mile from Powellville, and about one-half mile from Junior furnace. The station is marked according to note 7<sup>1</sup> with the exception that the west reference mark consists of a brass bolt driven into an oak stump and surrounded by a triangle of nails. The reference marks are at the following distances and directions from the station: 1.85 meters north, 1.76 meters east, 1.86 meters south, and 1.76 meters west.

*Howland* (Greenup County, Ky., A. T. M., 1885).—Between Tygarts Creek and Shultz Creek and between the right and left forks of Beechy Creek, about 3½ miles west of Liberty post office on a point of land belonging to James Howland, about 400 meters northwest of his house and about 100 meters west of the main county road from Shultz Creek to the mouth of Brushy Creek. The station is marked according to note 7.<sup>1</sup> The reference marks are at the following distances and directions from the station: 1.97 meters north, 1.84 meters east, 1.81 meters south, and 1.86 meters west.

*Scioto* (Scioto County, Ohio, A. T. M., 1885).—On land belonging to George Davis, about 1½ miles west of his distillery, which is on the west side of the Scioto River about 1½ miles northwest of Portsmouth. The station is marked according to note 7.<sup>1</sup> The reference marks are at the following distances and directions from the station: 1.92 meters north, 1.91 meters east, 1.88 meters south, and 1.86 meters west.

*Cave* (Greenup County, Ky., A. T. M., 1885).—On the ridge forming the divide between Leatherwood Creek and White Oak Creek on land belonging to the Kenton Iron Co., about 2 miles from the old Kenton furnace. The station is at the head of Peter Cave Creek, a small tributary of White Oak Creek. It is marked according to note 7.<sup>1</sup> The reference marks are at the following distances and directions from the station: 1.86 meters north, 1.51 meters east, 1.99 meters south, and 1.77 meters west.

*Round Top* (Lewis County, Ky., A. T. M., 1885).—On a river hill known locally as Round Top, the highest point along the Ohio River between Pitts and Cincinnati. The station is about 5 miles west of Quincy, 1 mile from Bevis landing, and just back of L. Johnson's house. It is marked according to note 7.<sup>1</sup> The reference marks are at the following distances and directions from the station: 1.79 meters north, 1.90 meters east, 1.81 meters south, and 1.81 meters west.

*Twin Creek* (Adams County, Ohio, A. T. M., 1886).—On the ridge forming the divide between Upper Twin Creek and Lower Twin Creek, which flow into the Ohio River, and Churn Creek, which flows into Brush Creek and thence into the Scioto River. The station is on land belonging to Wash McGraw, about one-half mile northwest of his house. It is marked according to note 7.<sup>1</sup> The reference marks are at the following distances and directions from the station: 2.28 meters north, 2.13 meters east, 2.17 meters south, and 2.21 meters west.

*Peach Mount* (Adams County, Ohio, A. T. M., 1886).—On a ridge about 2 miles by road northwest of Mineral Springs, on land belonging to James Miller, a short distance northwest of his house. The station is marked according to note 7.<sup>1</sup> The reference marks are at the following distances and directions from the station: 1.83 meters north, 2.12 meters east, 1.85 meters south, and 2.04 meters west.

*Cherry Ridge* (Lewis County, Ky., A. T. M., 1886).—On the highest point of a ridge about 2 miles southeast of Concord and 1½ miles south of the south bank of the Ohio River. The station is on land belonging to Miss Wood, just west of the property line between her land and that of Mrs. Lee, which is on the east side of the mountain. There is a quarry on the west slope of the mountain about 200 meters below the station. The station is marked according to note 7.<sup>1</sup> The reference marks are at the following distances and directions from the station: 2.30 meters north, 2.47 meters east, 2.40 meters south, and 2.55 meters west.

<sup>1</sup> See p. 35.

*Cave Hill* (Adams County, Ohio, A. T. M., 1886).—On the highest point of Cave Hill about 4 miles northwest of the town of West Union. Clark Hill, which is about 8 feet higher than Cave Hill, is about one-fourth mile west. The station is on land belonging to John Drennan about one-half mile north of a schoolhouse. It is marked according to note 7.<sup>1</sup> The reference marks are at the following distances and directions from the station: 2.03 meters north, 2.06 meters east, and 2.04 meters south, 2.17 meters west.

*Ash Ridge* (Brown County, Ohio, A. T. M., 1887).—On a rise of ground 3 miles south of South Fincastle, about 1 mile north of the village of Carlisle and one-fourth mile northwest of a church, on land belonging to Dr. Evans, of Georgetown. The station is marked according to note 7.<sup>1</sup> except that the underground mark is a bottle filled with cement. The reference marks are at the following distances and directions from the station: 1.84 meters north, 1.89 meters east, 1.83 meters south, and 1.81 meters west. The following azimuths are from the station: Russellville spire, 25° 42'; James M. Parker's house, 153° 00'; John Schwallies' house, 226° 06'; schoolhouse, 309° 33'; and church mentioned above, 327° 10'.

*Minerva* (Mason County, Ohio, A. T. M., 1887).—About one-fourth mile north of the crossroads where are located churches, stores, etc., which form the village of Minerva, in a field belonging to George F. Winter directly across the road from Mr. Wilson's house. The station is marked according to note 7.<sup>1</sup> The reference marks are at the following distances and directions from the station: 1.74 meters north, 1.86 meters east, 1.77 meters south, 1.82 meters west. The following azimuths were read at the station: Front gable Christian Church (wood), 348° 59'; back gable Methodist Church (brick), 352° 52'; back gable Catholic Church (wood), 355° 26'; front gable Baptist Church (brick), 1° 54'; east chimney Winter's house, 51° 53'; and front door Wilson's house, 286° 06'.

*Tate* (Clermont County, Ohio, A. T. M., 1887).—About 1½ miles north of Saltair, a small crossroads hamlet of three or four houses and a postoffice, one-half mile east of the Tate and Munroe township line, in the fence line forming the boundary between the land of J. Hibbets on the north and that of Mr. Salt on the south. The station is marked according to note 7.<sup>1</sup> The reference marks are at the following distances and directions from the station: 1.84 meters north, 1.86 meters east, 1.83 meters south, and 1.83 meters west. The following azimuths and approximate distances are from the station: E. Frazer's white wooden cottage, east gable, one-half mile, 357° 55'; Salt's brick house, west gable, one-third mile, 3° 53'; John Tatman's house, east gable, one-half mile, 69° 18'; J. Hibbet's house chimney, one-fourth mile, 177° 23'.

*Flaughner* (Pendleton County, Ky., A. T. M., 1887).—About 1 mile west of Lenoxburg and three-fourths mile west of the county line, on the south side of the Lenoxburg and Falmouth turnpike in an apple orchard belonging to David Flaughner, about 50 meters south of his house and just west of his large tobacco barn. The station is marked according to note 7.<sup>1</sup> The reference marks are at the following distances and directions from the station: 1.80 meters north, 1.85 meters east, 1.84 meters south, and 1.83 meters west. The northwest corner of Flaughner's tobacco barn is 9.37 meters from the station and the southwest corner is 15.68 meters distant.

*Stevens* (Kenton County, Ky., A. T. M., 1887; 1889).—About 2½ miles east of Independence and 1 mile west of the little hamlet of Staffordsburg in the dooryard near the house of John A. Stevens opposite the forks in the roads leading east to Staffordsburg, north to Covington, and west to Independence. The station is marked according to note 7.<sup>1</sup> The reference marks are at the following distances and azimuths from the station: 1.85 meters, 65° 35'; 1.83 meters, 155° 35'; 1.82 meters, 245° 35'; and near the corner of the house, 11.17 meters, 335° 35'. The northwest corner of the chimney is 12.01 meters from the station in azimuth 327° and the northeast corner of the house is 15.8 meters in azimuth 302°.

*Dry Ridge* (Grant County, Ky., A. T. M., 1889).—About one-third mile east of the railway station at Dry Ridge on the north side of the turnpike to Knoxville. There is a bend in the road about 150 meters west of the station and but for this bend the station would be in the middle of the road, that is, it is in the prolongation of the straight part of the road west of the bend. The station is marked according to note 7.<sup>1</sup> and the surface mark is surrounded by a block of concrete 2 feet deep and 16 inches in diameter. The reference marks are at the following distances and directions from the station: 1.82 meters north, 1.82 meters east, just north of the north road fence 15 meters south, and in the middle of a path 10.45 meters west. There is a house about 150 meters north of the station. An elm tree marked with a blaze is in the hollow on the north side of the turnpike 89.2 meters from the station in azimuth 81° 14'.

*Tanner* (Boone County, Ky., A. T. M., 1889).—About 1½ miles from Florence and one-half mile west of the toll-gate, on the Burlington pike, on land belonging to Noah Clore, nearly south of his house. The station is marked according to note 7.<sup>1</sup> The reference marks are at the following distances and directions from the station: 1.84 meters north, 1.84 meters east, 1.83 meters south, and 1.83 meters west. The corner stone at the corner of Noah Clore's and E. K. Tanner's lands is 18.5 meters from the station in azimuth 278° 52'.

*Stow* (Switzerland County, Ind., A. T. M., 1890).—About 2 miles south of East Enterprise, in the southeast corner of NW. ¼ sec. 9, T. 3 N., R. 2 W., on the west side of the pike between East Enterprise and Markland. The station is on land belonging to Uziel U. Stow, in the cleared field northeast of his house and just north of a clump of timber known as the deer park. It is 21.5 meters from the center of the pike, 32 meters south of the south edge of an apple orchard, and 27 meters northeast of a frog pond. The station is marked according to note 7.<sup>1</sup> The reference marks are at the following distances and directions from the station: 1.83 meters north, 1.83 meters east, 1.83 meters south, and 1.83 meters west.

*Reizin* (Ripley County, Ind., A. T. M., 1889).—About 1 mile east of Elrod and about 300 meters south of the road from Elrod to Dillsboro, on land belonging to Joseph Beall about 12 meters east of the line fence between his land

<sup>1</sup> See p. 35.

and that of Reizin Johnson. The station is marked according to note 7.<sup>1</sup> The reference marks are at the following distances and directions from the station: 1.82 meters north, 1.84 meters east, 1.82 meters south, and 11.9 meters west. The west reference mark is in the fence line mentioned above. A lone hickory tree, marked with a blaze and a triangle of nails, is 55.3 meters N. 24° 11' E. from the station.

*Culbertson* (Switzerland County, Ind., A. T. M., 1890).—About 11 miles by road in a northerly direction from Vevay, in Pleasant Township, in the northwest corner of SE.  $\frac{1}{4}$  sec. 33, T. 5 N., R. 12 E., on land belonging to James Culbertson. The station is on the highest point of a pasture on the opposite side of the pike from Culbertson's house, about 200 meters from the pike, and about 15 meters east of the center of a road running south from the pike. The station is marked according to note 7.<sup>1</sup> The reference marks are at the following distances and directions from the station: 1.80 meters north, 1.87 meters east, 1.81 meters south, and 10.86 meters west. The west reference mark is in the fence line on the east side of the road.

*Correct* (Ripley County, Ind., A. T. M., 1890).—About one-half mile north of Correct post office, in Johnson Township, in the southwest corner of SE.  $\frac{1}{4}$  SE.  $\frac{1}{4}$  sec. 27, T. 7 N., R. 11 E., on the west side of the county road from Correct to Versailles. The station is nearly on the line between sections 27 and 34. It is marked according to note 7.<sup>1</sup> The reference marks are located as follows: About 1 foot inside of the fence line on the west side of the road 7.27 meters east of the station, on the east side of the road 19.85 meters east of the station, in the fence line 9.21 meters south of the station, and about 1 foot inside of the fence on the west side of the road 20.25 meters from the station in azimuth 220° 43'. The north gable of Mr. Jackson's barn is 49.4 meters from the station in azimuth 285° 50', and a walnut tree is 82.3 meters from the station in azimuth 172° 51'.

*Glasgow* (Ripley County, Ind., A. T. M., 1890; 1906).—About 1 $\frac{1}{4}$  miles south of the town of Osgood, on the west side of the continuation of the road to Ashman & Glasgow's quarries on land belonging to Jasper S. Bilby, of the United States Coast and Geodetic Survey. The station is in the SE.  $\frac{1}{4}$  SE.  $\frac{1}{4}$  sec. 28, T. 8 N., R. 11 E., 178.0 meters north and 28.7 meters west of the stone marking the southeast corner of the section. The station is marked according to note 7.<sup>1</sup> The reference marks are located as follows: West side of road 30.63 meters from the station in azimuth 226° 45', west side of road 22.96 meters in azimuth 271° 37', east side of road 34.43 meters in azimuth 271° 37', and west side of road 27.94 meters from the station in azimuth 308° 43'. Five tons of stones were used in anchoring the legs of the tripod and scaffold.

*Green* (Jennings County, Ind., G. A. F., 1890).—About 5 miles north of the town of Butlerville and 2 miles southwest of the town of Zenas, in Columbia Township near the northeast corner of sec. 34, T. 8 N., R. 9 E., 282.6 meters west and 18.6 meters south of the stone marking the northeast corner of the section. The station is on land belonging to Samuel Rush and is marked according to note 7,<sup>1</sup> except that there are only three reference marks. The reference marks are in the fence line on the south side of the road along the north side of the section and are at following distances and azimuths from the station: 21.13 meters 131°, 13.08 meters 180° 30', and 20.42 meters 233° 25'.

*Holton north base* (Ripley County, Ind., A. T. M., 1890).—About 1 mile east of Holton, in Otter Creek Township, in the southeast corner of sec. 2, T. 7 N., R. 10 E., on land belonging to Sam Cox, 28.9 meters south of the south rail of the Baltimore & Ohio Southwestern Railroad track. The station is marked by a cross and small drill hole in the top of a copper bolt set in the center of the top of a block of limestone 3 feet square and 2 $\frac{1}{2}$  feet thick made up of two parts, one 9 inches thick and the other 21 inches thick, cemented together. This block rests on a concrete foundation 4 feet square and 1 foot thick, with a hole 1 foot square at the center to give access to the underground mark, which consists of a copper bolt in the top of a limestone post 6 inches square and 2 feet long. The surface mark projects about 6 inches above the ground and has its upper edges beveled. It was intended to mount a shaft on this monument, but there is no record of its having been done. Four reference marks, each consisting of a stone post 6 inches square and 2 feet long, with a copper bolt at the center of the top, are at the following distances and azimuths from the station: 15.0 meters 85° 54', 14.95 meters 175° 54', 15.00 meters 265° 54', and 15.01 meters 355° 54'.

*Holton south base* (Ripley County, Ind., A. T. M., 1890).—About 1 $\frac{1}{4}$  miles north of New Marion, in Center Township, in the northwest corner of sec. 25, T. 7 N., R. 10 E., on land belonging to Mr. Hilson. The station is marked exactly the same as *Holton north base*, described above. The reference marks are at the following distances and azimuths from the station: 13.02 meters 54° 37', 16.67 meters 138° 34', 15.73 meters 214° 39', 11.75 meters 306° 56'. The second and third reference marks are in the fence line on the south side of the public road north of the station.

*Mud Lick* (Jefferson County, Ind., A. T. M., 1890).—About 7 miles from Madison and one-half mile south of Mud Lick post office, in the southeast corner of NW.  $\frac{1}{4}$  sec. 26, T. 5 N., R. 10 E., on land belonging to William H. Buckhannon. The station is on the west side of the Michigan road, which is very nearly on the half-section line north and south of section 26, and is just north of the county road to Lancaster, which is on the half-section line east and west of section 26. The station is marked according to note 7.<sup>1</sup> The reference marks are at the following distances and azimuths from the station: 32.7 meters 8° 08', 44.16 meters 8° 08', 50.44 meters 278° 04', and 57.82 meters 305° 00'. The east edge of the chimney on Buckhannon's house is in azimuth 190° 15' from the station, the east edge of the chimney on Denney's house is in azimuth 212° 38', and the east edge of the chimney on a house south of the station is in azimuth 355° 28'.

*Stout* (Jefferson County, Ind., G. A. F., 1890; 1914).—About 5 miles southwest of the town of Dupont, about the same distance northeast of the town of Paris, and about 1 mile north of Neils Creek post office, on land belonging to Mr. Shawhan, a son-in-law of A. O. Stout, who owned the land when the station was established. The station is about one-third mile north of Shawhan's house, near the northeast corner of sec. 25, T. 5 N., R. 8 E. The north line of this

<sup>1</sup> See p. 35.

section is also the county line between Jefferson and Jennings Counties. The station is marked according to note 7,<sup>1</sup> except that there are only three reference marks and they have the numbers 1, 2, and 3 cut in the tops. They are in the fence line west of the station and are at the following distances and magnetic bearings from the station: No. 1, 12.48 meters S. 43° 12' W.; No. 2, 8.45 meters S. 86° 48' W.; and No. 3, 14.00 meters N. 36° 41' W. The stone marking the northwest corner of NE.  $\frac{1}{4}$  NE.  $\frac{1}{4}$  sec. 25 is 13.16 meters N. 39° 55' W. (mag.) from the station.

*Tripp* (Jennings County, Ind., G. A. F., 1890; 1914).—About 1 mile southwest of North Vernon, 100 meters south-east of the North Vernon-Seymour pike on land belonging to Thomas Noon, about 100 meters south of his house and 100 meters east of an old barn. The station is about 10 meters south of the north line of sec. 4, T. 6 N., R. 8 E., and is marked according to note 8.<sup>1</sup> The reference marks are in the fence line north of the station at the following distances and azimuths from the station: 34.56 meters 110° 38', and 29.93 meters 257° 08'. Other azimuths were read as follows: Large concrete post at eastern end of a row of posts, about 100 meters distant, 98° 38'; William Day's house, about 150 meters distant, 127° 08'; Noon's house, 193° 08'.

*Miller* (Jennings County, Ind., G. A. F., 1889; 1914).—About 2 $\frac{1}{2}$  miles south of Brownstown in a small clearing known as the "Old Ike Miller peach orchard," on top of a ridge about 1 mile east of the main road from Brownstown, on land belonging to Miss Caroline Sanders. The station is in the SW.  $\frac{1}{4}$  SW.  $\frac{1}{4}$  NW.  $\frac{1}{4}$  sec. 25, T. 5 N., R. 4 E., about 100 meters northwest of a small cabin on the Sanders place. The station is marked according to note 9.<sup>1</sup> When visited in 1914 one reference mark was found in good condition and another was found with the top broken off 6 inches below the surface of the ground, but the third one could not be found. The broken mark is 11.67 meters S. 10° 52' E. (mag.) from the station, and the other is 11.73 meters N. 16° 20' W. (mag.) from the station.

*Weed Patch* (Brown County, Ind., G. A. F., 1889).—On Weed Patch Hill, claimed by some, though incorrectly, to be the highest point of land in the State, about 3 miles south-southeast of Nashville. The station is in the northern part of the SW.  $\frac{1}{4}$  SE.  $\frac{1}{4}$  SE.  $\frac{1}{4}$  sec. 32, T. 9 N., R. 3 E., in a peach orchard belonging to Rufus W. Reddick, just north of the road running east and west across the top of the hill. The station is marked according to note 9.<sup>1</sup> The reference marks are at the following distances and magnetic bearings from the station: 32.7 meters S. 37° 44' E.; near the corner of a log barn, 37.8 meters S. 14° 00' W.; and near an apple tree, 15.0 meters N. 7° 02' W.

*Fountain* (Jackson County, Ind., G. A. F., 1887).—About 2 $\frac{1}{2}$  miles from the town of Clear Springs, in the NW.  $\frac{1}{4}$  sec. 24, T. 6 N., R. 2 E., on land belonging to Thomas Fountain, a short distance northwest of his house and barn. The station is in an open field near the edge of a beech woods. It is marked according to note 9.<sup>1</sup> The reference marks are at the edge of the woods at the following distances and magnetic bearings from the station: 26.88 meters S. 62° 36' W., 22.89 meters N. 55° 04' W., and 19.00 meters N. 18° 41' E. A lone beech tree 6.7 meters southeast of the first reference mark bears S. 48° 16' W. (mag.) from the station.

*Rariden* (Lawrence County, Ind., G. A. F., 1887).—About 3 miles from Mitchell on the top of a hill on the farm of S. R. Rariden, about one-fourth mile west of his house. The hill is wooded except near the station. The station is in the northwest corner of sec. 27, T. 4 N., R. 1 W., and is marked according to note 9.<sup>1</sup> The reference marks are at the following distances and magnetic bearings from the station: 6.73 meters N. 0° 43' W., 9.14 meters S. 89° 23' E., and 8.26 meters N. 86° 56' W. Three trees marked with spikes are at the following distances and magnetic bearings from the station: Oak, 14.5 meters N. 45° 43' E.; poplar, 15.7 meters S. 26° 35' E.; and oak with broken top, 20.6 meters S. 68° 04' W.

*Leonard* (Monroe County, Ind., G. A. F., 1887).—About 7 miles southwest of Bloomington, on the crest of a hill on the south side of the Stamford road, in the NE.  $\frac{1}{4}$  NW.  $\frac{1}{4}$  sec. 26, T. 8 N., R. 2 W. The station is on the north edge of a young orchard belonging to Thomas Ragan just north of his house. It is marked according to note 9.<sup>1</sup> The reference marks are at the following distances and magnetic bearings from the station: 21.43 meters N. 83° 30' W., 17.10 meters north, and 33.18 meters N. 78° 13' E. The first and third marks are in the fence line on the south side of the Stamford road, and the second mark is near the fence line on the north side of the road. There is a stump just south of the first reference mark.

*Beard* (Lawrence County, Ind., G. A. F., 1887).—About 7 miles from Harrodsburg and 2 $\frac{1}{2}$  miles from Springville, on a hill near the center of a cultivated field owned by J. T. Beard. The station is in Perry Township in the SE.  $\frac{1}{4}$  sec. 10, T. 6 N., R. 2 W. It is marked according to note 9.<sup>1</sup> The reference marks are at the following distances and magnetic bearings from the station: 37.98 meters N. 17° 00' E., 51.17 meters S. 42° 28' E., and 71.14 meters S. 66° 28' W. The second reference mark is in line with a mulberry tree about 125 meters from the station. A large oak is near the section line just east of the mulberry tree.

*Calvary* (Greene County, Ind., G. A. F., 1886).—In the extreme northwest corner of Center Township about 10 miles east of Worthington and about the same distance northeast of Bloomfield in the NE.  $\frac{1}{4}$  NE.  $\frac{1}{4}$  sec. 2, T. 7 N., R. 4 W., on the highest point of a high hill on land owned by Westley Gaston who lives about one-fourth mile northeast of the station. The station is marked according to note 9.<sup>1</sup> The reference marks are near the fence line on the north side of the road south of the station and are at the following distances and magnetic bearings from the station: On the line between sections 1 and 2, 209.5 meters S. 62° 18' E.; in range with a large tree on the opposite side of the road, 107.7 meters S. 1° 20' E.; and 143.3 meters S. 30° 30' W.

*Osborn* (Martin County, Ind., G. A. F., 1886).—About 4 miles south and 1 mile east of Scotland, in the northwest corner of the SW.  $\frac{1}{4}$  NE.  $\frac{1}{4}$  sec. 20, T. 5 N., R. 4 W., on top of a hill on land owned by James Osborn. There is a road which makes a right-angled bend to the north a short distance southwest of the station and another right-angled bend

<sup>1</sup> See p. 35.

to the east just northwest of the station. The home of H. T. Sumerville is on the west side of the north-and-south section of this road about 100 meters west of the station. The station is marked according to note 9.<sup>1</sup> The reference marks are at the following distances and magnetic bearings from the station: Near the fence east of the station, 30.5 meters N. 70° 30' E.; near the corner of the field where the two fence lines intersect, 56.2 meters S. 43° 45' E.; and near the fence line west of the station, 65.4 meters S. 23° 30' W.

*Sisson* (Sullivan County, Ind., G. A. F., 1885).—About 2 miles from Pleasantville just south of the road to Carlisle and south of a small dwelling house occupied by James L. Anderson which is on the north side of the road. The station is in Jefferson Township in the SW.  $\frac{1}{4}$  NE.  $\frac{1}{4}$  sec. 10, T. 6 N., R. 8 W., on land belonging to Mr. Sisson, an old man living about three-fourths mile north of the station. The station is marked according to note 9.<sup>1</sup> The reference marks are at the following distances and magnetic bearings from the station: In the fence corner where the fence west of the station joins the road fence, 67.5 meters N. 76° 00' W.; in the yard of Anderson's house, 52.7 meters N. 15° 05' W.; and on the inside of the fence along the south side of the road, 61.8 meters N. 52° 51' E. The second reference post is in line between the southeast corner of the house and the well, 4.85 meters from the house and 2.59 meters from the well.

*Wright* (Greene County, Ind., G. A. F., 1886).—In Wright Township near the center of sec. 21, T. 8 N., R. 7 W., on land owned by W. H. Smith whose house and barns are about 150 meters in a northwesterly direction from the station. The station is on the crest of the highest ground in the neighborhood and is marked according to note 9.<sup>1</sup> The reference marks are near the fence along the west side of the road east of the station at the following distances and magnetic bearings from the station: Just south of the driveway to Smith's house, 98.7 meters N. 47° 30' E.; 77.7 meters N. 88° 30' E.; and near the southeast corner of the quarter section, 137.6 meters S. 38° 30' E.

*Summit* (Knox County, Ind., G. A. F., 1884).—About 2 $\frac{1}{2}$  miles from Bruceville on the northwest side of the road from that place opposite the point where the road to Bicknell branches to the southeast. The station is in Washington Township in plat 122 near the southern end of a large field owned by Peter Fox who lives southeast of the station on the southwest side of the Bicknell road. There is a schoolhouse at the junction of the two roads and its northwest corner is 91.4 meters S. 68° 30' E. from the station. The station is marked according to note 9.<sup>1</sup> The reference marks are just inside the fence line on the north side of the Bruceville road at the following distances and magnetic bearings from the station: 79.74 meters S. 68° 30' E., 49.28 meters S. 12° 52' E., and 52.8 meters S. 42° W. There is a lone black walnut tree 27.4 meters N. 85° W. of the station and a similar tree on A. Green's land 71.6 meters N 70° E. The north-west corner of a house in ruins on the opposite side of the road is 83.8 meters S. 47° W. from the station.

*Merom College* (Sullivan County, Ind., G. A. F., 1885).—The center of the spire on the cupola of Merom College. The station was marked on the inside of the cupola by a cross and a copper tack in the top of the center post of the spiral stairway leading from the attic to the cupola.

*Honey Creek* (Crawford County, Ill., G. A. F., 1884).—In Honey Creek Township in an open field belonging to J. W. Love in the southwest corner of NE.  $\frac{1}{4}$  NW.  $\frac{1}{4}$  NE.  $\frac{1}{4}$  sec. 35, T. 6 N., R. 12 W. The station is 157.6 meters south of the fence along the south side of the section-line road and is marked according to note 2.<sup>1</sup> Three reference posts are located as follows: In the fence line 157.6 meters north, 214.2 meters west, and 264.7 meters N. 54° 15' W. The north-east corner of the section mentioned above is 616.0 meters distant N. 74° 10' E.

*Belle Air* (Clark County, Ill., G. A. F., 1884).—This station was established by the United States Engineers in 1879. It is in Orange Township in section 32, T 9 N., R. 13 W., 23.5 meters north of the fence on the south side of the section-line road dividing Clark and Crawford Counties, and 66.9 meters N. 53° 17' E. from the northeast corner of a house belonging to Isaac Hart. The station is marked according to note 4.<sup>1</sup> Three stone reference posts with the letters U. S. inscribed in the tops are located as follows: In the fence line on the south side of the road, 41.4 meters S. 38° 7' W.; in the same fence line 56.6 meters S. 58° 8' E.; and in the fence line on the north side of the road, 17.8 meters S. 49° 50' E. The section corner between sections 4 and 5 is 559 meters S. 86° 28' W.

*Hunt City* (Jasper County, Ill., G. A. F., 1884).—This station was established in 1879 by the United States Engineers. It is in Grandville Township, in the NE.  $\frac{1}{4}$  NW.  $\frac{1}{4}$  sec. 7, T. 7 N., R. 14 W., about 10 miles northeast of Newton and three-fourths mile northeast of Hunt City, a small station on the Danville, Olney and Ohio River Railroad. The station is marked according to note 4.<sup>1</sup> Three stone reference posts are located as follows: One on the east side of the section-line road west of the station, 678.88 meters S. 85° 32' W., and two on the south side of the section-line road north of the station, one distant 334.71 meters N. 33° 52' E., and the other distant 282.62 meters N. 9° 54' W. The northwest corner of the section mentioned above is 749.0 meters N. 66° 46' W.

*Claremont* (Richland County, Ill., G. A. F., 1884).—This station was established in 1879 by the United States Engineers. It is in German Township, in sec. 29, T. 4 N., R. 14 W., on land belonging to the Brinkley heirs, about 3 miles in a northwesterly direction from the town of Claremont. The station is marked according to note 4.<sup>1</sup> Three stone reference posts are located as follows: 23.1 meters N. 67° 33' W., 7.8 meters N. 0° 39' W., and 24.6 meters N. 71° 45' E. The northwest corner of the section mentioned above is 847 meters N. 60° 03' W. from the station.

*Oblong* (Crawford County, Ill., U. S. E., 1879).—This station was established by the United States Engineers. It is in Oblong Township, in the SE.  $\frac{1}{4}$  SE.  $\frac{1}{4}$  sec. 32, T. 7 N., R. 13 W., and is marked according to note 4.<sup>1</sup> Three stone reference posts are along the east side of the road west of the station at the following distances and bearings from the station: 125.7 meters S. 44° 15' W., 90.0 meters S. 78° 32' W., and 97.7 meters N. 65° 13' W. A land-survey stone is on the south line of section 32, one-fourth mile west of the southeast corner of the section, 131 meters S. 46° 23' W. from the station. The southeast corner of section 32 is 325.6 meters S. 73° 42' E. from the station.

<sup>1</sup> See p. 35.

*Buffalo Mound* (Jasper County, Ill., U. S. E., 1879).—This station was established by the United States Engineers. It is in Fox Township, on a hill known as Buffalo Mound, about 2½ miles southwest of the village of St. Marie, in section 1 near the line between sections 1 and 2, T. 5 N., R. 10 E. The station is marked according to note 4.<sup>1</sup> Three stone reference posts are on the west side of the section-line road west of the station at the following distances and bearings from the station: 44.4 meters S. 40° 46' W., 28.9 meters N. 87° 19' W., and 45.3 meters N. 38° 54' W. The corner of sections 1, 2, 11, and 12 is 966 meters S. 1° 29' W. from the station.

*Newton* (Jasper County, Ill., F. W. P., 1883).—In Smallwood Township, about 4½ miles south of the town of Newton, in the northwest corner of the SE. ¼ SW. ¼ sec. 25, T. 6 N., R. 9 E. The station is marked according to note 2<sup>1</sup> except that the marble post is encased in the foundation of a brick pier which extends about 3 feet above the ground and is capped with a marble slab 2 inches thick and 16½ inches square, with a small drill hole at the center directly above the cross on the post. The pier is hollow above the top of the post and has openings in the side to allow access to the station mark on the post. The reference posts are in range directly west of the station at distances of 67.48 meters and 459.88 meters, respectively. Another brick pier, used for latitude work, similar to the one described above, is 15 meters due west of the station. The following azimuths and distances are from the station: Southwest corner of section 25, 607.4 meters, 50° 59'; McMurray's house chimney, about one-third mile, 125° 34'; schoolhouse chimney, about two-fifths mile, 133° 39'; Weaver's house chimney, about three-fourths mile, 157° 27'; I. Wilson's house east lightning rod, about one-half mile, 9° 13'.

*Denver* (Richland County, Ill., G. A. F., 1883).—This station was established in 1879 by the United States Engineers. It is in Denver Township, about 5½ miles north of the town of Noble in the NW. ¼ NE. ¼ sec. 21, T. 4 N., R. 9 E., on the eastern edge of a timber lot belonging to Mr. Kinkade, whose home is a little more than one-fourth mile east of the station. The station is marked according to note 4.<sup>1</sup> Three stone reference posts are at the following distances and bearings from the station: On the north side of the road north of the station, 344.92 meters N. 15° 27' E.; on the east side of the road east of the station, 578.78 meters N. 69° 35' E.; and on the west side of the road east of the station, 568.15 meters S. 70° 01' E. The corner of sections 15, 16, 21, and 22 is 628.32 meters N. 58° 52' E. from the station.

*Onion Hill* (Richland County, Ill., U. S. E., 1879).—This station was established by the United States Engineers. It is on Onion Hill, in Denver Township, about 5 miles southwest of the town of West Liberty, in the NE. ¼ sec. 2, T. 4 N., R. 9 E. The station is marked according to note 4.<sup>1</sup> Three stone reference posts are located as follows: On the south side of the road north of the station, 205.68 meters N. 33° 02' E.; on the north side of the same road, 181.04 meters N. 25° 31' W.; and on the west side of the road west of the station, 354.02 meters N. 84° 35' W. The northeast corner of section 2 is 502.7 meters N. 69° 25' E. from the station.

*Olney west base* (Jasper County, Ill., U. S. E., 1879).—This station was established by the United States Engineers. It is in Fox Township, in the NW. ¼ NE. ¼ sec. 21, T. 5 N., R. 10 E. The station is marked by a stone post surrounded by a bed of brickwork 3 feet square, 4 feet below the surface of the ground. Two other stones similar to the station mark but without the brickwork are 4 feet below the ground, one 8.02 meters north of the station and the other 8.06 meters south. Three stone reference posts are located as follows: Two on the south side of the road north of the station, one 246.7 meters N. 2° 45' W., and the other 356.0 meters N. 45° 32' E., and the third 302.0 meters S. 61° 00' E. An oak post used for a latitude pier in 1880 is 16.19 meters S. 88° 36' E. The northeast corner of section 21 is about 727 meters N. 67° 19' E. from the station.

*Olney check base* (Richland County, Ill., U. S. E., 1879).—This station was established by the United States Engineers. It is in Preston Township, in sec. 6, T. 4 N., R. 11 E., 20.1 meters S. 53° 10' E. from the southeast corner of the German Reformed Church. The station is marked according to note 4.<sup>1</sup> Three stone reference posts are located as follows: On the south side of the road south of the station, 22.6 meters S. 12° 12' W.; at the northeast corner of the cemetery just west of the station, 73 meters N. 3° 35' W.; on the north side of the above road, 53.5 meters S. 80° 21' E. The quarter-section stone on the west line of section 6 is 943.9 meters N. 31° 44' W. from the station.

*Olney east base* (Jasper County, Ill., U. S. E., 1879).—This station was established by the United States Engineers. It is in St. Marie Township, about 3½ miles east and one-half mile north of the town of West Liberty, in sec. 19, T. 5 N., R. 11 E. The station is marked by a brass bolt set in a drill hole in the top of a stone post 2½ feet below the surface of the ground. The post is surrounded by a bed of brickwork. Two other stone posts are 2½ feet below the ground, one 7.91 meters north and the other 8.04 meters south. Three stone reference posts are located as follows: 3.61 meters N. 49° 49' E., 322 meters S. 58° 02' E., and 208 meters S. 35° 50' W. The northwest corner of section 19 is about 1,054 meters N. 77° 12' W. from the station.

*Olney middle base* (Jasper County, Ill., U. S. E., 1879).—This station was established by the United States Engineers. It is in Fox Township, near the middle of the Olney base, in the NW. ¼ sec. 23, T. 5 N., R. 10 E., about 1.1 miles east and 0.5 mile north of the town of West Liberty. The station is marked by a stone post 2½ feet below the surface of the ground. The northeast corner of section 23 is about 712 meters N. 66° 18' E. from the station.

*Island Creek* (Jasper County, Ill., G. A. F., 1883).—In Grove Township near the southwest corner of SW. ¼ sec. 28, T. 8 N., R. 8 E., 2½ miles east and 4 miles south of the town of Montrose, on cultivated land belonging to the Caldwell estate. The station is marked according to note 2.<sup>1</sup> One reference mark is just inside the hedge which bounds the road and section to the westward, distant 11.11 meters, and the other is just inside the road fence to the southward, distant 37.4 meters. The southwest corner of section 28 is 58.4 meters distant in azimuth 22° 12' and the west chimney of

<sup>1</sup> See p. 35.

Caldwell's house, which is nearly across the road from the station, is in azimuth  $146^{\circ} 56'$ . The Catholic Church is just across the road south of the station, and the cross on the church is in azimuth  $355^{\circ} 18'$ .

*Lucas* (Effingham County, Ill., G. A. F., 1883).—In Lucas Township, 8 miles south and  $2\frac{1}{2}$  miles west of the town of Deiterich, in the NW.  $\frac{1}{4}$  SE.  $\frac{1}{4}$  NW.  $\frac{1}{4}$  sec. 28, T. 6 N., R. 7 E., on cultivated land, slightly elevated, belonging to Louis Joergens. The station is marked according to note 2.<sup>1</sup> Broken crockery and glass were mixed with the soil about the station mark. One reference mark is in the fence line on the south side of the road north of the station 495.95 meters distant in azimuth  $180^{\circ} 00'$ , and the other is in the fence line on the east side of the road west of the station 492.9 meters distant in azimuth  $90^{\circ} 00'$ . The corners of section 28 are at the following distances and azimuths from the station: Southwest corner, 1,302.8 meters  $22^{\circ} 32'$ ; northwest corner, 715.3 meters  $135^{\circ} 14'$ ; northeast corner, 1,221.2 meters  $247^{\circ} 35'$ ; and southeast corner 1,629.5 meters  $315^{\circ} 16'$ .

*Parkersburg* (Richland County, Ill., U. S. L. S., 1879).—About 11 miles south of Olney on a rise of ground about 80 feet above the general level. Near the northeast corner of fractional section 30, T. 2 N., R. 11 E. The station is marked by two stone posts, one at the surface and the other directly below it. There are four stone reference posts at the following distances and directions from the station: 48.7 meters S.  $69^{\circ} 54' E.$ , 74.0 meters N.  $68^{\circ} 27' W.$ , 44.7 meters N.  $83^{\circ} 22' E.$ , and 93.0 meters N.  $28^{\circ} 40' E.$  The first two are on the south side of the road north of the station, and the third on the north side of the same road. The northwest corner of section 30 is 848.5 meters N.  $55^{\circ} 40' W.$  from the station. *Parkersburg latitude station* is 34.68 meters N.  $87^{\circ} 44' W.$  from the station.

*Holtzhausen* (Clay County, Ill., G. A. F., 1883).—About 5 miles by road east-southeast of Farina, in Oskaloosa Township in the NE.  $\frac{1}{4}$  NW.  $\frac{1}{4}$  SW.  $\frac{1}{4}$  sec. 7, T. 4 N., R. 5 E., on a prominent hill in a pasture owned by William Holtzhausen and about 930 meters north-northeast from his house. The station is probably marked according to note 2.<sup>1</sup> The corners of section 7 are at the following distances and azimuths from the station: Southwest corner, 408.1 meters  $21^{\circ} 12'$ ; northwest corner, 1,255.25 meters  $174^{\circ} 24'$ ; northeast corner, 2,013.84 meters  $232^{\circ} 28'$ ; and the southeast corner 1,627.95 meters  $284^{\circ} 12'$ . Other distances and azimuths were measured as follows: Large black oak, 218.0 meters  $64^{\circ} 48'$ ; large elm tree, 151.8 meters  $85^{\circ} 33'$ ; north chimney of C. Moor's house, about one-half mile  $254^{\circ} 54'$ ; and east chimney of Holtzhausen's house, about 930 meters  $30^{\circ} 45'$ .

*Mound* (Effingham County, Ill., G. A. F., 1883).—In Mound Township, 1 mile west and three-fourths mile north of the village of Altamont, very nearly in the center of the SW.  $\frac{1}{4}$  NE.  $\frac{1}{4}$  sec. 8, T. 7 N., R. 4 E., on a hill in cultivated land belonging to John Ehlers. The station is marked according to note 2,<sup>1</sup> except that there is only one reference mark. Broken crockery was mixed with the earth around the station mark. The reference post is in the fence line north of Ehlers's house in range with the west end of the house and the station 602.23 meters from the station in azimuth  $179^{\circ} 30'$ . The corners of section 8 are at the following distances and azimuths from the station: Southwest corner, 1,468.48 meters  $43^{\circ} 38'$ ; northwest corner, 1,160.38 meters  $129^{\circ} 42'$ ; northeast corner, 891.64 meters  $224^{\circ} 55'$ ; and the southeast corner, 1,194.51 meters  $328^{\circ} 14'$ . The southwest corner of Ehlers's house is 494.5 meters from the station in azimuth  $179^{\circ} 30'$  and Bucholtz's barn is in azimuth  $257^{\circ} 32'$ .

*Sturgess* (Fayette County, Ill., G. A. F., 1883).—About 1 mile south of the town of Vandalia, near the southeast corner of the SW.  $\frac{1}{4}$  NW.  $\frac{1}{4}$  sec. 21, T. 6 N., R. 1 E., on a hill in cultivated land about 30 meters north by east from the northwest corner of Col. Sturgess's house. The station is marked according to note 2<sup>1</sup> except there are three reference marks instead of two. One reference mark is near the northwest corner of the house 29.37 meters from the station, another one is in this same direction at a distance of 15.62 meters, and the third is in a direction perpendicular to the above direction east by south from the station at a distance of 14.43 meters.

*Hartlin* (Marion County, Ill., G. A. F., 1882).—About three-fourths mile south and 1 mile west of the town of Alma, in the SW.  $\frac{1}{4}$  SE.  $\frac{1}{4}$  sec. 12, T. 3 N., R. 2 E., 12 meters north of the section line, on a hill in cultivated land known as the old Hartlin place but owned in 1882 by T. W. Purcell. The station is 32 meters north of the barn and 72 meters east-northeast from the front door of the house both of which buildings are across the road from the station. The station is marked according to note 3<sup>1</sup> except there are three reference marks instead of two at the following distances from the station: 15.2 meters east, 15.2 meters west, and 20.9 meters south.

*Bording* (Clinton County, Ill., G. A. F., 1882).—About  $1\frac{1}{2}$  miles east of the town of Carlyle, in the SE.  $\frac{1}{4}$  SW.  $\frac{1}{4}$  sec. 17, T. 2 N., R. 2 W., on Bording Hill, in the middle of a cultivated field owned by Mrs. Corcoran whose house is just south of the station. The station is about 200 meters north of the road and is marked according to note 2.<sup>1</sup> One reference mark is just east of the house, 216.88 meters south by east from the station and the other is near the road fence, southeast of the house, 248.77 meters from the station and in range with the first reference mark and the station.

*Hoile* (Bond County, Ill., G. A. F., 1882).—On the north side of the town of Greenville, in the SE.  $\frac{1}{4}$  NE.  $\frac{1}{4}$  sec. 10, T. 5 N., R. 3 W., on the top of a high hill, in the yard northeast of the dwelling house of C. Hoile. The station is marked according to note 2<sup>1</sup> except there are no reference posts. The following distances and azimuths were measured: Southeast corner of Hoile's house, 28.71 meters  $27^{\circ} 00'$ ; northeast corner of Hoile's house, 25.69 meters,  $44^{\circ} 55'$ ; oak tree, 13.00 meters  $44^{\circ} 55'$ ; oak tree, 9.11 meters  $79^{\circ} 05'$ ; cherry tree, 8.50 meters  $162^{\circ} 36'$ ; elm tree, 4.91 meters,  $285^{\circ} 33'$ ; elm tree, 12.54 meters  $298^{\circ} 16'$ ; oak tree, 14.90 meters  $342^{\circ} 35'$ ; and hickory tree, 14.08 meters  $8^{\circ} 27'$ .

*Geoffrey* (Clinton County, Ill., G. A. F., 1881).—In Santa Fe Township, near the center of the NE.  $\frac{1}{4}$  NE.  $\frac{1}{4}$  sec. 8, T. 1 N., R. 3 W. The station is marked according to note 2.<sup>1</sup> One reference mark is near the fence line on the south side of the road north of the station, just west of the road leading to Mr. Geoffrey's house, 223.8 meters west of the stone at the northeast corner of section 8 and 144.5 meters from the station in azimuth  $179^{\circ} 27'$ . The other reference

<sup>1</sup> See p. 35.

mark is in the fence line on the west side of the road east of the station, 148.3 meters south of the stone at the north-east corner of section 8 and 217.8 meters from the station in azimuth  $269^{\circ} 07'$ .

*Parkinson* (Madison County, Ill., G. A. F., 1881).—About  $1\frac{1}{2}$  miles west by south from the town of Highland, near the middle of the NE.  $\frac{1}{4}$  sec. 12, T. 3 N., R. 6 W., on land owned by A. J. Parkinson and a short distance east of his house and barns. The station is near the southeast corner of an apple orchard on the north side of a plank fence and about 14 feet west of an osage orange hedge. It is marked according to note 2.<sup>1</sup> Each of the two reference marks is about 1 foot west of the hedge, one 5.70 meters northeast of the station and the other the same distance southeast. A rock used as a surveyor's mark is 1.07 meters north of the latter and 5.02 meters from the station.

*Berger* (St. Clair County, Ill., G. A. F., 1881).—In Summerfield Township, about 1 mile north of the village of Summerfield and about 3 miles east and one-half mile north of the village of Lebanon, near the northwest corner of the NE.  $\frac{1}{4}$  NW.  $\frac{1}{4}$  NW.  $\frac{1}{4}$  sec. 22, T. 2 N., R. 6 W., on land owned by Dr. A. Berger. The station is marked according to note 2.<sup>1</sup> The two reference marks are on the north boundary of section 22 as near as could be determined, one in range with the east row of trees in Dr. Berger's orchard, 82.6 meters from the station, in azimuth  $146^{\circ} 26'$ , and the other 124.5 meters from the station, in azimuth  $236^{\circ} 59'$ . Other azimuths were observed as follows: Tree at southwest corner of Dr. Berger's orchard,  $12^{\circ} 38'$ ; cherry tree at east end of eighth row from north end of orchard, 49.6 meters from the station,  $72^{\circ} 26'$ ; south chimney of J. Whittaker's house,  $241^{\circ} 13'$ ; and southwest corner of Whittaker's land,  $244^{\circ} 37'$ .

*Turkey Hill* (St. Clair County, Ill., G. A. F., 1880).—Near the middle of the south line of the NW.  $\frac{1}{4}$  sec. 5, T. 1 S., R. 7 W., in an orchard belonging to Mack Champion (negro) and about 75 meters west of his house. The station is on the top of a small cultivated hill near the north end of the third row of trees counting from the east side of the orchard and is marked according to note 2.<sup>1</sup> One reference mark is near the foot of a walnut tree in the southwest corner of an adjoining field 40.50 meters N.  $84^{\circ} 30'$  E. from the station. The other reference mark is near a pear tree 10.75 meters N.  $28^{\circ} 00'$  W. from the station.

*Clarks Mound* (St. Clair County, Ill., R. E. H., 1871; 1880).—On the bluffs overlooking the American Bottom, three-fourths mile south of French Village, near the middle of the south line of the NW.  $\frac{1}{4}$  sec. 35, T. 2 N., R. 9 W., on land belonging in 1880 to William Clark. The station is on the top of a prominent mound known locally as Clarks Mound, a short distance northwest of Mr. Ogles's house, and is marked according to note 2,<sup>1</sup> except that the underground mark is a bottle. One reference mark is 15.24 meters (inclined distance) from the station in azimuth  $21^{\circ} 54'$ , and the other is 15.24 meters (inclined distance) in azimuth  $278^{\circ} 34'$ . Three trees, each marked with a triangular blaze, are at the following distances and magnetic bearings from the station: Hickory, 19.6 meters, N.  $41^{\circ} 30'$  E.; white oak, 12.0 meters, S.  $57^{\circ} 30'$  E.; and hickory, 28.1 meters, S.  $51^{\circ} 30'$  E.

*Sugar Loaf Mound* (Madison County, Ill., R. E. H., 1871; 1880).—About 3 miles northwest of Collinsville near the middle of the north line of the NE.  $\frac{1}{4}$  sec. 20, T. 3 N., R. 8 W., on land belonging in 1880 to Conrad Witte, whose house is east of the station. The station is on the north side of the top of a very prominent mound, known locally as Sugarloaf Mound, which is on the edge of the bluff overlooking the American Bottom and about 150 or 200 feet above the general level to the westward and 50 feet above that to the eastward. The station is marked according to note 2,<sup>1</sup> except that there are no reference marks. A small private cemetery is just south of the station.

*Insane Asylum* (St. Louis County, Mo., R. E. H., 1871).—This asylum, known also as the County Lunatic Asylum, is situated on the county farm, which forms part of a larger tract of land known as Gratiot League Square. It is about 5 miles in a southwesterly direction from the courthouse at St. Louis and about 150 meters south of the Arsenal Street road at a point about one-half mile westerly from its intersection with the Kings Highway. The station is the finial of the cupola of the building.

*American Bottom upper base* (Madison County, Ill., C. H. B., 1872).—On the west slope of the Illinois bluffs on the east side of the American Bottom about one-fourth mile north of the Collinsville road and just east of the road along the foot of the bluffs on land belonging to A. Sumner. The station is marked at the surface by a cross in a copper bolt set in the top of a limestone post 12 by 14 inches and 40 inches long and underground by the apex of an earthenware pyramid 4 feet below the surface. Two limestone reference posts 5 inches square and 30 inches long are at the following distances and azimuths from the station: 7.3 meters,  $204^{\circ} 40'$  (in prolongation of base); and 7.3 meters,  $294^{\circ} 40'$  (right angles to base line).

*American Bottom lower base* (St. Clair County, Ill., C. H. B., 1872).—On the west slope of the Illinois bluffs on the east side of the American Bottom about 1 mile north of the Belleville Rock road and about one-fourth mile north of a small settlement called French Village. The station is on land belonging to Frances Simoin, 4 meters from the fence along the west side of the road, which extends north and south along the foot of the bluffs. The station is marked the same as *American Bottom upper base* described above, and the post containing the surface mark is inscribed on three sides as follows: U. S. C. S., 1872, BASE. One reference stone is 12.0 meters from the station in azimuth  $24^{\circ} 38'$  (prolongation of base) and the other 19.2 meters in azimuth  $294^{\circ} 38'$  (perpendicular to direction of base).

*Dreyer* (St. Clair County, Ill., R. E. H., 1871; 1880).—On the bluffs about 6 miles northwest of the town of Centerville and about  $1\frac{1}{2}$  miles a little west of south of Falling Springs in the southern part of sec. 27, T. 1 N., R. 10 W. The station is about 17 meters north of the Carondolet road near where it strikes the bluffs, in a field belonging to Freidrick Dreyer, about 370 meters west by north from his house. The station is marked according to note 2,<sup>1</sup> except that the surface mark is a spike in the top of a cedar post projecting about 4 inches above the ground and that the top of the second reference post is inscribed with the letters U. S. C. & G. S. Three reference posts are in the fence line on the north side of the road at the following distances and azimuths from the station: 23.33 meters,  $325^{\circ} 59'$ ;

<sup>1</sup> See p. 35.

19.64 meters,  $11^{\circ} 08'$ ; and 32.90 meters,  $56^{\circ} 17'$ . The second or center reference post (described above) is 368.8 meters from the northwest corner of Dreyer's corn house.

*Minoma* (St. Louis County, Mo., C. H. B., 1872).—The flagstaff on the cupola of the residence of Jefferson Clark about 7 miles from St. Louis and one-half mile north of the Natural Bridge road.

*Kleinschmidt* (St. Louis County, Mo., R. E. H., 1871).—In T. 44 N., R. 6 E., on an eminence known as Terrills Hill in the southwest part of the commons of Carondelet, south of the River des Peres, on a lot belonging to Henry Kleinschmidt at the northeast corner of the intersection of Lemar Ferry and Sappington Barracks roads. The station is marked according to note 5.<sup>1</sup> Two cedar reference stubs 12.5 meters apart are near the fence line on the north side of the Sappington Barracks road, one 12.6 meters due south of the station and 40.2 meters from the east corner of the lot and the other 11.5 meters west of the station and 68.7 meters from the west corner of the lot. The rock foundation at the southeast corner of Kleinschmidt's house is 45.4 meters northwest of the station and the rock foundation at the northeast corner of Bauer's house south of the Sappington Barracks road is 50.4 meters southwest.

*Morgan* (St. Louis County, Mo., R. E. H., 1871).—About 11 miles in a northwesterly direction from St. Louis in the NE.  $\frac{1}{4}$  sec. 1, T. 45 N., R. 5 E., on the highest point of the tract of land lying southwest of the intersection of Olive Street and Warson road. The station is marked according to note 5.<sup>1</sup>

*Patterson* (Jefferson County, Mo., R. E. H., 1873).—About 7 miles in a southwesterly direction from the town of Fenton, one-fourth mile west of the Hillsborough road and just north of the Old State road, in an open field belonging to a Mr. Patterson. The station is marked according to note 5.<sup>1</sup>

*Kessler* (St. Louis County, Mo., R. E. H., 1871).—In T. 45 N., R. 4 E., on land belonging to Louis Kessler, on a summit covered with timber just northwest of the intersection of Smith and Kehr's mill roads. The station is quite near the Kehr mill road just west of an angle in the road and is marked according to note 5.<sup>1</sup> The house of Henry Pope is on the south side of the Smith road south by east from the station.

*Tavern Rock* (Franklin County, Mo., C. H. B., 1873).—On the south bank of the Missouri River about 1 mile west of the St. Louis County line, on the top of a small hill 141 meters west by south from the northwest corner of Mr. Godair's house. The station is marked according to note 1.<sup>1</sup>

*Lynch* (Jefferson County, Mo., C. H. B., 1873).—About  $3\frac{1}{2}$  miles from the town of Catawissa and one-half mile north-northeast from a stone Catholic Church known locally as the Rock Church on a high hill nearly east of Mr. Lynch's house. The station is just east of a winding road or lane which passes over the top of the hill and is marked according to note 1.<sup>1</sup>

*Halleck* (Franklin County, Mo., C. H. B., 1873).—About  $7\frac{1}{2}$  miles west of Grays Summit on the north side of the State or Manchester road directly opposite Mr. Breitenbach's store which is also the Halleck post office. The station is 2 meters north of the fence on the north side of the road and is marked according to note 1.<sup>1</sup> The northeast corner of the store is 20.91 meters from the station and the northwest corner, 20.45 meters.

*Dieckhaus* (St. Charles County, Mo., C. H. B., 1873).—In Fenme Osage Township about 6 miles northeast of the town of Washington and 2 miles north of the Missouri River on the top of a hill a short distance northeast of the house of Mr. Dieckhaus and on the opposite side of the road. The station is marked according to note 1.<sup>1</sup>

*Peters* (Franklin County, Mo., C. H. B., 1874).—In the western part of Union Township about 4 miles west of the courthouse and 3 miles west of Mann's store, on the top of a cultivated hill on the farm of Henry Peters on the opposite side of the road and about 400 meters south of his house. The station is marked according to note 1.<sup>1</sup> An oak tree marked with a triangular blaze is beyond the fence 53 meters southeast of the station and a lane leading to a spring is about 114 meters (paced) south.

*Enoch Knob* (Franklin County, Mo., C. H. B., 1874).—In sec. 3, T. 44 N., R. 2 W., about  $1\frac{1}{4}$  miles from the town of Newport on a mound known as Enochs Knob the property of Mr. Sellmeyer and just west of his cultivated lands. The station is about 80 meters west of the fence on the east side of the road east of the mound and is marked according to note 1.<sup>1</sup>

*Berger* (Franklin County, Mo., C. H. B., 1874; 1907).—About 4 miles west by south from the town of New Haven, in the SW.  $\frac{1}{4}$  sec. 32, T. 45 N., R. 3 W., on land belonging to Andrew J. Hale. It is on a hill known locally as Kaisers Hill, the highest one of several prominent hills in the northwestern part of Franklin County. Berger Knob is the most northern one of four hills forming the group of which Kaisers Hill is the most southern. The top of the hill is cultivated and the station is on the southeastern extremity of the top of the knoll, at the southern edge of the clearing, about 30 meters to the left of where the road enters the clearing, and is marked according to note 1.<sup>1</sup> A latitude pier constructed in 1906 is 16.69 meters N.  $9^{\circ} 46'$  W. from the station, and a longitude pier constructed in 1907 is 19.89 meters north and 2.90 meters west of the station.

*Jacobs* (Franklin County, Mo., C. H. B., 1874; 1878).—About 15 miles from the town of New Haven and 20 miles from the town of Washington, in the extreme southeast corner of the NW.  $\frac{1}{4}$  SW.  $\frac{1}{4}$  sec. 28, T. 43 N., R. 3 W., on land belonging to E. B. Jacobs (nonresident) and immediately west of the cultivated land owned by J. Schmidt, who lives one-third mile northeast of the station. The station is northwest of the Canaan road on the western edge of a branch road leading to the State road, 17 meters west of the fence along the east side of the road, and 97 meters north of a right-angled bend in the road. The station is marked according to note 1.<sup>1</sup> Two oak trees, each marked with a triangular blaze and a notch, are at the following distances and azimuths from the station: 12.92 meters  $166^{\circ} 59'$ , and 13.41 meters  $195^{\circ} 42'$ .

<sup>1</sup> See p. 35.

*Winter* (Gasconade County, Mo., C. H. B., 1874; 1878).—Near the fence line on the south side of the State road, about  $1\frac{1}{2}$  miles east of Drake post office, which is at the intersection of the State road and Iron road. The station is on the edge of a small orchard on the farm of Henry Winter, nearly across the road from his house and 31 meters (paced) east of the east line of his barns. It is marked according to note 1.<sup>1</sup> The southeast corner of Mr. Winter's house is 30.54 meters from the station in azimuth  $166^{\circ} 24'$ , and the southeast corner of the NE.  $\frac{1}{4}$  NW.  $\frac{1}{4}$  sec. 24, T. 43 N., R. 5 W., is 71.93 meters distant in azimuth  $290^{\circ} 28'$ .

*Gasconade* (Gasconade County, Mo., C. H. B., 1874; 1878).—On a wooded hill about 250 meters east of the Iron road about one-sixth mile south of its junction with the Mount Sterling road, on land owned by J. Boesch, sr., just south of F. Oschner's land. The station is about 20 meters south of the center of the north side of the NW.  $\frac{1}{4}$  SE.  $\frac{1}{4}$  sec. 3, T. 44 N., R. 5 W., and is marked according to note 1.<sup>1</sup> The stone marking the northeast corner of the NW.  $\frac{1}{4}$  SE.  $\frac{1}{4}$  sec. 3 is 217 meters from the station in azimuth  $264^{\circ} 06'$ . Three oak trees, each marked with a triangular blaze and one, two, or three notches corresponding with the number, are at the following distances and azimuths from the station: No. 1, 16.33 meters  $58^{\circ} 51'$ ; No. 2, 8.81 meters  $228^{\circ} 36'$ ; and No. 3, 11.66 meters  $301^{\circ} 12'$ .

*Turnpike Bluff* (Gasconade County, Mo., H. W. B., 1878).—On a prominent bluff of the same name in the western part of Gasconade County, overlooking the Gasconade River, which skirts the southwest base of the bluff about 360 feet below the station. The station is near the center of sec. 3, T. 44 N., R. 6 W., at the center of a small Indian mound about 10 meters in diameter and  $1\frac{1}{2}$  meters high, made of stones roughly piled together. Two or three similar mounds are a short distance down the slope of the bluff. The station is probably marked according to note 3.<sup>1</sup> The house of Charles Brieske is at the foot of the hill on the northeast side, and the best approach to the station is from this direction.

*Geyer* (Gasconade County, Mo., H. W. B., 1878).—In the NE.  $\frac{1}{4}$  sec. 28, T. 43 N., R. 6 W., on land belonging to the heirs of C. Geyer, about 2 miles south by west from a small church at the intersection of the Mount Sterling road and the State road. The station is marked according to note 3.<sup>1</sup>

*Bradford* (Osage County, Mo., H. W. B., 1879).—About 2 miles northwest of Mint Hill post office and  $1\frac{1}{2}$  miles south by west of Bailey Creek post office, in the SE.  $\frac{1}{4}$  sec. 14, T. 44 N., R. 8 W., on the land of T. J. Bradford, on the northwest side about 30 meters distant from the Linn and Chamois road. The station is marked according to note 3.<sup>1</sup> Three trees, marked with one, two, or three notches, according to the number, are at the following distances and azimuths from the station: No. 1, 6.95 meters  $99^{\circ} 05'$ ; No. 2, 17.53 meters  $209^{\circ} 20'$ ; and No. 3, 8.53 meters  $271^{\circ} 45'$ .

*Pilot Knob* (Osage County, Mo., H. W. B., 1879).—On the northern one of the two summits of a prominent hill, known locally as Pilot Knob, in the southeastern part of Osage County, about 5 miles from Rollin's ferry on the Gasconade River. The station is near the middle of the northern part of sec. 3, T. 41 N., R. 8 W., or possibly just across the line in sec. 34, T. 42 N., and is marked according to note 3.<sup>1</sup>

*McDaniel* (Osage County, Mo., H. W. B., 1879).—On a high point of the prominent ridge running nearly north and south through the middle of Osage County, about 3 miles by road southwest by south from the town of Linn. The station is about midway between the towns of Richfountain and L'Ours Creek, on the northeast side of the road connecting those two places, about one-fourth mile southeast of the junction of this road with the Linn and Westphalia road, on the edge of a cleared field belonging to John N. McDaniel. It is in the southeast corner of the NW.  $\frac{1}{4}$  SE.  $\frac{1}{4}$  sec. 23, T. 43 N., R. 9 W., and is marked according to note 3.<sup>1</sup>

*Kennedy* (Osage County, Mo., H. W. B., 1879).—In the southwestern part of the county on land belonging to Bernard Schwartz about 20 meters east of the Vienna and Castle Rock road and near the center of the north side of the NE.  $\frac{1}{4}$  sec. 36, T. 42 N., R. 11 W. Mr. Schwartz lives about one-third mile south of the station. The station is marked according to note 3.<sup>1</sup>

*Cedar* (Callaway County, Mo., H. W. B., 1879; 1887).—On the central and highest one of the three points of the prominent bluff on the north side of the Missouri River directly opposite Jefferson City. The station is at the center of a small Indian mound about 12 meters in diameter and 2 meters high. It was marked originally according to note 3,<sup>1</sup> but in 1887 it was reported that the surface marks had been removed leaving only the underground mark, a bottle of ashes.

*Belshe* (Cole County, Mo., H. W. B., 1879).—In the southwestern part of Cole County on the road from Jefferson City to Tusculumbia, about 1 mile southeast of Spring Garden Hill, a little more than one-half mile northeast of Locust Mound post office and 50 meters east of the county line, near the center of the N.  $\frac{1}{4}$  SW.  $\frac{1}{4}$  sec. 19, T. 42 N., R. 13 W. The station is in the yard near the house of August Pfitzer and is marked according to note 3.<sup>1</sup> The northeast corner of Pfitzer's house is 7.96 meters from the station in azimuth  $46^{\circ} 05'$  and a prominent tree used as a gatepost in the northeast corner of the yard is 16.52 meters distant in azimuth  $187^{\circ} 35'$ .

*Moreau* (Cole County, Mo., H. W. B., 1879).—In the western part of the county about 7 miles south of Centerville and 1 mile northeast of the village of Russellville, about 150 meters south of the first road north of the State road and about 300 yards east of the road leading northeast from Russellville. The station is near the center of the NW.  $\frac{1}{4}$  NE.  $\frac{1}{4}$  sec. 35, T. 44 N., R. 14 W., on land belonging to John Neederweiner who lives on the State road about one-third mile south. It is marked according to note 3.<sup>1</sup>

*Medlock* (Cole County, Mo., H. W. B., 1879).—About 2 miles north-northwest of Elton and 6 miles east-northeast of Centertown, in the northeast corner of the SW.  $\frac{1}{4}$  sec. 37, T. 45 N., R. 13 W., in the southwest corner of a cultivated field where the road makes a right angled turn to the north. The station is on land belonging to Noah Hoover and is marked according to note 3.<sup>1</sup> The west gable of Hoover's house is about 150 meters from the station in azimuth  $283^{\circ}$ .

<sup>1</sup> See p. 35.

*Christian* (Moniteau County, Mo., H. W. B., 1879).—About 1 mile east-southeast of the courthouse in the town of California, on a narrow strip of land between the State road and the Missouri Pacific Railroad belonging to the heirs of J. J. Christian, near the center of the southern edge of the NE.  $\frac{1}{4}$  sec. 27, T. 45 N., R. 15 W. The station is about 75 meters south of the railroad and about 40 meters north of the road and is marked according to note 3.<sup>1</sup> The southwest corner of the Christian house is about 300 meters from the station in azimuth 249° 28' and the northeast corner of H. Boepler's house is about 150 meters distant in azimuth 40° 22'.

*High Point* (Moniteau County, Mo., H. W. B., 1880; 1902).—In the southern part of the county about 12 miles south of the town of California and one-half mile northeast of the village of High Point, near the middle of the southern edge of the W.  $\frac{1}{2}$  sec. 9, T. 43 N., R. 15 W. The station is on the estate of George Radcliff, sr., and is marked according to note 3.<sup>1</sup> It was found in 1902 that the surface marks had been removed.

*Hunter (Versailles south base)* (Morgan County, Mo., F. D. G., 1880; 1897).—In Moreau Township about 4 miles east of Versailles, in the SE.  $\frac{1}{4}$  SW.  $\frac{1}{4}$  sec. 2, T. 42 N., R. 17 W., on land owned (1897) by the estate of D. C. Hale. The station is marked by a cross in the top of a copper bolt set in a rough-dressed block of Warrensburg sandstone 0.65 meter square and 0.24 meter deep inscribed "U. S. C. & G. S. 1897" and the block in turn is set in concrete. The underground mark is similar except that the sandstone block is 0.54 meter deep by 0.28 meter square. The reference posts are the same as described in note 3.<sup>1</sup>

*Cole* (Moniteau County, Mo., F. D. G., 1880).—About 3 miles east-southeast of the town of Tipton, in the northern part of sec. 30, T. 45 N., R. 16 W., on land owned by Mrs. S. F. Cole. The station is at the center of an old windmill which was used in place of an observing scaffold. It is marked according to note 3<sup>1</sup> except the reference marks are only 4 feet from the station.

*Versailles north base* (Morgan County, Mo., F. D. G., 1880; 1902).—About 5 miles north-northeast of the town of Versailles in the southern part of the W.  $\frac{1}{2}$  SW.  $\frac{1}{4}$  sec. 9, T. 43 N., R. 17 W., on land belonging to Moses H. Tipton. The station is just east of Tipton's house about midway between the north road fence and the southwest one of his three barns. It is marked the same as *Hunter (Versailles south base)* described above. In 1902 it was found that a rail fence had been built over the station.

*Hubbard* (Morgan County, Mo., F. D. G., 1880; 1891).—About three-fourths mile northeast of Syracuse near the center of the SE.  $\frac{1}{4}$  sec. 11, T. 45 N., R. 18 W., on land owned in 1891 by Joseph James. The station was marked originally according to note 3.<sup>1</sup> In 1891 it was learned that at some previous date the owner of the land had removed the surface marks by mistake but later had replaced them as near as possible in their original positions. The underground mark was not disturbed and should be used to check the position of the surface marks when the station is recovered.

*Hughes* (Morgan County, Mo., F. D. G., 1880; 1902).—On the Warsaw road about 5 miles nearly due west of Versailles, near the center of sec. 5, T. 42 N., R. 18 W., on land owned by Robert Hughes. The station is marked according to note 3.<sup>1</sup> When recovered in 1902, the station mark was found to be badly defaced but still in place. The reference marks could not be found.

*Schnackenburg* (Benton County, Mo., F. D. G., 1882).—About 3 miles northeast of Cole Camp, in the SE.  $\frac{1}{4}$  NW.  $\frac{1}{4}$  sec. 13, T. 43 N., R. 20 W., on land owned by C. Schnackenburg. The station is marked according to note 3.<sup>1</sup>

*Heard* (Pettis County, Mo., F. D. G., 1880; 1891).—In the northeast quarter of Sedalia, just east of the cemetery, 2.7 meters south of the south line of Tower Avenue (named for the signal which stood over the station) and about 40 meters east of New York Avenue, on land belonging to George Heard, who lives on the north side of the street nearly opposite the station. The station is marked according to note 3.<sup>1</sup>

*Kendrick* (Pettis County, Mo., F. D. G., 1882).—About 4 miles northwest of Green Ridge, in the NW.  $\frac{1}{4}$  sec. 26, T. 45 N., R. 23 W., in an orchard belonging to John Kendrick about 30 meters east of his house. The station is marked according to note 3.<sup>1</sup>

*High Point Tebo* (Johnson County, Mo., F. D. G., 1882).—About 6 miles northwest of the town of Windsor in the NW.  $\frac{1}{4}$  SE.  $\frac{1}{4}$  sec. 21, T. 44 N., R. 24 W., on land belonging to General ———, of New York. The station is marked according to note 3.<sup>1</sup>

*Knob Noster* (Johnson County, Mo., F. D. G., 1882; 1907).—On a prominent hill known as Knob Noster in 1882, but since called Price or Guihen's Hill after the names of successive owners, about two-thirds mile north by east from the railway station called Knob Noster. The station is in the SW.  $\frac{1}{4}$  NW.  $\frac{1}{4}$  sec. 15, T. 46 N., R. 24 W., and is marked according to note 3.<sup>1</sup> A concrete longitude pier built in 1907 is 3.62 meters directly south of the station.

*Normal* (Johnson County, Mo., F. D. G., 1883; 1906).—On the chimney at the southeast corner of the Missouri State Normal School building at Warrensburg. The chimney is 12 feet square and in 1883 was capped with four heavy blocks of sandstone. The station is at the center of the stone at the northwest corner of the chimney and is marked by a drill hole at the center of a triangle cut in the stone. A regular station mark, described in note 3,<sup>1</sup> used as a reference mark is in the yard 57.57 meters directly south of the station. In 1906 it was found that a brick superstructure had been built on the top of the chimney and in order to recover the station it was necessary to remove a few of the bricks just above the sandstone block at the northwest corner. The bricks were replaced, but two sets of ranges were set to indicate the position of the station. One range of the first set consists of a stone post 6 inches square marked with a cross and drill hole set flush with the ground 7.80 meters north of the fence along the south side of the grounds and 25.46 meters west of the west edge of a north-and-south walk on the campus; and of a cross cut in the stone foundation of the building on the south face of the pilaster on the south side of the basement entrance at the southeast

<sup>1</sup> See p. 35.

corner of the south wing of the building. This range bears S. 7° 55' W. from the station. The second range of the first set consists of another stone post marked with a drill hole and the letters U. S. C. & G. S. and projecting 3 inches above the ground, on the east side of the ball grounds 20.55 meters south of an east-and-west walk and 32.20 meters west of the east fence; and of another cross cut in the east face of the main building south of the steps at the northeast corner and 0.75 meter north of the southeast corner of the building. This range bears a little south of east from the station. The second set of ranges is on the chimney itself. The first range of this set consists of a copper nail cemented in each of two drill holes on the north side of the chimney on top of the projecting part of the sandstone block containing the station mark. The second range of this set consists of similar marks, one in the west projection of this same stone and the other in the east face of the chimney 1.43 meters above the roof and 0.34 meter from the southeast corner of the chimney. The intersection of the two lines of either set of ranges described above gives the exact position of the station.

*Caldwell* (Johnson County, Mo., F. D. G., 1882).—In a pasture belonging to Henry Caldwell almost directly across the road south of his house and a short distance west of the Clinton road which forms the boundary between Johnson and Henry counties. The station is in the northeast corner of the W.  $\frac{1}{4}$  SE.  $\frac{1}{4}$  sec. 26, T. 44 N., R. 25 W., about 50 meters south of the road in front of Caldwell's house, and is marked according to note 3.<sup>1</sup>

*Baker* (Johnson County, Mo., F. D. G., 1883).—On the highest part of a prominent hill about 1 mile north of the town of Kingsville, on land belonging to Edward Baker and close to his house. The station is in the S.  $\frac{1}{4}$  E.  $\frac{1}{4}$  SE.  $\frac{1}{4}$  sec. 25, T. 46 N., R. 29 W., and is marked according to note 3.<sup>1</sup>

*Hutton Mound* (Cass County, Mo., F. D. G., 1883).—About 14 miles southeast of the town of Harrisonville, on a hill known locally as the Big Mound belonging to Thomas Hutton, who lives about five-eighths of a mile west of the station. The station is in the NE.  $\frac{1}{4}$  NW.  $\frac{1}{4}$  SE.  $\frac{1}{4}$  sec. 1, T. 43 N., R. 30 W., and is marked according to note 3.<sup>1</sup>

*Chapel Hill* (Johnson County, Mo., F. D. G., 1883).—About one-fourth mile south-southwest from the village of Chapel Hill, on land belonging to Dr. Joseph Ragsdale about 125 meters south-southeast of his house. The road in front of Dr. Ragsdale's house is the boundary line between Johnson and Lafayette counties, and a new range line leads north from this road. The station is in the NE.  $\frac{1}{4}$  SE.  $\frac{1}{4}$  sec. 1, T. 47 N., R. 29 W., about 2 meters south of the middle of the line bounding the 40-acre division and is marked according to note 3.<sup>1</sup> In 1883 Dr. Ragsdale contemplated moving his house to a site about 30 meters southeast of the station.

*Thornton* (Cass County, Mo., F. D. G., 1883).—About 4 miles northeast of the town of Pleasant Hill, 3 meters south of the fence on the south side of the county line road between Cass and Jackson counties, on land belonging to Charles Thornton. The station is in the NE.  $\frac{1}{4}$  NW.  $\frac{1}{4}$  NW.  $\frac{1}{4}$  sec. 4, T. 46 N., R. 30 W., and is marked according to note 3.<sup>1</sup>

*Fulton* (Cass County, Mo., F. D. G., 1883).—About 2 $\frac{1}{2}$  miles east-southeast of Harrisonville, in sec. 2, T. 44 N., R. 31 W., 51.4 meters east-southeast of the northwest corner of the northeast quarter of the section, 21.7 meters south of the fence on the south side of the road along the north side of the section, and 21.8 meters east of a small house. The station is on land belonging to L. G. Fulton and is marked according to note 3.<sup>1</sup>

*Bowler* (Jackson County, Mo., F. D. G., 1884).—On a small hill about 2 $\frac{1}{2}$  miles southwest of the town of Lees Summit, on land belonging to J. O. Bowler about one-third mile west of his house. The station is in the NW.  $\frac{1}{4}$  SW.  $\frac{1}{4}$  sec. 18, T. 47 N., R. 31 W., about 20 meters south of an apple orchard. It is marked according to note 3.<sup>1</sup>

*Berry* (Cass County, Mo., F. D. G., 1884).—About 1 $\frac{1}{2}$  miles west of the town of Belton, in the SW.  $\frac{1}{4}$  sec. 10, T. 46 N., R. 33 W., near the east center of a cultivated field belonging to Mrs. R. C. Berry. The station is about midway between the Santa Fe Railroad to the north and the Belton wagon road to the south, and is marked according to note 3.<sup>1</sup> A forked cottonwood tree marked with a triangular blaze is 85.2 meters from the station in azimuth 93° 23'.

*Marty* (Johnson County, Kans., F. D. G., 1884).—About 4 miles northeast of the town of Lenexa in the SE.  $\frac{1}{4}$  sec. 19, T. 12 S., R. 25 E., in an open field about one-fourth mile southeast of John Marty's house, 11 meters north of a farm road, and 20 meters west of a hedge. The station is marked according to note 3,<sup>1</sup> except that the reference posts are 6 feet distant. The station post is surrounded with charcoal.

*Haskin* (Johnson County, Kans., F. D. G., 1885).—About 7 $\frac{1}{2}$  miles east of the town of Spring Hill, in the SW.  $\frac{1}{4}$  sec. 18, T. 15 S., R. 25 E., 13.9 meters northeast of the northeast corner of U. A. Haskin's barn and nearly due south of his dwelling house. The station is marked according to note 3,<sup>1</sup> except that the reference posts are 6 feet distant. The station post is surrounded with charcoal. The southwest corner of section 18, which is at the intersection of two roads, is 202.84 meters south-southwest from the station. The southeast tree in a small orchard between Haskin's house and barn is 7.2 meters northwest of the station.

## SUPPLEMENTARY POINTS.

*Creed* (Kanawha County, W. Va., A. T. M., 1881).—On the western point of a hill known as Coopers Hill about 11 miles from Charleston and 1 $\frac{1}{4}$  miles from the mouth of Coopers Creek, on land belonging to the Bliss Merrill estate. The station is marked by a 1-inch drill hole 4 inches deep in a large rock, one of a group of rocks. Three other drill holes 1 inch in diameter and 3 inches deep are in rocks at the following distances and azimuths from the station: 3.70 meters 141° 13', 1.93 meters 335° 33', and 1.52 meters 52° 29'.

*Elk* (Kanawha County, W. Va., A. T. M., 1881).—About 2 miles from Charleston and 1 mile west of Elk River on a ridge extending west from the river just north of Magazine Creek. The station is on land belonging to the Brigham heirs and is marked by a nail in the top of a stake. The underground mark is an earthenware pyramid 2 feet below the surface. Five stumps marked with nails are at the following distances and magnetic directions from the station:

<sup>1</sup> See p. 35.

White oak stump with one nail, 5.82 meters S.  $74^{\circ} 43'$  E.; white oak stump with one nail, 7.22 meters S.  $4^{\circ} 05'$  W.; chestnut oak stump with two nails 7.41 meters S.  $57^{\circ} 20'$  W.; stump with three nails 4.15 meters N.  $68^{\circ} 52'$  W.; and a chestnut oak stump with two nails, 7.22 meters N.  $23^{\circ} 18'$  W.

*Martin* (Kanawha County, W. Va., A. T. M., 1881).—About  $1\frac{1}{2}$  miles from Charleston and just north of Cemetery Hill, on a hill known as Martin's Hill. The station is not on the highest part of the hill but about 2 meters south of the line fence between the land of Dick Martin and that of William Melton. It is marked by a nail in the top of a stake and 2 feet underground by an earthenware pyramid. A stump marked with 2 nails is 9.98 meters S.  $37^{\circ}$  E. (mag.) from the station and another stump marked with 4 nails is 3.69 meters S.  $31^{\circ} 08'$  W. (mag.). A lone chestnut oak is N.  $89^{\circ} 35'$  E. (mag.) from the station.

*Ferguson* (Kanawha County, W. Va., A. T. M., 1881).—On the south side of the Kanawha River opposite Charleston, on land belonging to Judge Ferguson and near the northwest corner of his office. The station is in line between the southwest corner of the office and the corner of the yard fence to the northwest and is 4.04 meters directly west of the northwest corner of the office. The station is marked by a stake and 20 inches underground by an earthenware pyramid. The following distances are from the station: North fence, 7.1 meters; west fence, 4.2 meters; northwest corner of fence, 9.1 meters; and southwest corner of office, 6.7 meters.

*Fort Scammon* (Kanawha County, W. Va., A. T. M., 1881).—On a high hill opposite the mouth of Elk River. There was a battery here during the Civil War and the hill is sometimes called Battery Hill. The old ramparts are on the highest part of the hill and the station is at the northeast corner just outside the ditch and just inside of the fence separating a cleared field from the old fort which is overgrown with trees and bushes. The station is marked by a nail in the top of a stake and 2 feet underground by an earthenware pyramid. A black walnut tree in the cleared field is about 50 meters N.  $69^{\circ} 47'$  E. (mag.) from the station and a hole drilled in a rock is 3.05 meters S.  $48^{\circ} 07'$  E. (mag.). Four oak trees, each marked with a blaze and a nail, are at the following distances and magnetic directions from the station: 4.48 meters S.  $24^{\circ} 15'$  E., 11.1 meters S.  $5^{\circ} 42'$  W., 11.9 meters N.  $71^{\circ} 20'$  W., and 14.25 meters N.  $50^{\circ} 32'$  W.

*Charleston astronomic* (Kanawha County, W. Va., G. W. D., 1881; 1883).—In the northwestern part of the state-house grounds at Charleston. The station is marked by a sandstone pier resting on a heavy masonry foundation. It was learned in 1883 that the statehouse was to be remodeled. Measurements were made to the location of a proposed new cupola. The station is 41.94 meters west and 5.10 meters south of this cupola.

*Springville* (Greenup County, Ky., A. T. M., 1885).—On the highest part of the river hills just back of the town of Springville and directly across the Ohio River from the city of Portsmouth, Ohio. The station is close to the brow of the hill on the highest part of the hill as seen from Portsmouth and about 15 minutes' walk from the ferry landing. It is on land belonging to the Scioto Fire Brick Co. and is marked according to note 7.<sup>1</sup> The reference marks are at the following distances and directions from the station: 2.03 meters north, 2.73 meters east, 2.00 meters south, and 1.54 meters west.

*Portsmouth north meridian* (Scioto County, Ohio, A. T. M., 1885).—In the grounds of the Children's Home in the southeast part of the city of Portsmouth. The station is marked by a brass bolt in the top of a stone post 12 inches square and 8 feet long which projects  $3\frac{1}{2}$  feet above the surface of the ground.

*Portsmouth south meridian* (Scioto County, Ohio, A. T. M., 1885).—In the grounds of the Children's Home in the southeast part of the city of Portsmouth, a short distance south of *Portsmouth north meridian* described above. The station is marked by a brass bolt in the top of a stone post 12 inches square and 8 feet long which projects 2 feet above the surface of the ground.

*Lookout House* (Kenton County, Ky., A. T. M., 1889).—About  $2\frac{1}{2}$  miles from the customhouse at Covington on the top of the cupola of the Lookout House, a German beer garden owned by Alois Hempel.

*Observatory, Cincinnati* (Hamilton County, Ohio, A. T. M., 1889).—On the southwest corner of the square or central part of the Cincinnati Observatory on Mount Lookout. The station is just southwest of the dome and is marked by a copper tack surrounded by three other tacks in the form of a triangle.

*Mount Lookout transit pier* (Hamilton County, Ohio, G. W. D., 1881; 1889).—In the grounds of the Cincinnati Observatory on Mount Lookout, 24.87 meters N.  $5^{\circ}$  W. from the northwest corner of the observatory, and 12.8 meters west and 29.6 meters north of the center of the dome. The station is marked by a sandstone pier built of three pieces cemented together in the form of an H. The pier is inscribed as follows: "U. S. Coast and Geodetic Survey, 1881."

*Price Hill* (Hamilton County, Ohio, A. T. M., 1889).—On the top of Price Hill in the city of Cincinnati, at the center of the tower at the southeast corner of the brick building of the Price Hill incline engine house.

*Mount Adams Convent* (Hamilton County, Ohio, A. T. M., 1889).—The center of the belfry on the roof of the Passionist Monastery on Mount Adams, Cincinnati, just back of the Highland House and the Mount Adams incline. This monastery was formerly the old Cincinnati Observatory.

*Fort Thomas*<sup>2</sup> (Kenton County, Ky., 1912).—On the roof of the stone water tower on the military reservation at Fort Thomas, Ky. Station is in northwest angle of parapet walls, and is marked by reference to two cross marks cut in the top of the parapet wall. One in the west end of the north wall is 1.95 feet from the station; the other in the north end of the west wall is 2.01 feet from the station.

*Brothers Protectory*<sup>2</sup> (Hamilton County, Ohio, 1912).—Center of cross on steeple on southeast part of main buildings of the Mount Alverno Protectory for Boys on the river bluff southwest of Price Hill.

<sup>1</sup> See p. 35.<sup>2</sup> Copied from "Report on a plan of sewerage, city of Cincinnati." See p. 5.

*Warsaw School*<sup>1</sup> (Hamilton County, Ohio, 1912).—On the south side of the apex of the roof of the Warsaw public school on Glenway Avenue, at the end of the Warsaw car line. This building is an old one and has been condemned. The station was marked by a copper tack surrounded by eight other copper tacks, and referenced to four chimneys as follows (in each case the near angle of chimney is point measured to): Chimney to east is distant 24.5 feet; chimney southeast of station is distant 11.5 feet; chimney to southwest is distant 8.0 feet; chimney west of station is distant 18.8 feet.

*Eden Park water tower*<sup>1</sup> (Hamilton County, Ohio, 1912).—The tip of the spire of the water tower in the northern part of Eden Park.

*Hughes High School*<sup>1</sup> (Hamilton County, Ohio, 1912).—On the tar and gravel roof of the high tower on Hughes High School, on the west side of Clifton Avenue, opposite Calhoun Street. Center is marked (in temporary manner) by a spike driven in the roof, and is referenced in permanent manner by two bronze disks set, one in the north and the other in the west parapet wall. From the center to the disk in the north wall is 16.03 feet, and to the disk in the west wall is 12.86 feet. These disks are of bronze, 3¼ inches across, and bear the inscription "City of Cincinnati—Topographic Survey of 1912." In the center of each disk is a triangle and a cross cut with a chisel indicates the exact point on the disk used.

*Westwood School*<sup>1</sup> (Hamilton County, Ohio, 1912).—On the highest part of the roof of the Westwood public school, closely in line with the south edge of the large chimney, and about 25 feet to the east of it. Marked by a large nail driven into the tar and gravel roof and referenced as follows: A bronze disk (see description of Hughes High School) set in the east face of large chimney is 25.21 feet from the station; a similar disk set in the vertical face of the brick parapet wall on south side of roof is 39.02 feet from the station. A cross inside a triangle cut in a brick in southwest corner of base of small chimney is 10.41 feet east of station, and a similar mark cut in the east tile pillar over the main entrance to school is 47.53 feet from the station.

*Stross*<sup>1</sup> (Hamilton County, Ohio, 1912).—On top of the ridge west of Cumminsville, on a rent farm belonging to the Emery estate, and about 800 feet southwest of the barn. Station is marked by bronze disk (see description of Hughes High School, above) in the upper face of a concrete block. This block is triangular in plan, 1½ feet thick, its upper face being 2 feet below the surface of the ground. No surface mark was set at the center, but two reference marks were set as follows: Concrete post with nail in top was set alongside wire fence on west side of road; it is 151.12 feet from station in bearing north 46° west. The other reference mark is a similar concrete post on east side of road, 101.9 feet from station in bearing south 57° west.

*Clifton School*<sup>1</sup> (Hamilton County, Ohio, 1912).—On the roof of Clifton School, west side of Clifton Avenue, opposite Woolper Avenue. Station is south of the ventilator on the south half of the roof and is marked by a copper tack surrounded by three other tacks in form of a triangle. The station was referenced as follows: Reference No. 1 is a copper tack surrounded by four others driven in the northwest corner of a projection on the south cupola of the building. Mark is 1.7 feet above the roof and 14.95 feet from the station. Reference No. 2 is a copper tack surrounded by four others, driven in the vertical face of the ridge of the roof, over which the roof tiling projects. It is 6.68 feet from the station. Reference No. 3 is a copper tack surrounded by four others, driven in the west edge of the tin roof directly west of small ventilator, and 16.65 feet from the station. Reference No. 4 is a copper tack surrounded by four others, driven in the tin roof 4 feet from its west edge and 8 feet from its south edge. Mark is 12.72 feet from the station.

*College Hill Methodist Home*<sup>1</sup> (Hamilton County, Ohio, 1912).—The tip of the cupola on the large brick building, the Methodist Home for the Aged, on the west side of Hamilton Avenue in the southern part of College Hill.

*Observatory*<sup>1</sup> (Hamilton County, Ohio, 1912).—In the grounds of the Cincinnati Observatory on Mount Lookout, in the western part of the grounds, about 275 feet west of the west side of the main building of the observatory. Marked by a bronze disk in a concrete block similar to the one placed at Norwood Station.

*Norwood*<sup>1</sup> (Hamilton County, Ohio, 1912).—In the lot on Mound Street, city of Norwood, in which stands the large black water tank. Station is 69.3 feet from center of tower in bearing south 12° west. Center is marked by a cross cut in bronze disk (see description of Hughes High School) set in top of a concrete block. This block, which was molded in place, is triangular in form, extends 3 feet below surface of ground, about 1½ feet above, is 2 feet on an edge, and has in each of its three vertical faces a triangle cast sunken.

*Longview*<sup>1</sup> (Hamilton County, Ohio, 1912).—The lowest portion of the flagpole on Longview Asylum for the Insane, just east of the former village of Carthage.

*Mount Washington School*<sup>1</sup> (Hamilton County, Ohio, 1912).—On the roof of the tower of the Mount Washington public school on Beechmont Avenue, corner Campus Lane. Station is marked by a single copper tack. It is 1.5 feet inside west rail; 5.1 feet from northwest railing corner; 8.3 feet from southwest railing corner; and 3.3 feet from the northwest and 5.1 feet from the southwest corners of the trap door.

*Madisonville School*<sup>1</sup> (Hamilton County, Ohio, 1912).—On the roof of the Madisonville public school, near its southern end, the exact point being marked by a wire nail driven into the tar and gravel roof. Station is 13.9 feet from the southeast and southwest corners (close to roof) of large ventilator. Bronze disks such as are described for Hughes High School were placed as follows: In the vertical face of the brick parapet wall rising above the south end of the roof; a cross cut in this disk is 10.84 feet from the station. A similar disk was set in the vertical face of the west parapet wall near south end of building. This disk is 48.33 feet from the station.

<sup>1</sup> Copied from "Report on a plan of sewerage, city of Cincinnati." See p. 5.

*Kennedy*<sup>1</sup> (Hamilton County, Ohio, 1912).—In Kennedy Heights on the brow of the hill, 250 feet south of the center line of Davenant Avenue, and 100 feet west of center line (produced) of Kinell Avenue. In a brush covered lot belonging to the Bullock estate. Marked by a disk in a concrete block similar to the one placed at Norwood (see p. 51).

*St. Joe*<sup>1</sup> (Hamilton County, Ohio, 1912).—Center of cross on steeple of Mount St. Joseph, the mother house of the Sisters of Charity, on the river bluff, 2 miles east of the former village of Delhi.

*Reading*<sup>1</sup> (Hamilton County, Ohio, 1912).—A braced pole close to fence along west side of an open field on brow of hill, north of Hamel Road and east of the village of Reading. Not permanently marked.

*Vincennes latitude and longitude* (Knox County, Ind., E. S., 1881).—In the courthouse yard at Vincennes, 55.58 meters east and 14.78 meters north of the cupola of the clock tower of the courthouse, about 6 meters from the iron fence along Broadway Street and about midway between Seventh and Eighth Streets. The station is marked by a cross in the top of a short stone post projecting 2 or 3 inches above the surface of the ground. On either side of this is a longer stone post projecting about 3 feet above the ground and used for supporting the instrument. The two high posts are inscribed as follows: "U.S. Coast and Geodetic Survey, 1881."

*Forder* (St. Louis County, Mo., C. H. B., 1873).—Within the common of Carondolet, south of the River des Peres, about 250 meters south-southwest of the intersection of the telegraph road and the Jefferson Barracks road, on a gentle rise a few meters north of a 20-foot road near its intersection with the telegraph road. The station is marked by an iron nail in the top of a stake with a mound of dirt thrown up over it. The underground mark is an earthenware pyramid with edges about 6 inches long and having on its southern face the letters U.S.C.S., set 2 feet below the general surface of the ground.

*St. Louis standpipe* (St. Louis City, Mo., C. H. B., 1871).—On the top of the cap of the standpipe, 180 feet high, at the corner of Grand Avenue and Fourteenth Street, St. Louis. The station is marked by a nail in a plank nailed to the timbers which are framed in the brick masonry at the top of the standpipe. There are four arrows pointing toward the station cut in the top of the iron cap of the standpipe.

*Northwest corner* (Franklin County, Mo., C. H. B., 1874).—The stone at the northwest corner of sec. 36, T. 45 N., R. 2 E., about 318 meters north-northeast of station *Tavern Rock*.

*Polemann's house* (Franklin County, Mo., C. H. B., 1874).—Near the intersection of the South Point road and the county rock road to Union, about 2 miles west of station *Halleck*. The station is the northeast corner of the chimney at the south end of Henry Polemann's house. Station *Corner fifth meridian* described below is 263.33 meters east and 146.45 meters north of the station.

*Corner fifth meridian* (Franklin County, Mo., C. H. B., 1874).—The stone marking the half section corner at the east side of sec. 13, T. 43 N., R. 1 W., 263.33 meters east and 146.45 meters north of station *Polemann's house*, described above. There are two white oak witness trees near the station, one east and the other west. The original marks on the trees, "S. IIIX," were discovered in 1874 by cutting out a section of each tree.

*Doermann Hill* (Gasconade County, Mo., F. D. G., 1878).—Two miles north of Drake and one-fourth mile south of Doermann's house on the west side of the iron road about 200 meters north of where the Millers Landing road branches from the iron road. The station is marked by a stone post 3 feet long, dressed to 6 inches square at the top, projecting about 3 inches above the ground, and marked with a cross and the letters U. S. C. S. The stone at the southeast corner of sec. 34, T. 44 N., R. 5 W., is 363.6 meters N. 59° E. (mag.) from the station. The signal used at this station was a barrel on the top of a pole fastened in the top of a tree.

*L'Ours Creek spire* (Osage County, Mo., H. W. B., 1879).—The 50-foot spire of the small brick Roman Catholic Church at L'Ours Creek.

*Koeltztown spire* (Osage County, Mo., H. W. B., 1879).—The 125-foot spire of the large brick Roman Catholic Church at Koeltztown.

*Jefferson City astronomic* (Cole County, Mo., H. W. B., 1879).—On a hill in the extreme southeastern part of Jefferson City, on the east side of the Castle Rock road, about one-fourth mile south of the national cemetery and about the same distance north of the fair grounds, in the front yard of the house of E. T. Manchester, on the right-hand side of the walk leading from the front gate to the house. The station is marked by a cross in the top of a stone post, 6 inches square and 2½ feet long, projecting about 2 inches above the ground. The letters U. S. C. S. are inscribed in the top of the post.

*Cooks Knob ice house* (Johnson County, Mo., F. D. G., 1882).—In the northwest corner of SE. ¼, NE. ¼ sec. 14, T. 47 N., R. 24 W., on a knob about 7 miles north of station *Knob Noster*. The station is the center of a pole on the ridge of E. Cook's ice house, 9 inches south of the ventilator on the building.

*Hazel Hill* (Johnson County, Mo., F. D. G., 1882).—About 11 miles north of Warrensburg on the highest part of Hazel Hill, in the northwest corner of SE. ¼, SW. ¼ sec. 2, T. 47 N., R. 26 W. The station is marked by a nail in the top of a 3-foot stake. It is also marked 2½ feet below the ground by a small bottle of ashes.

*Kansas City astronomic* (Jackson County, Mo., C. H. S., 1882; 1907).—This station has been destroyed by building operations.

*State line 3* (Johnson County, Kans., F. D. G., 1885).—On the west side of the State line road about one-half mile north of the road from Aubry. The station is marked by a nail in the top of a stake. The State boundary stone at the southeast corner of the NW. ¼ sec. 26, T. 14 S., R. 25 E., is 552.16 meters south of the station.

<sup>1</sup> Copied from "Report on a plan of sewerage, city of Cincinnati." See p. 5.

*State line 1* (Johnson County, Kans., F. D. G., 1885).—About  $1\frac{1}{2}$  miles south of New Santa Fe, on the north side of the Belton-Olathe road, just west of the State line road. Missouri stone, which is at the southeast corner of SW.  $\frac{1}{4}$  sec. 35, T. 13 S., R. 25 E., at the intersection of the two roads, is 15.82 meters from the station in azimuth  $297^{\circ} 33'$ . No description of the marking of the station is available.

*Base 1* (Johnson County, Kans., F. D. G., 1885).—About 760 meters west of the State line road and 205 meters south of an east-and-west road on land belonging to Tryon brothers. The station is marked by a bottle  $2\frac{1}{4}$  feet below the surface of the ground.

*Base 2* (Johnson County, Kans., F. D. G., 1885).—This station is 271.24 meters from *Base 1*, described above, in azimuth  $18^{\circ} 43'$ .

*State line 2* (Johnson County, Kans., F. D. G., 1885).—On the State line road about midway between two east-and-west roads. The stone marking the northeast corner of the NW.  $\frac{1}{4}$  sec. 26, T. 12 S., R. 25 E. is 2.90 meters from the station in azimuth  $191^{\circ} 09'$ . No description of the marking at this station is available.

## LOUISVILLE CONNECTION.

### PRINCIPAL POINTS.

*Blocher* (Scott County, Ind., E. H. P., 1914).—About three-fourths mile north-northeast of the town of Blocher, 250 meters east of the Baltimore & Ohio Southwestern Railroad, 120 meters northeast of a concrete culvert on the Deputy-Madison pike, and directly opposite the house of Mrs. Elizabeth J. Brinton, which is on the west side of the pike. The station is 70 meters east of the pike, on land belonging to D. R. Chasteen, who lives one-half mile southeast of the station, and is 5 meters south of Chasteen's north line fence. It is marked according to note 8.<sup>1</sup> Both reference marks are in the fence line north of the station, one between two small cedars, about 20 meters apart, 100 meters east of the pike, and 32.08 meters from the station in azimuth  $261^{\circ} 31'$ . The other reference mark is 30 meters east of the pike and 34.62 meters from the station, in azimuth  $99^{\circ} 25'$ .

*Finley* (Scott County, Ind., E. H. P., 1914).—About 9 miles southwest of Scottsburg and  $2\frac{1}{2}$  miles west-southwest of the Leota store, on the eastern edge of the flat-topped hills known locally as Finley Knobs, about three-fourths mile south of the Scottsburg-Salem road and one-fourth mile east of the Scott-Washington county line. The station is on the highest ground in the most northeasterly cultivated field on the hill, on land belonging to Mrs. Sarah Wolfe, one-fourth mile northeast of her house. A spur begins 250 meters north of the station and extends in a northeasterly direction, ending in a knob three-fourths mile from the station. The station is marked according to note 8.<sup>1</sup> One reference mark is in a fence line 60 meters west of the timber line and 30.30 meters from the station, in azimuth  $24^{\circ} 00'$ . The other reference mark is on the timber line on the east brow of the hill, 3 meters lower than the station and 41.88 meters distant, in azimuth  $271^{\circ} 43'$ .

*Summit* (Clark County, Ind., J. B. B., 1886; 1914).—On the Indiana State Forest Reservation, 2 miles west of the administration building of the reservation, 3 miles northwest of Henryville, and one-half mile south of the Henryville-Brownstown wagon road, on the top of a timbered knob known locally as Salaam Knob. The station is on the east slope of the top, about 1 meter below the highest point, and is marked according to note 10.<sup>1</sup> A lone pine tree 10 inches in diameter towers above the small trees which cover the top of the hill and is visible from Henryville. It stands on the highest point of the knob, 17.42 meters from the station, and is marked with a triangular blaze on the east side. The reference marks are at the following distances and directions from the station: 1.83 meters north (azimuth  $193^{\circ}$ ), 1.86 meters east (azimuth  $281^{\circ}$ ), and 1.84 meters south.

*Marysville* (Clark County, Ind., E. H. P., 1914).—About one-half mile northwest of the depot at Marysville, 300 meters northwest of the schoolhouse and 150 meters east of the house of George Harmon, on land belonging to Samuel W. Taffinger, of Jefferson. The station is in an open field 8.1 meters from the fence on the southwest side of the Marysville-Lexington pike, and is marked according to note 8.<sup>1</sup> The reference marks are in the fence line on the northeast side of the pike, one 25.77 meters from the station, in azimuth  $280^{\circ} 53'$ , and the other 33.13 meters, in azimuth  $173^{\circ} 54'$ .

*O. & M.* (Clark County, Ind., J. L. C., 1884; 1914).—About 3 miles north of Charlestown, 4 miles south of Otisco, about 300 meters west of the Baltimore & Ohio Southwestern Railroad, and 50 meters west of the Charlestown-Lexington wagon road. The station is 150 meters north of schoolhouse No. 9 of Charlestown Township and 50 meters northwest of a large beech tree standing at the head of a ravine close to the road, on land belonging to Mrs. Magdalene Flinchbaugh. The ground to the westward slopes down to a narrowing ridge and to the northeastward spreads out into a flat field, the highest point of which is about 100 meters north of the station. The station is marked according to note 8,<sup>1</sup> with the exception of the reference marks, which are the same as described in note 10.<sup>1</sup> They are at the following distances and directions from the station: 1.75 meters north, 1.82 meters east, and 1.87 meters south.

*Popp* (Clark County, Ind., E. H. P., 1914).—About three-fourths mile southwest of Bennettsville, a station on the Chicago, Indianapolis & Louisville Railway, and  $2\frac{1}{2}$  miles northwest of St. Joseph, on the top of a timbered hill known locally as Haystack Knob, on land belonging to George Popp, who lives three-eighths of a mile northeast. Rock has been quarried on the top of the hill, leaving it a nearly flat, rocky surface, with a rim of earth on the outer edge. The station is on the highest ledge of rock 3 meters from the northeast end and 1 meter from the east side of the rim.

<sup>1</sup> See p. 35.

It is marked by a standard disk station mark set in the concrete, which fills in a hole 7 inches square and 10 inches deep, dug in the soft sandstone ledge. The subsurface mark is the point of a nail projecting one-fourth inch above the cement, which fills a hole 1 inch in diameter and 6 inches deep drilled in the bottom of the larger hole. The reference marks are stone posts 5 inches square and 2 feet long projecting 4 inches above the ground and marked in the top with a cross-lined arrow pointing toward the station. One reference mark is on the south rim at the brow of the hill, 8.56 meters from the station, in azimuth  $42^{\circ} 20'$ , and the other is on the rim on the west brow of the hill, 1 meter lower than the station and 12.24 meters distant, in azimuth  $102^{\circ} 10'$ . The station is about 2 meters east of the old station *Haystack*, which was established in 1884 and destroyed later by the quarrying.

*Lutz* (Clark County, Ind., J. L. C., 1884; 1914).—About 2 miles south-southwest of Charlestown and one-half mile east of the Baltimore & Ohio Southwestern Railway and the Louisville & Northern Electric Railway, 200 meters south-east of the Clark County poorhouse, 200 meters west of the farmhouse on the old Lutz farm now owned by John E. Long. The station is in the northwest corner of a field, 5.4 meters east of the west fence and 3.4 meters south of the north fence, 10 meters east of the pike, and 6 meters south of the road leading to the Long house. It is marked according to note 10.<sup>1</sup> The reference marks are at the following distances and directions from the station: 1.79 meters north, 1.81 meters east, and 1.86 meters south.

*Six Mile* (Floyd County, Ind., J. L. C., 1884; 1914).—About 6 miles north of New Albany, 2 miles south of St. Joseph, and one-fourth mile west of Six Mile switch on the Chicago, Indianapolis & Louisville Railway, on land belonging to Peter Weber, about 250 meters east of the house of Jacob Eberly, and 100 meters east of his east line. The land near Eberly's house is about 90 feet higher than the station. The station is on the footpath leading up the timbered spur from Six Mile switch to the top of the "Knobs" and to Eberly's house. It is marked according to note 10.<sup>1</sup> The reference marks are at the following distances and directions from the station: 1.91 meters north, 1.83 meters east, and 1.85 meters south. The east reference mark is on the trail described above. The station is about 75 meters east of an old stone quarry.

*Sims* (Jefferson County, Ky., J. L. C., 1884).—There is no description available for this station. It is probably marked according to note 10,<sup>1</sup> that is, the same as the other stations established in this locality by Prof. J. L. Campbell in 1884.

*Bangs* (Floyd County, Ind., G. A. F., 1879).—Near the State Street turnpike on land belonging to J. B. Bangs, a short distance northeast of his house on the point of the range of hills on which his house stands. The hill is wooded except that part immediately surrounding the station, which is clear of both trees and stumps. The station is marked according to note 9,<sup>1</sup> except that the tops of the stone posts are dressed to 4 inches square instead of 6. The reference marks are 1.83 meters from the station, north, east, and south (magnetic), respectively.

*Blind Asylum, Louisville* (Jefferson County, Ky., G. A. F., 1879).—In the cupola on top of the dome of the Kentucky Institution for the Blind, on Franklin Avenue near Pope Street, Louisville. The station is marked by a copper nail in the top of the circular cover of the ventilator. As reference marks there are four copper nails in the balustrade of the cupola, so placed that the diagonal lines joining them intersect at the station. They are at the following distances and directions from the station: 1.231 meters north, 1.250 meters east, 1.301 meters south, and 1.280 meters west.

*Williams* (Harrison County, Ind., G. A. F., 1879).—On a hill near Bridgeport, on land belonging to Frank Williams, on the highest ground of a cultivated field south of his house. The station is in the SW.  $\frac{1}{4}$  SE.  $\frac{1}{4}$  sec. 12, T. 4 S., R. 5 E., and is marked according to note 9,<sup>1</sup> except that the tops of the stone posts are dressed to 4 inches square instead of 6, and that the underground mark is a copper nail in the stopper of a glass bottle filled with ashes. The reference marks are 1.83 meters from the station north, east, and south (magnetic), respectively.

*Cox* (Jefferson County, Ky., G. A. F., 1879).—About 5 miles from Louisville, on the highest point of a prominent knob known as Cox's Knob, on land belonging to Ben Figgs. The station is about 30 meters back of an old sandstone quarry on the northern point of the knob, and is marked according to note 9,<sup>1</sup> except that the tops of the stone posts are dressed to 4 inches square instead of 6. The reference marks are 1.83 meters from the station, north, east, and south (magnetic), respectively.

*Louisville north base* (Jefferson County, Ky., G. A. F., 1879).—In the outskirts of Louisville, three-fourths mile south of the southern boundary of the fair grounds and 100 meters north of Bells Lane, known locally as Gravel Pit Lane. The station is on the farm of Joseph Oechsli, and 25 meters north of his barn. It is marked by a cross in the top of a copper bolt set in a drill hole in the top of a granite post 4 feet 10 inches long and about 10 or 12 inches square. The top of the post is dressed in the form of a pyramid, with the inscription "U. S. C. & G. S., N. Base 1879," cut in the south face, and projects  $1\frac{1}{2}$  feet above the ground. The underground mark is an earthenware pyramid with edges about 4 inches long and with the letters U. S. C. S. cut in the four faces, buried about  $3\frac{1}{2}$  feet below the surface of the ground. There are three reference marks, each consisting of a stone post  $2\frac{1}{2}$  feet long dressed to 4 inches square at the top, marked with a cross and an arrowhead pointing toward the station, and they are located as follows: 1.83 meters north, in the prolongation of the base line; 1.83 meters east, at right angles to the base line; and 1.83 meters south, in the line of the base.

*Louisville south base* (Jefferson County, Ky., G. A. F., 1879).—About 7 miles from Louisville, a short distance east of the Salt River turnpike and a few meters east of the Cecilian branch of the Louisville & Nashville Railroad, just north of a farm road crossing. The station is in a cultivated field on land belonging to B. H. Kerrick, whose house is on the opposite side of the railroad a short distance north. It is marked the same as the *Louisville north base*, described above, except that "S. Base" replaces "N. Base" in the inscription. The reference marks are located as

<sup>1</sup> See p. 35.

follows: 1.83 meters north, in the line of the base; 1.83 meters east, at right angles to the base line; and 1.83 meters south, in the prolongation of the base line.

*Riley* (Jefferson County, Ky., G. A. F., 1879).—Near the Blue Lick pike, about  $3\frac{1}{2}$  miles from the Preston Street turnpike, on land belonging to W. H. Riley, on the only cleared knob of several knobs north of his house. The station is marked according to note 9,<sup>1</sup> except that the tops of the posts are dressed to 4 inches square instead of 6. The reference marks are 1.83 meters from the station north, east, and south, respectively.

*Potts* (Harrison County, Ind., C. S., 1880; 1882).—South-southwest of Bridgeport and southeast of Elizabeth, in the NW.  $\frac{1}{4}$  SW.  $\frac{1}{4}$  sec. 11, T. 5 S., R. 5 E., on land belonging to J. Potts. The station is marked by a granite post 2.8 feet long, dressed to 4 inches square at the top, and marked with a cross and the letters U. S. C. G. S. The underground mark is a glass bottle filled with ashes about 3.1 feet below the ground. Four hard-burned bricks, each marked with an arrow head pointing toward the station, are 2.3 feet below the ground and 2.5 feet from the station north, east, south, and west (magnetic), respectively. The station is surrounded by a concentric ring of charcoal 1 foot wide, 0.9 foot deep, and 8.4 feet in diameter, about 2 feet below the surface of the ground. The following distances and magnetic bearings are from the station: Chestnut tree, 28.7 meters N.  $66^{\circ} 50'$  E.; nearest corner of barn, 53.2 meters S.  $31^{\circ} 12'$  E.; nearest corner of dwelling, 39.7 meters; lightning rod on dwelling, N.  $87^{\circ} 09'$  W.; nearest corner of small shed, 22.5 meters.

*Mountain Top* (Bullitt County, Ky., C. S., 1880).—On the top of the most easterly high point of a hill known as Dawsons Knob, which is on the south side of the Salt River between Bardstown Junction on the east and Pitts Point on the west, the latter place being at the junction of Salt River and Rolling Fork. The station is about 9 meters south of the road along the top of the ridge on land belonging to W. H. Holsklaw. It is marked by a granite post 2.8 feet long dressed to 4 inches square at the top and marked with a cross and the letters U. S. C. G. S. The underground mark is a glass bottle filled with ashes 3.1 feet below the ground. Three reference marks, each consisting of a granite post 2 feet long dressed to 4 inches square at the top and marked with a diagonal cross with an arrowhead at the end of one diagonal pointing toward the station, are 1.83 meters from the station north, east, south, and west (magnetic), respectively.

*Dobbins* (Bullitt County, Ky., J. F. P., 1883).—About 3 miles southwest of Belmont furnace and 1 mile southwest of the house of Joseph L. Dobbins, on the highest knob in the vicinity, on land belonging to the Tilden brothers. The station is marked by an iron bolt set in a drill hole in a boulder about 3 inches below the surface of the ground. The bolt projects 4 inches above the surface of the boulder and there is a pile of stones built around and over it. There are three reference marks, each consisting of a boulder with an inscribed arrow pointing toward the station, 1.83 meters from the station north, east, and south, respectively.

*Keith* (Nelson County, Ky., J. F. P., 1883).—About 5 miles by road northwest of Boston, on the northeast end of a large flat appearing hill known locally as Keiths Knob. The station is on land belonging to George M. Miller, on the end of the ridge directly back of his house. It is marked according to note 11.<sup>1</sup> Three reference marks, each consisting of a boulder with an arrow pointing toward the station chiseled in its upper surface, are 1.83 meters from the station north, east, and south, respectively.

*Jackson* (Bullitt County, Ky., J. F. P., 1883).—About 7 miles from Bardstown Junction and about  $1\frac{1}{4}$  miles east of Big Springs station on the Bardstown branch of the Louisville & Nashville Railroad, on land belonging to Dora Jackson, on the top of a rounded knob about one-fourth mile to the northward of his house. The station is marked according to note 11.<sup>1</sup> Three reference marks, each consisting of a boulder with an arrow pointing toward the station chiseled in its upper surface, are 1.83 meters from the station north, east, and south, respectively.

*White Lick* (Nelson County, Ky., C. S., 1882).—A short distance south-southwest of Samuels, a small town on the Louisville & Nashville Railroad, on the highest point of a hill known locally as Hays Knob, White Lick, or Stone-Quarry Hill, the second hill from the north end of a group of hills on the west side of the railroad. The station is near the east end of the top of the hill on land belonging to R. Simmons. It is marked by a limestone post 3 feet long with the top dressed to 5 inches square with a cross and the letters U. S. C. S. cut in the upper surface. The underground mark is a bottle buried about 4 feet deep and protected by a thin block of sandstone resting on four sandstone pillars. Four reference marks, each consisting of a hard-burned brick with a cross and an arrowhead pointing toward the station cut in the upper surface, are about 2 feet below the ground and 1 meter from the station north, east, south, and west, respectively.

*Willett* (Nelson County, Ky., J. F. P., 1883).—About 4 miles north by west from the monastery of La Trappe and about 1 mile southwest of the house of William Peak, on the highest knob in the vicinity, on land belonging to James Willett. The station is marked according to note 11.<sup>1</sup> A white oak tree marked with a triangular blaze is 13.7 meters S.  $3^{\circ}$  W. from the station and a hickory marked in a similar manner is 13.6 meters S.  $68^{\circ}$  W.

*Thompson* (Nelson County, Ky., J. F. P., 1883).—About 5 miles southeast of the town of New Haven and 2 miles south of the Louisville & Nashville Railroad on the northwest end of a long timbered ridge overlooking the Rolling Fork of the Salt River. The station is on land belonging to James Thompson about three-fourths mile southeast of his house. It is marked according to note 11.<sup>1</sup> A reference mark consisting of a boulder with an arrow pointing toward the station cut in the upper surface is 1.83 meters east of the station. A similar mark cut in the highest rock on the hill is 7.36 meters S.  $28^{\circ}$  E. from the station and a chestnut tree marked with a triangular blaze is 7.6 meters S.  $57^{\circ}$  W.

<sup>1</sup> See p. 35.

*Burkett* (Nelson County, Ky., J. F. P., 1883).—About 7 miles from Bardstown, 1 mile east of Botland post office and 1 mile west of the Beech Fork of the Salt River, on the north side of the Bardstown-Springfield turnpike. The station is on land belonging to A. Burkett on the highest ground between his house and the pike, just northeast of a clump of small cedars. It is marked according to note 11.<sup>1</sup> The following distances and directions are from the station: Red oak stump, 19.1 meters N. 42° W.; white oak stump, 13.9 meters N. 34° E.; white oak tree marked with a triangular blaze, 17.4 meters S. 28° E.; and a cedar tree marked with a triangular blaze, 12.1 meters S. 46° W.

*Rohan* (Nelson and Marion Counties, Ky., J. F. P., 1883).—On the county line on the top of the most conspicuous knob in either county, known very generally as Rohans Knob. The station is marked according to note 11.<sup>1</sup> Three reference marks, each consisting of a bowlder with an arrow pointing toward the station cut in the upper surface, are 1.83 meters from the station north, east, and south, respectively. An oak stump is 9.1 meters N. 10° E. from the station and a similar stump is 6.2 meters S. 9° E.

*Ferriell* (Marion County, Ky., J. F. P., 1883).—About one-half mile southwest of Chicago, on the top of a hill overlooking the village, on land belonging to Mr. Ferriell. The station is marked according to note 11.<sup>1</sup> Three reference marks, each consisting of a bowlder with an arrow pointing toward the station cut in the upper surface, are 1.83 meters from the station north, east, and west, respectively.

*Penick* (Marion County, Ky., J. F. P., 1883).—About 3 miles from Penick, three-fourths mile west of Asbury Church and about one-half mile south of the Lebanon branch of the Louisville & Nashville Railroad on the end of a hill extending north toward the railroad. The station is on land belonging to the Penick estate and is marked according to note 11.<sup>1</sup>

#### SUPPLEMENTARY POINTS.

*Haystack* (Clark County, Ind., J. L. C., 1884, 1914).—Lost.

*Bartle* (Clark County, Ind., J. L. C., 1886).—There is no description available for this station. It is probably marked according to note 10,<sup>1</sup> that is, the same as the other stations established in this locality by Prof. J. L. Campbell.

*St. Martin's Church* (Jefferson County, Ky., C. S., 1880).—The spire of St. Martin's Church which is on Shelby Street between Kellar Street and Broadway, Louisville.

*Cave Hill Cemetery* (Jefferson County, Ky., C. S., 1880).—The pedestal of the angel on top of the stone spire at the entrance to Cave Hill Cemetery, Louisville.

*Bonifacius Church* (Jefferson County, Ky., C. S., 1880).—The spire of Bonifacius Church, which is on Green Street between Jackson and Hancock Streets, Louisville.

*Christ Church* (Jefferson County, Ky., C. S., 1880).—The spire of Christ Church, which is on Second Street between Green and Walnut Streets, Louisville.

*St. Paul's Church* (Jefferson County, Ky., C. S., 1880).—The cross on top of the spire of St. Paul's Church at the corner of Sixth and Walnut Streets, Louisville.

*Catholic Cathedral* (Jefferson County, Ky., C. S., 1880).—The cross on top of the spire of the Catholic Cathedral, which is on Fifth Street between Walnut and Green Streets, Louisville.

*Baptist Church* (Jefferson County, Ky., C. S., 1880).—The spire of the Baptist Church at the corner of Fourth and Walnut Streets, Louisville.

*Second Presbyterian Church* (Jefferson County, Ky., C. S., 1880).—This church is at the corner of Second and College Streets, Louisville.

*Broadway Baptist Church* (Jefferson County, Ky., C. S., 1880).—The spire of the Baptist Church on Broadway between First and Brook Streets, Louisville.

*German Methodist Church* (Jefferson County, Ky., C. S., 1880).—The spire of the German Methodist Church at the corner of Market and Hancock Streets, Louisville).

*City Hall* (Jefferson County, Ky., C. S., 1880).—The pole on top of the tower of the City Hall, Louisville.

*Malt House elevator* (Jefferson County, Ky., C. S., 1880).—The grain elevator of the Malt House at the corner of Thirteenth and Maple Streets, Louisville.

*Church of the Messiah* (Jefferson County, Ky., C. S., 1880).—The spire of the Church of the Messiah, or Unitarian, Church at the corner of Fourth and York Streets, Louisville.

*Cedar Glade* (Bullitt County, Ky., J. F. P., 1883).—About 5½ miles from Mount Washington village, on land belonging to H. H. Swieringen on the highest point of an elongated hill about 1¼ miles from his house. Cedar Glade schoolhouse is on the south end of the same hill, about one-eighth mile from the station. The station is marked by a drill hole in a stone about 14 inches below the surface of the ground and by a pile of earth and stones around the base of the signal pole.

*Mount Washington Church spire* (Bullitt County, Ky., J. F. P., 1883).—The white spire on the red brick Baptist Church in Mount Washington village.

*Bardstown Junction Methodist Church* (Bullitt County, Ky., J. F. P., 1883).—The very small spire of the only Methodist church in Bardstown Junction. The church is a small wooden structure.

*Dry Knob* (Bullitt County, Ky., J. F. P., 1883).—On the northwest side of a clearing on the top of Dry Knob, on land belonging to Henry Trunquel, of Bardstown Junction. The station is a pole in the top of a hickory tree marked with a triangular blaze. Three other small trees marked with triangular blazes are at the following distances and directions from the station: Red oak, 6.86 meters N. 6° W.; red oak, 7.32 meters S. 80° W.; and a hickory tree, 6.71 meters N. 70° W.

<sup>1</sup> See p. 35.

*Indian Knob* (Bullitt County, Ky., J. F. P., 1883).—About  $1\frac{1}{4}$  miles south-southwest of Bardstown Junction on the summit of a conspicuous knob known locally as Indian Knob. The station is a pole in the top of a pine tree marked with a triangular blaze. Three other trees, each marked with a blaze and nails, are at the following distances and directions from the station: Pine tree, 6.25 meters N.  $55^\circ$  E.; chestnut oak tree, 4.72 meters N.  $24^\circ$  W.; and a pine tree, 1.98 meters S.  $6^\circ$  W.

*Britts Knob* (Bullitt County, Ky., J. F. P., 1883).—About 3 miles southeast of Bardstown Junction, on the highest point of a knob about three-fourths mile south of Thomas Britt's house. The station is on land belonging to the Tilden brothers, who live at Belmont Furnace, and is marked by a pile of stone around the base of the signal pole.

*Lebanon Junction Knob* (Bullitt County, Ky., J. F. P., 1883).—About 1 mile from Lebanon Junction, near the road to Belmont Furnace, on the top of the most conspicuous knob in the vicinity, on land belonging to Mr. Thompson, who lives near the base of the hill. The station is a pole in the top of a hickory tree which is marked with a triangular blaze on the east side. Three other small hickory trees, each marked with a blaze, are at the following distances and directions from the station: 3.7 meters N.  $45^\circ$  W, 2.9 meters S.  $85^\circ$  W., and 4.6 meters S.  $83^\circ$  E.

*Bardstown Catholic Church spire* (Nelson County, Ky., J. F. P., 1883).—The spire of the St. Joseph Catholic Church at Bardstown. It is the most conspicuous spire in the town.

*Loretto Convent spire* (Marion County, Ky., J. F. P., 1883).—The only spire on the convent and academy of the Loretto sisterhood.

*Gethsemane La Trappe monastery spire* (Nelson County, Ky., J. F. P., 1883).—The only spire on the Trappist abbey at Gethsemane.

*Buzzards Roost* (Larue County, Ky., J. F. P., 1883).—On the top of a rocky point of Muldaughs Hills, known locally as Buzzard Roost, nearly opposite and overlooking the town of New Haven. The station is a pole in the top of an oak tree marked with a triangular blaze.

*New Hope Distillery smokestack* (Nelson County, Ky., J. F. P., 1883).—The smokestack of the distillery at New Hope and the only tall chimney in the town.

*Chicago Catholic Church spire* (Marion County, Ky., J. F. P., 1883).—The only spire in the town of Chicago.

*St. Charles Catholic Church spire* (Marion County, Ky., J. F. P., 1883).—About 3 miles from St. Marys, a station on the Louisville & Nashville Railway. The station is the cross on the southeast one of the two spires on the St. Charles Roman Catholic Church.

*Lebanon Catholic Church spire* (Marion County, Ky., J. F. P., 1883).—The large gilt cross on the top of the spire of the large Roman Catholic Church in Lebanon.

#### COMPUTATION, ADJUSTMENT, AND ACCURACY OF THE ELEVATIONS.

The zenith distances directly observed at the primary triangulation stations were first computed. These zenith distances were corrected for height of the object observed and of the instrument so as to refer them all to the ground at each station or to the station marks.

The difference of elevation of each pair of stations in the main scheme of primary triangulation was then computed from the observations over the line joining them by the formula

$$h_2 - h_1 = s \tan \frac{1}{2} (\zeta_2 - \zeta_1) \left[ 1 + \frac{h_2 + h_1}{2\rho} + \frac{s^2}{12\rho^2} \right]$$

in which  $h_2$  and  $h_1$  are elevations of the stations,  $\zeta_2$  and  $\zeta_1$  are the measured zenith distances, as corrected for height of instrument and of object observed,  $s$  is the horizontal distance between the stations, and  $\rho$  is the radius of curvature.

As there are two or more lines to each new station, many rigid conditions exist between the observed differences of elevation, even if the connections with the precise leveling were ignored, and the least square adjustment furnishes the readiest accurate means of deriving the required elevations.

The necessity of determining the elevations of points in the triangulation is apparent in connection with the six base lines, as these elevations furnish the means to refer the base lengths to the same average level of the ocean.

The elevations of the stations at the higher levels must be known at least approximately in order to reduce the horizontal measures to what they would have been if the stations *observed upon* had been at the sea level. This reduction is ordinarily but a small fraction of a second of arc and was ignored for all the triangulation in this publication. From a geographical point of view it is important that the third or height coordinate of points in the triangulation should be determined. The foundation for the elevations is furnished by the adjusted precise

level net,<sup>1</sup> one line of which follows closely the thirty-ninth parallel, near which lies the triangulation under discussion.

A continuous series of zenith distances of any magnitude exists only in Missouri from stations Jacobs and Berger in the eastern part to Bowler near the Kansas line. The first adjustment fixed these elevations. In a second adjustment all the stations occupied in 1914 to connect the thirty-ninth parallel triangulation with the scheme in the vicinity of Louisville are involved. In the third adjustment the stations of the Louisville base net with the three adjoining stations are fixed in elevation.

FIRST ADJUSTMENT.

In the first adjustment all stations of the primary scheme are involved. The elevations of stations Bowler, Baker, Knob Noster, Heard, Hubbard, Cole, Versailles north base, Hunter, Christian, and Medlock were held fixed at 330.97, 306.20, 279.40, 281.29, 294.80, 281.48, 322.30, 319.47, 278.90, and 266.90 meters, respectively. These elevations were determined by lines of spirit leveling which connected them with the precise leveling net. In addition, some spirit leveling in 1878, by the party while engaged on the reconnoissance, fixed the differences of elevation between the stations Bradford, Turnpike, Bluff, Geyer, Gasconade, and Winter. The elevations of this group of five stations and of the remaining 19 stations connected by the observations are unknowns to be determined by least squares from the 67 observed differences of elevation indicated below.

In the following tabulation the observed differences of elevation treated in the first adjustment are shown, together with their adjusted values. The weight,  $p$ , assigned to each observed difference of elevation, is inversely proportional to the square of the length,  $s$ , of the line between stations in meters, and was conveniently computed by the formula  $\log p = 9 - 2 \log s$ . The observed difference of elevation is given the sign of the elevation of the second station named minus the elevation of the first. The quantity contained in the last column but one is the correction to be added to an observed difference of elevation to obtain the corresponding adjusted difference.

Adjustment of elevations—thirty-ninth parallel.

Station 1	Station 2	Weight $p$	Observed difference of elevation, $h_2 - h_1$	Adjusted difference of elevation, $h_2 - h_1$	Adjusted minus observed $v$	$pvv$
			<i>Meters</i>	<i>Meters</i>	<i>Meters</i>	
Bowler.....	Chapel Hill.....	1.16	- 1.15	- 1.28	-0.13	0.020
Do.....	Thornton.....	5.01	-11.03	-11.29	-.28	.339
Do.....	Fulton.....	1.28	- 8.64	- 9.11	-.47	.283
Chapel Hill.....	Normal.....	.04	-61.89	-61.97	-.08	.006
Do.....	Baker.....	3.46	-23.35	-23.49	-.14	.008
Do.....	Thornton.....	2.91	-10.16	-10.01	+ .15	.066
Thornton.....	Baker.....	3.31	-13.35	-13.48	-.13	.056
Do.....	Hutton Mound.....	.95	-17.73	-18.09	-.36	.123
Do.....	Fulton.....	2.12	+ 2.20	+ 2.18	-.02	.001
Fulton.....	Baker.....	1.68	-15.13	-15.06	-.07	.472
Do.....	Hutton Mound.....	4.10	-20.32	-20.27	+ .05	.010
Baker.....	Normal.....	1.20	-38.62	-38.48	+ .14	.024
Do.....	Caldwell.....	.83	- 4.45	- 4.98	-.53	.233
Do.....	Hutton Mound.....	1.54	- 4.96	- 4.61	+ .35	.188
Hutton Mound.....	Caldwell.....	.73	+ 3.05	+ 3.03	+ .02	.245
Normal.....	Knob Noster.....	3.78	+11.66	+11.68	+ .02	.002
Do.....	High Point Tebo.....	1.61	+36.66	+36.70	+ .04	.003
Do.....	Caldwell.....	2.21	+37.54	+37.50	-.04	.004
Caldwell.....	Knob Noster.....	1.17	-26.07	-25.82	+ .25	.073
Do.....	High Point Tebo.....	3.88	- 7.70	- 8.00	-.30	.039
Knob Noster.....	Kendrick.....	3.68	+ 5.2	+ .67	+ .15	.083
Do.....	High Point Tebo.....	2.01	+24.95	+25.02	+ .07	.010
Kendrick.....	Heard.....	2.36	+ 7.0	+ 1.22	+ .52	.637
Do.....	Schnackenberg.....	1.29	+52.93	+52.50	-.43	.239
Do.....	High Point Tebo.....	4.25	+24.39	+24.35	-.04	.007
Heard.....	Hughes.....	.64	+56.72	+57.28	+ .56	.201
Do.....	Schnackenberg.....	1.70	+51.04	+51.28	+ .24	.098
Schnackenberg.....	High Point Tebo.....	.85	-28.51	-28.15	+ .36	.110
Do.....	Hubbard.....	.83	-37.96	-37.77	+ .19	.030
Do.....	Hughes.....	1.76	+ 6.34	+ 6.00	-.34	.204

<sup>1</sup> See Special Publication No. 18, U. S. Coast and Geodetic Survey.

Adjustment of elevations—thirty-ninth parallel.

Station 1	Station 2	Weight $p$	Observed difference of elevation, $h_2-h_1$	Adjusted difference of elevation, $h_2-h_1$	Adjusted minus observed $v$	$pvv$
			<i>Meters</i>	<i>Meters</i>	<i>Meters</i>	
Hubbard.....	Hughes.....	1.32	+43.99	+43.77	-0.22	0.084
Hughes.....	Cole.....	1.22	-56.97	-57.09	-.12	.018
Do.....	Versailles north base.....	6.11	-16.08	-16.27	-.19	.221
Do.....	Hunter.....	5.27	-19.26	-19.10	+.16	.135
Cole.....	Moreau.....	1.19	-.91	-1.72	-.81	.781
Do.....	High Point.....	2.42	+13.11	+12.74	-.37	.332
Versailles north base.....	do.....	2.64	-28.42	-28.12	+.30	.238
Christian.....	Moreau.....	4.18	+.55	+.86	+.31	.402
Do.....	Belshe.....	1.07	+32.78	+33.00	+.22	.052
Do.....	High Point.....	4.22	+15.13	+15.32	+.19	.152
Hunter.....	do.....	3.00	-25.03	-25.25	-.22	.150
Do.....	Belshe.....	.93	-8.20	-7.57	+.63	.369
High Point.....	Moreau.....	4.81	-14.47	-14.46	+.01	.000
Do.....	Belshe.....	2.44	+17.65	+17.68	+.03	.002
Moreau.....	Medlock.....	4.83	-13.13	-12.86	+.27	.352
Do.....	Cedar.....	1.51	-10.02	-9.96	+.06	.005
Do.....	Kennedy.....	.83	+8.76	+8.81	+.05	.002
Do.....	Belshe.....	3.49	+32.47	+32.14	-.33	.380
Medlock.....	Cedar.....	3.36	+2.66	+2.90	+.24	.194
Do.....	Belshe.....	1.14	+45.63	+45.00	-.63	.453
Belshe.....	Cedar.....	.87	-41.55	-42.10	-.55	.263
Do.....	Kennedy.....	1.35	-22.99	-23.33	-.34	.157
Cedar.....	Bradford.....	.97	+16.71	+17.14	+.43	.179
Do.....	McDaniel.....	1.34	+22.50	+22.16	-.34	.155
Do.....	Kennedy.....	1.26	+18.39	+18.77	+.38	.181
McDaniel.....	Bradford.....	4.36	-5.00	-5.02	-.02	.002
Do.....	Pilot Knob.....	4.63	+6.39	+6.31	-.08	.026
Do.....	Kennedy.....	2.09	-3.34	-3.39	-.05	.005
Bradford.....	Pilot Knob.....	1.53	+11.02	+11.33	+.31	.129
Pilot Knob.....	Kennedy.....	1.48	-9.74	-9.70	+.04	.002
Do.....	Turnpike Bluff.....	.85	-30.01	-29.86	+.15	.019
Do.....	Geyer.....	2.14	-2.18	-2.63	-.45	.433
Gasconade.....	Berger.....	4.21	-3.94	-4.11	-.17	.122
Do.....	Jacobs.....	1.69	-5.08	-5.11	-.03	.002
Winter.....	Berger.....	2.56	+2.78	+2.81	+.03	.002
Do.....	Jacobs.....	4.69	+1.67	+1.81	+.14	.092
Berger.....	do.....	3.09	-.79	-1.00	-.21	.136

The probable error of an observation of weight unity derived from the preceding adjustment is  $\pm 0.31$  meter. In other words, the reciprocal observations over a line 31.7 kilometers (19½ miles) long, this being the length of line corresponding to unit weight, determined the difference of elevation of two points with such a degree of accuracy that it is an even chance whether the error is greater or less than 0.31 meter. The probable errors for lines of other than unit length were assumed to be proportional to their lengths.

The probable errors of the elevations fixed by precise leveling are about 0.05 meter. The lines of spirit leveling connecting the precise leveling with the stations of the triangulation are so short that their probable errors do not exceed 0.10 meter. Station Jacobs was assumed to be the least accurately determined station in the scheme under discussion. The probable error computed for it from the vertical angle observations alone is  $\pm 0.23$  meter. The probable error of this elevation when combined with the probable error due to the spirit leveling and precise leveling became  $\pm 0.25$  meter.

SECOND ADJUSTMENT.

In the second adjustment the elevation of station Lutz was determined by precise leveling, and its elevation, 183.376 meters, was held fixed. The elevations of 9 remaining stations connected by the observations are unknowns to be determined by a least square adjustment from the 21 observed differences of elevation indicated below. In this tabulation the observed differences of elevation are treated as in the first adjustment.

*Adjustment of elevations—Louisville connection.*

Station 1	Station 2	Weight, <i>p</i>	Observed difference of elevation, <i>h</i> <sub>2</sub> - <i>h</i> <sub>1</sub>	Adjusted difference of elevation, <i>h</i> <sub>2</sub> - <i>h</i> <sub>1</sub>	Adjusted minus observed, <i>v</i>	<i>pvv</i>
			<i>Meters</i>	<i>Meters</i>	<i>Meters</i>	
Lutz.....	Six Mile.....	5.78	+101.38	+101.34	-0.04	0.01
Do.....	Popp.....	6.05	+97.97	+98.05	+0.08	.04
Do.....	O. & M.....	14.9	+14.47	+14.45	-.02	.00
Six Mile.....	Popp.....	43.0	+3.28	+3.28	.00	.00
Do.....	O. & M.....	3.37	-86.84	-86.88	-.04	.01
O. & M.....	Popp.....	4.76	+83.92	+83.60	-.32	.49
Do.....	Summit.....	4.41	+97.34	+97.33	-.01	.00
Do.....	Marysville.....	7.08	+18.43	+18.59	+0.16	.18
Popp.....	Summit.....	3.56	+15.85	+13.74	-2.11	.05
Do.....	Marysville.....	1.78	-64.59	-65.01	-.42	.31
Marysville.....	Summit.....	5.42	+78.62	+78.74	+0.12	.08
Do.....	Finley.....	2.26	+96.69	+96.53	-.16	.06
Do.....	Blocher.....	4.32	-2.64	-2.61	+0.03	.00
Summit.....	Finley.....	10.03	+17.82	+17.79	-.03	.01
Do.....	Blocher.....	2.17	-81.61	-81.35	+0.26	.14
Blocher.....	Miller.....	.79	+68.23	+68.09	-.14	.02
Do.....	Stout.....	4.11	+11.71	+11.88	+0.17	.12
Finley.....	Miller.....	1.41	-30.80	-31.05	-.25	.09
Do.....	Stout.....	.23	-86.31	-87.26	-.95	.21
Stout.....	Miller.....	.63	+55.46	+56.21	+0.75	.35
Blocher.....	Finley.....	2.02	+99.08	+99.14	+0.06	.01

The probable error of an observation of weight unity derived from the preceding adjustment is ±0.29 meter.

The probable error of the elevation of station Lutz was found to be about ±0.05 meter from the precise leveling. The probable error approaches this value for stations adjacent to Lutz and is greatest for the most remote station. Station Miller was assumed to be the one least accurately determined and its probable error was therefore computed as a limiting value and found to be ±0.21 meter from the vertical angles alone or, when combined with the probable error of the elevation fixed by the precise leveling, it was ±0.22 meter.

THIRD ADJUSTMENT.

In the third adjustment the elevation of Louisville north base as determined by precise leveling, 136.55 meters, was held fixed. The elevation of Louisville south base was determined by the leveling along the base at the time of measurement. Its elevation was held fixed at 144.44 meters. The elevations of the 5 remaining stations connected by the observations are unknowns to be determined by a least square adjustment from the 13 observed differences of elevation indicated below. In this tabulation the observed differences of elevation are treated as in the first adjustment.

*Adjustment of elevations—Louisville base net.*

Station 1	Station 2	Weight, <i>p</i>	Observed difference of elevation, <i>h</i> <sub>2</sub> - <i>h</i> <sub>1</sub>	Adjusted difference of elevation, <i>h</i> <sub>2</sub> - <i>h</i> <sub>1</sub>	Adjusted minus observed, <i>v</i>	<i>pvv</i>
			<i>Meters</i>	<i>Meters</i>	<i>Meters</i>	
Louisville north base.....	Louisville south base.....					
Do.....	Williams.....	11.6	+160.24	+160.22	-0.02	0.0045
Louisville south base.....	do.....	17.9	+152.41	+152.33	-0.08	.1146
Louisville north base.....	Cox.....	12.1	+93.26	+93.41	+0.15	.2722
Louisville south base.....	do.....	34.6	+85.52	+85.52	0.00	.0000
Williams.....	do.....	6.4	-66.63	-66.81	-0.18	.2074
Cox.....	Blind Asylum.....	6.7	-71.07	-70.88	+0.19	.2419
Williams.....	do.....	2.5	-137.60	-137.69	-0.09	.0202
Cox.....	Bangs.....	2.4	+49.69	+49.34	-0.35	.2940
Williams.....	do.....	3.2	-17.67	-17.47	+0.20	.1280
Blind Asylum.....	do.....	4.7	+120.10	+120.22	+0.12	.0677
Williams.....	Riley.....	0.77	-18.33	-19.42	-1.09	.9148
Bangs.....	do.....	0.36	-3.06	-1.95	+1.11	.4436
Blind Asylum.....	do.....	0.89	+117.77	+118.27	+0.50	.2225

The probable error of an observation of weight unity derived from the preceding adjustment is ±0.33 meter.

The probable error of the elevation of Louisville north base was found to be about  $\pm 0.10$  meter from the precise leveling. Riley was assumed to be the station least accurately determined and its probable error was computed as a limiting value and found to be  $\pm 0.24$  meter from the vertical angles alone, or when combined with the probable error of the elevation fixed by the precise leveling it was  $\pm 0.26$  meter.

ACCURACY OF VERTICAL ANGLE RESULTS IN THE UNITED STATES.

The best test of accuracy is believed to be the probable error of an observation of unit weight. Such an observation is here considered to be the reciprocal nonsimultaneous observation over the length of line corresponding to unit weight, considered as 31.7 kilometers (19½ miles).

The vertical angle results of the two sections of triangulation considered in this publication have such accuracies that they would appear in the third, fourth, and fifth place of a table like the one on page 63, Special Publication No. 13, in which 25 sections of vertical angle results of triangulation in the United States, having separate least square adjustments, have been arranged in order of accuracy, the most accurate being placed first.

ELEVATIONS.

The datum for all the elevations is mean sea level.

The stations are in three classes: First, those fixed directly by the spirit leveling, whose elevations are subject to a probable error varying from  $\pm 0.06$  to  $\pm 0.35$  meter; second, the stations in the main scheme, fixed by reciprocal measures of vertical angles and subject to probable errors varying from  $\pm 0.1$  to  $\pm 1.8$  meters; and, third, the intersection stations, of which the elevations are fixed by measurements of vertical angles which are not reciprocal, the intersection stations not being occupied, and having their elevations subject to probable errors which may be as great as  $\pm 6$  meters in some cases.

The accuracy with which the elevation of a station in the main scheme is determined depends mainly upon the distance of that station from the nearest station whose elevation is fixed by spirit leveling. The spirit-leveling stations are given in the following table, under the heading "Class 1." Station Jacobs is probably the least accurately determined of all the stations in the main scheme.

TABLE OF ELEVATIONS

Thirty-ninth parallel.

WEST VIRGINIA STATIONS.<sup>1</sup>

Station	Point to which elevation refers	Elevation		Station	Point to which elevation refers	Elevation	
		Meters	Feet			Meters	Feet
<i>Class 2.</i>				<i>Class 3—Continued.</i>			
Briery	Station mark	1379.0	4524.3	Wray	Station mark	310.8	1019.7
Keeney	do	1199.5	3935.4	Oakland	do	333.1	1092.8
Beech	do	1265.1	4150.6	Creed	do	352.5	1156.5
Ivy	do	1091.4	3580.7	Elk	do	347.8	1141.1
Table Rock	do	535.0	1755.2	Martin	do	353.1	1158.5
Summersville	do	783.9	2571.8	Townsend Mountain	Tree tops	962	3156
Paint Creek	Ground	993.4	3259.2	Big Clear Creek Mountain	Ground	1270	4167
Holmes	Station mark	406.3	1333.0	Grassy Knob	Trees	1353	4439
Piney	do	335.8	1101.7	Big Sewall Mountain	Trees [80 ft. (?)]	1069	3507
Pigeon	do	387.7	1272.0	Coal River Mountain, long flat	Trees	1044	3425
Davis	do	322.4	1057.7	Coal River Mountain	Ground	1022	3353
Gebhardt	do	317.9	1043.0	Cold Knob	Trees	1035	3396
<i>Class 3.</i>				Jobs Knob	Ground	1326	4350
St. Albans west base	do	180.3	591.4				
Big Rocks	do	356.2	1168.0				

<sup>1</sup> These stations form a part of an adjustment not published here. This adjustment will be given when the Maryland and Virginia parts of the thirty-ninth parallel are printed.

## TABLE OF ELEVATIONS—Continued.

Thirty-ninth parallel—Continued.

## INDIANA STATIONS.

Station	Point to which elevation refers	Elevation		Station	Point to which elevation refers	Elevation	
		Meters	Feet			Meters	Feet
<i>Class 1.</i>				<i>Class 1—Continued.</i>			
Holton north base.....	Top of surface stone...	281.46	923.44	Glasgow.....	Top of surface stone...	302.39	990.21
Holton south base.....	.....do.....	278.72	914.44				

## ILLINOIS STATIONS.

<i>Class 1.</i>				<i>Class 2.</i>			
Berger.....	Surface mark.....	172.857	567.12	Clarks Mound.....	Surface mark.....	206.6	677.8
Bording.....	.....do.....	164.49	539.96	Turkey Hill.....	.....do.....	198.9	652.6
				Sugar Loaf Mound.....	.....do.....	190.0	623.4
				Dreyer.....	.....do.....	213.1	699.1

## MISSOURI STATIONS.

<i>Class 1.</i>				<i>Class 2—Continued.</i>			
Bowler.....	Top of surface stone...	330.97	1085.86	Jacobs.....	Station mark.....	283.5	930.1
Baker.....	.....do.....	306.20	1004.59	Doermann Hill.....	Ground at station.....	294.9	967.5
Knob Noster.....	.....do.....	279.40	916.66	<i>Class 3.</i>			
Heard.....	.....do.....	291.29	922.87	Koeltztown Church.....	Top of fourth (upper) step at front door.....	286.7	940.6
Hubbard.....	Surface of ground.....	294.80	967.19	Jefferson City astro-nomic.....	Top of station mark.....	211.3	693.2
Cole.....	Top of surface stone...	281.48	923.49	Cooks Knob (ice house).....	Top of cupola.....	266.5	874.3
Christian.....	Surface of ground.....	278.90	915.02	Hazel Hill.....	Surface mark.....	273.1	896.0
Versailles north base.....	Copper bolt.....	322.30	1057.41	Windsor public school.....	Top of cupola.....	292.7	960.3
Hunter.....	.....do.....	319.47	1048.13	Holden Methodist Church.....	Top of spire.....	295.8	970.5
Medlock.....	Top of surface stone...	266.90	875.65	Westport College.....	.....do.....	330.6	1084.6
<i>Class 2.</i>				Belton South Methodist Church.....	.....do.....	358.0	1174.5
Thornton.....	Station mark.....	319.7	1048.9	Kansas City Catholic Cathedral.....	.....do.....	338.2	1109.6
Fulton.....	.....do.....	321.9	1056.1	Lees Summit South Methodist Church.....	Top of cupola.....	331.5	1087.6
Hutton Mound.....	.....do.....	301.6	989.5	Independence court-house.....	Top of clock.....	344.0	1128.6
Chapel Hill.....	.....do.....	329.7	1081.7	Harrisonville Cumberland Presbyterian Church.....	Top of spire.....	320.7	1052.2
Normal.....	.....do.....	267.7	878.3	Warrensburg Presbyterian Church.....	.....do.....	293.0	961.3
Caldwell.....	.....do.....	305.2	1001.3	Centerview Cumberland Presbyterian Church.....	Top of cupola.....	281.3	922.9
High Point Tebo.....	.....do.....	304.4	998.7	Kingsville public school.....	.....do.....	291.1	955.1
Kendrick.....	.....do.....	280.1	919.0	Staley Mound.....	Top of chimney.....	309.6	1015.7
Schnackenberg.....	.....do.....	332.6	1091.2	Austin Methodist Church.....	Top of spire.....	295.1	968.2
Hughes.....	.....do.....	333.6	1110.9	Hicks City Christian Union Church.....	.....do.....	338.7	1111.2
High Point.....	.....do.....	294.2	965.2				
Moreau.....	.....do.....	279.8	918.0				
Belshe.....	.....do.....	311.9	1023.3				
Cedar.....	.....do.....	269.8	885.2				
Kennedy.....	.....do.....	288.6	946.8				
McDaniel.....	.....do.....	292.0	958.0				
Pilot Knob.....	.....do.....	293.3	978.7				
Bradford.....	.....do.....	286.9	941.3				
Turnpike Bluff.....	.....do.....	203.4	669.0				
Geyer.....	.....do.....	295.6	969.8				
Gasconade.....	.....do.....	288.6	946.8				
Winter.....	.....do.....	281.7	924.2				
Berger.....	.....do.....	284.5	933.4				

## Louisville connection.

<i>Class 1.</i>				<i>Class 2—Continued.</i>			
Rariden.....	Surface mark.....	277.53	910.52	Popp.....	Surface mark.....	281.4	923.2
Tripp.....	.....do.....	226.14	741.93	Summit.....	.....do.....	295.2	968.5
Lutz.....	.....do.....	183.376	601.63	Marysville.....	.....do.....	216.4	710.0
<i>Class 2.</i>				Blocher.....	.....do.....	213.8	701.4
Six Mile.....	.....do.....	284.7	934.1	Finley.....	.....do.....	313.0	1026.9
O. & M.....	.....do.....	197.8	648.9	Stout.....	.....do.....	225.7	740.5
				Miller.....	.....do.....	281.9	924.9

## Louisville base net.

<i>Class 1.</i>				<i>Class 2—Continued.</i>			
Louisville north base.....	Top of surface stone...	136.546	447.98	Cox.....	Top of surface stone...	229.96	754.5
Louisville south base.....	.....do.....	144.440	473.88	Blind Asylum.....	.....do.....	159.1	521.9
<i>Class 2.</i>				Bangs.....	.....do.....	279.3	916.3
Williams.....	.....do.....	296.8	973.7	Riley.....	.....do.....	277.3	909.9

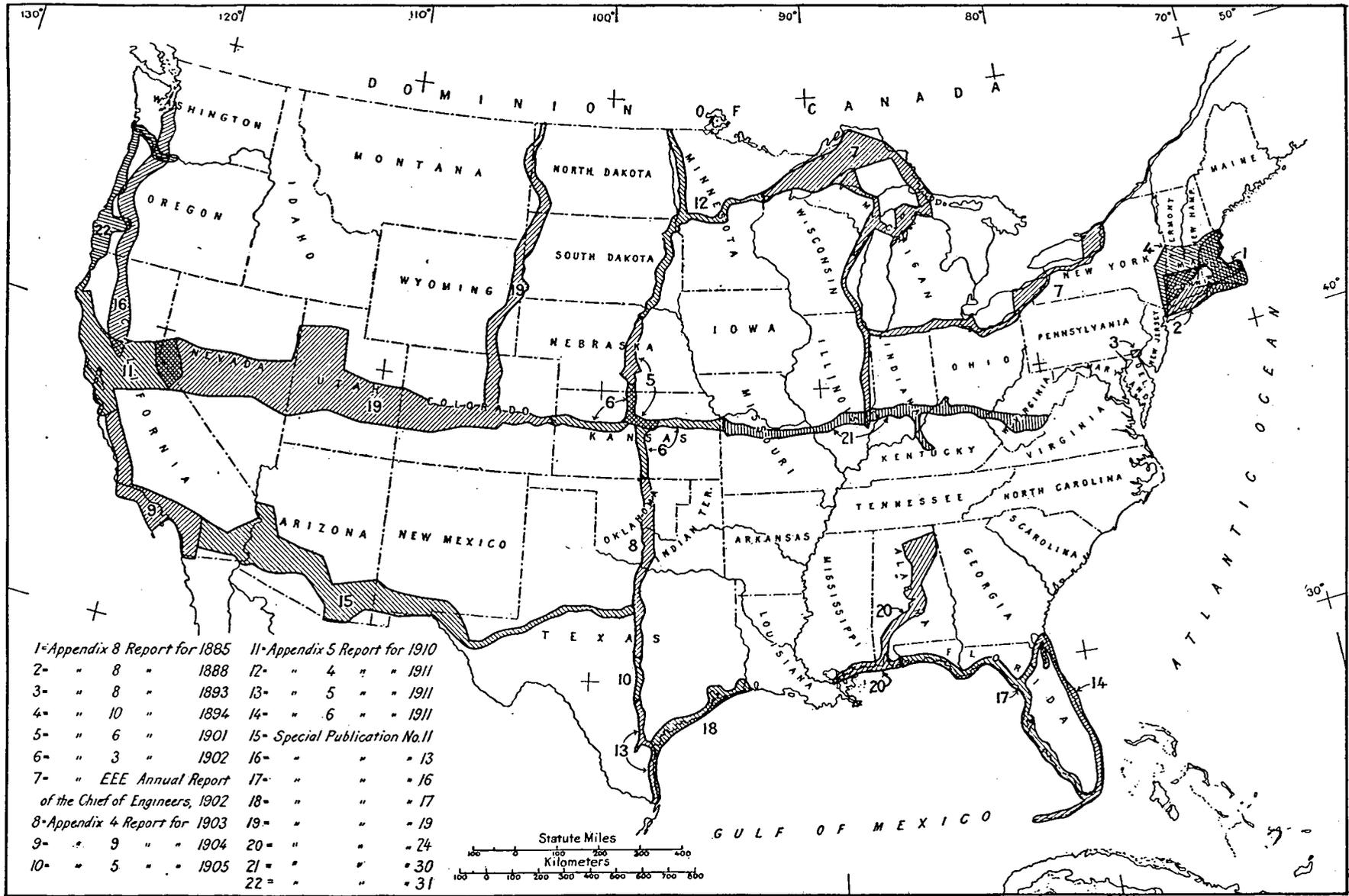


FIG. 1.—INDEX MAP SHOWING AREAS COVERED BY PUBLISHED TRIANGULATION WHICH HAS BEEN RIGIDLY COMPUTED ON THE NORTH AMERICAN DATUM.

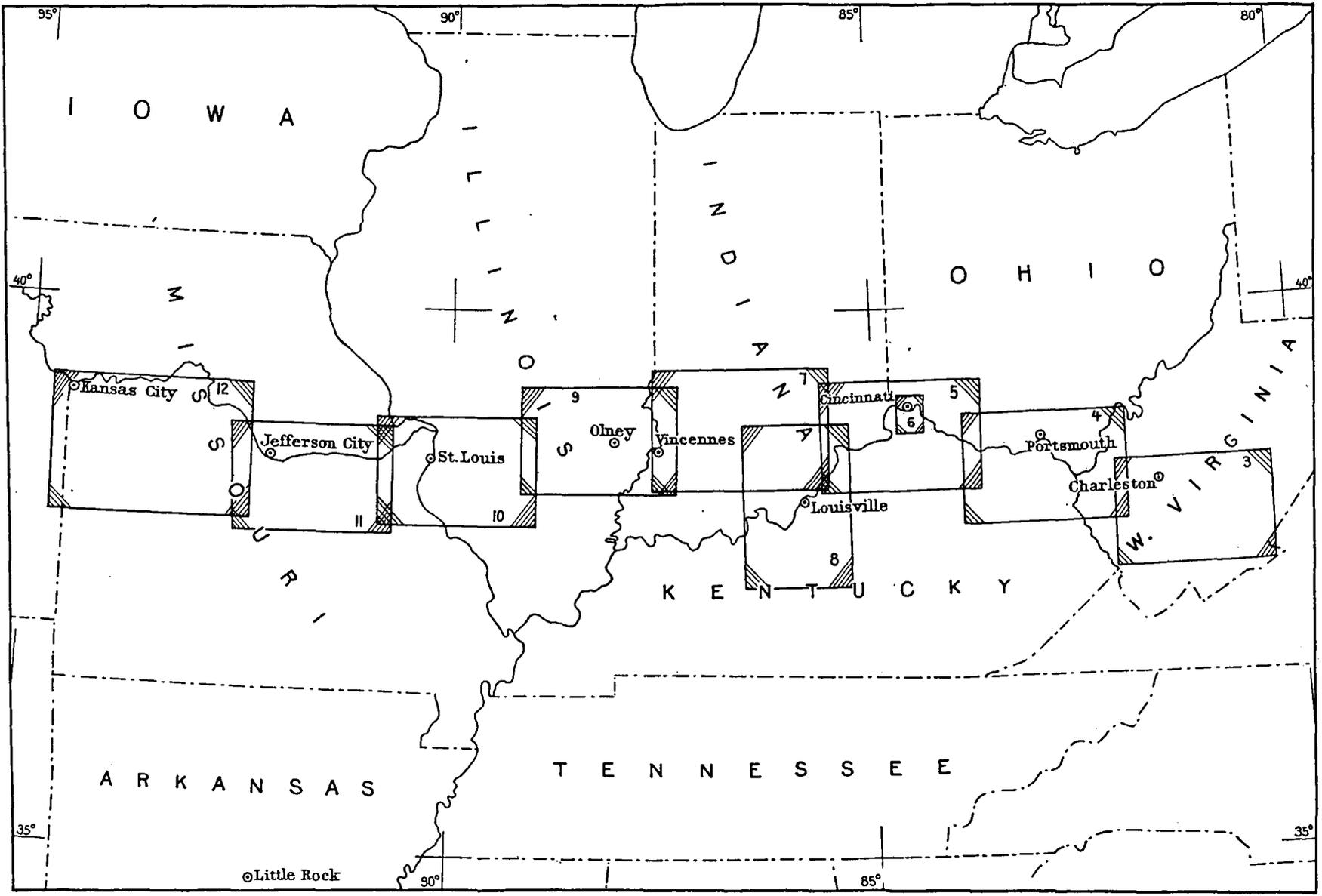


FIG. 2.—INDEX MAP SHOWING THE LIMITS OF EACH OF THE SKETCHES NOS. 3 TO 12.

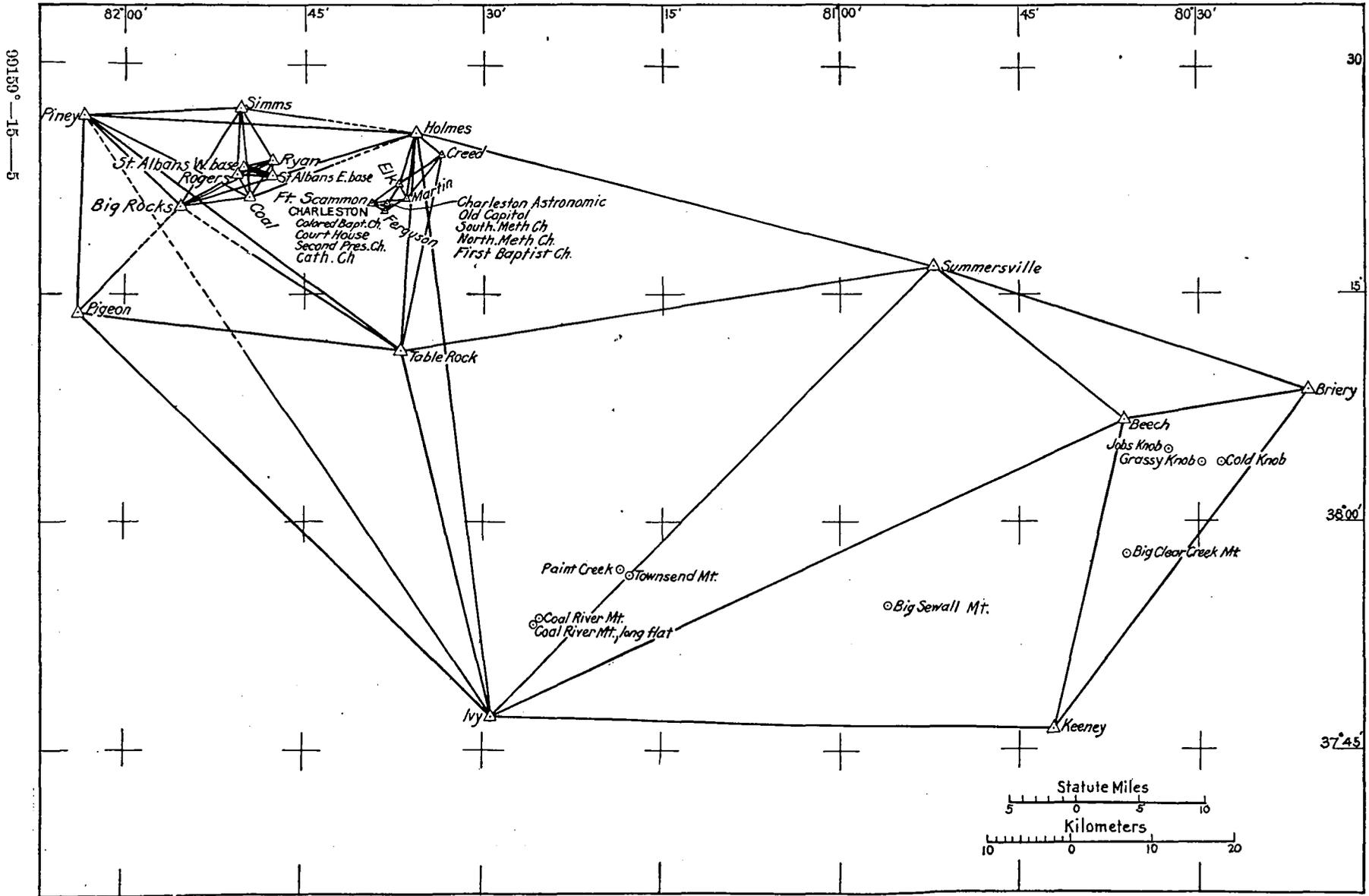


FIG. 3.—TRIANGULATION, THIRTY-NINTH PARALLEL. STATIONS BRIERY AND KEENEY TO ST. ALBANS BASE NET.

00150°—15—5



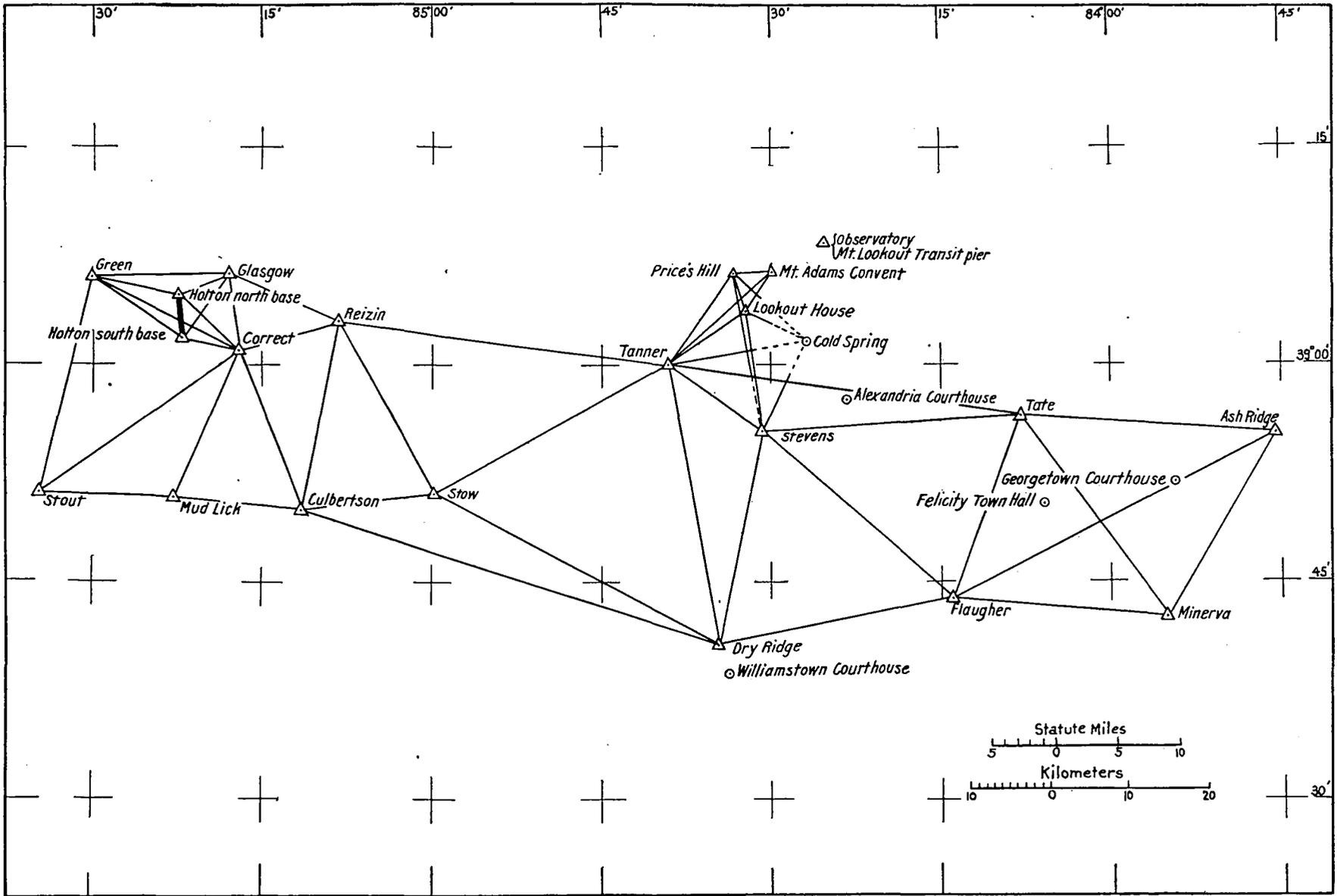


FIG. 5.—TRIANGULATION, THIRTY-NINTH PARALLEL, STATIONS ASH RIDGE AND MINERVA TO HOLTON BASE NET.

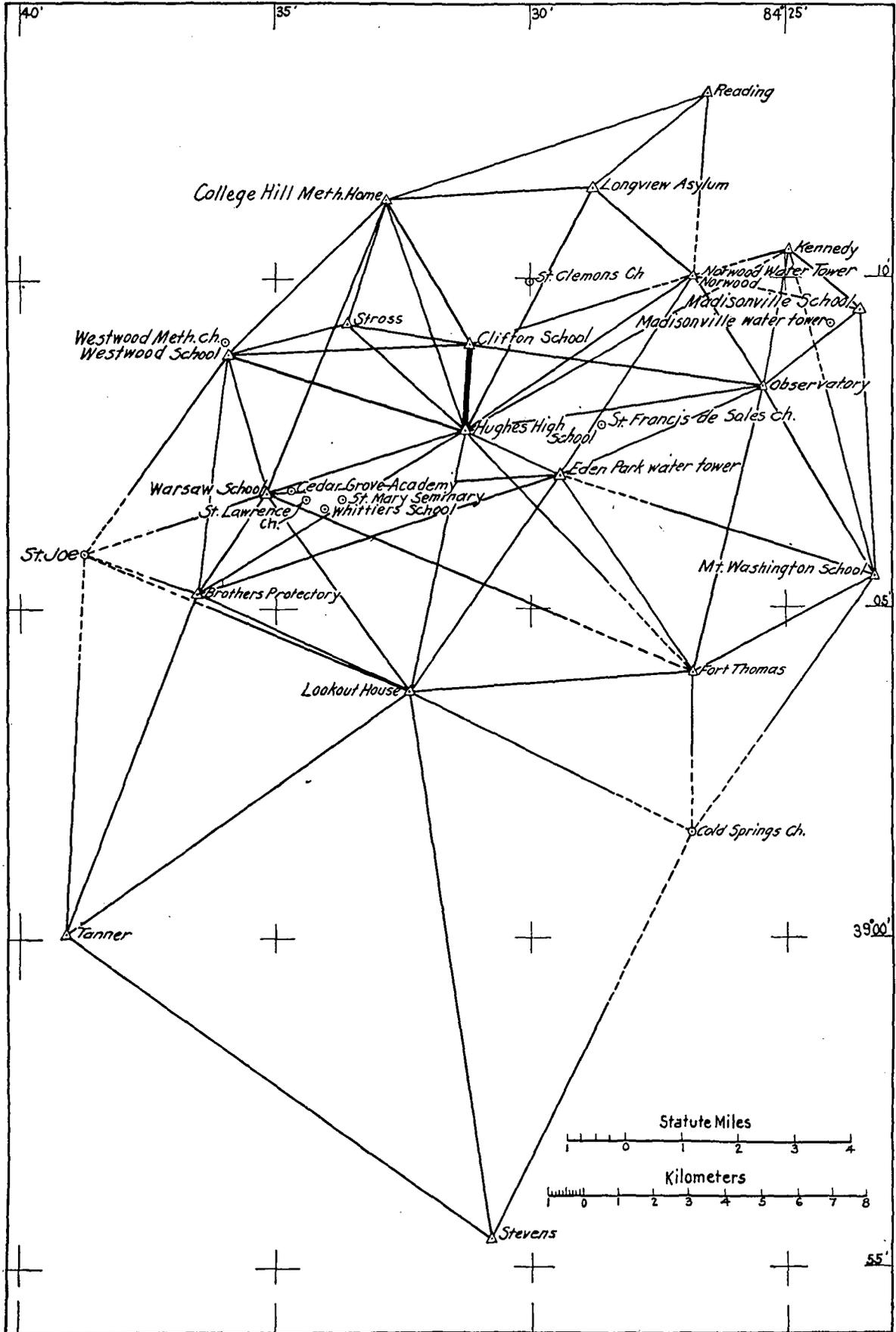


FIG. 6.—TRIANGULATION, THIRTY-NINTH PARALLEL, CITY OF CINCINNATI.

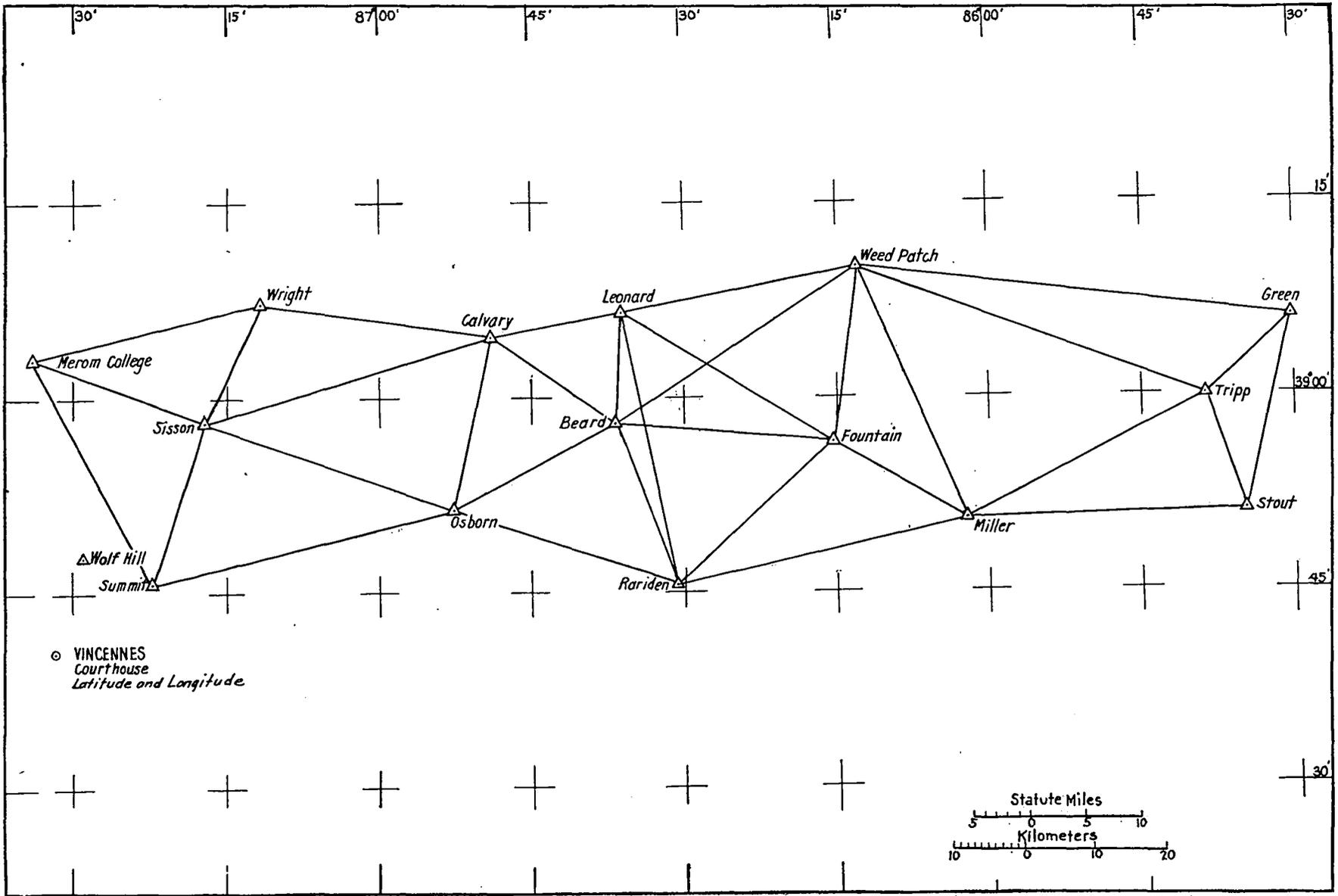


FIG. 7.—TRIANGULATION, THIRTY-NINTH PARALLEL, HOLTON BASE NET TO VINCENNES.

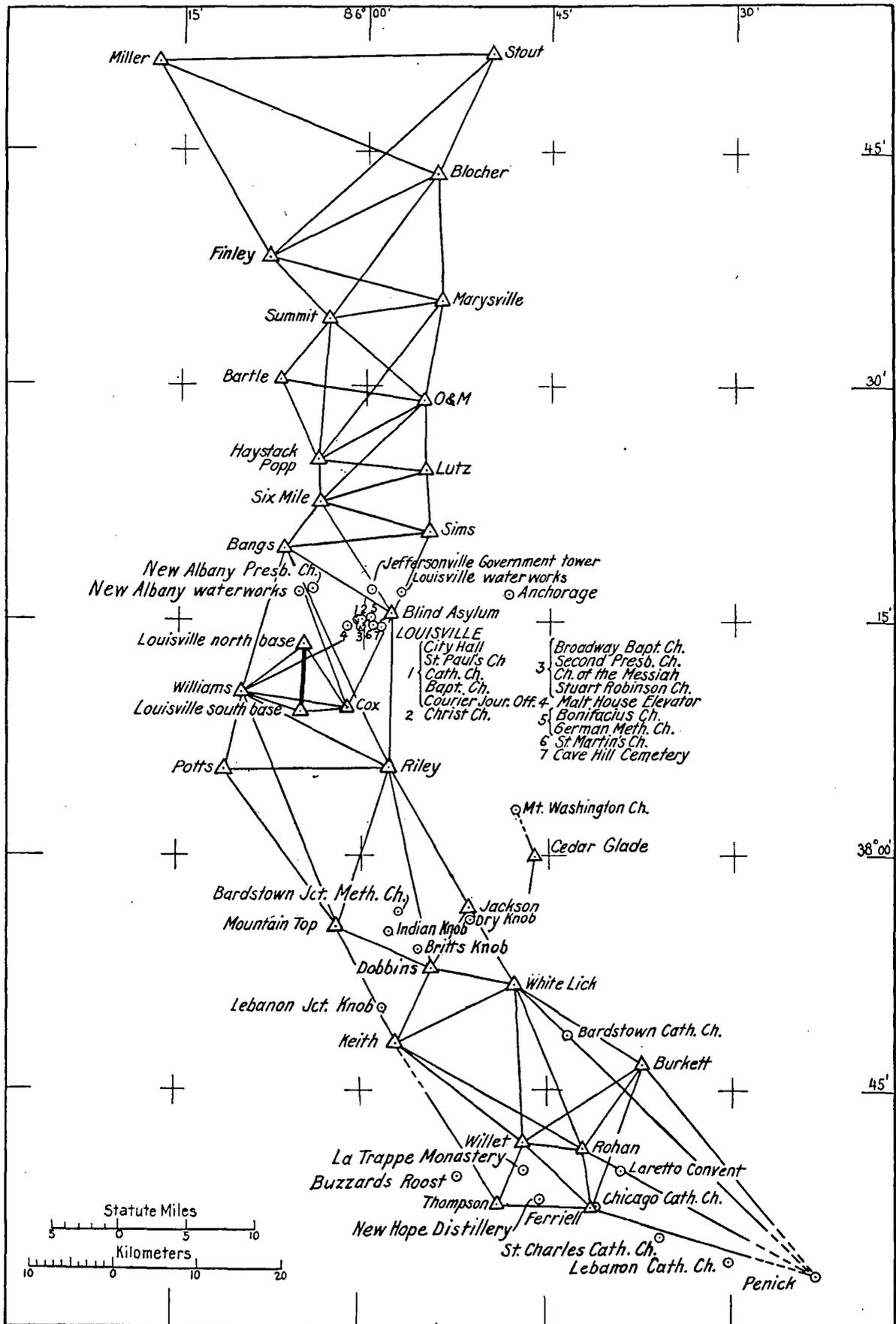


FIG. 8.—TRIANGULATION, LOUISVILLE CONNECTION.

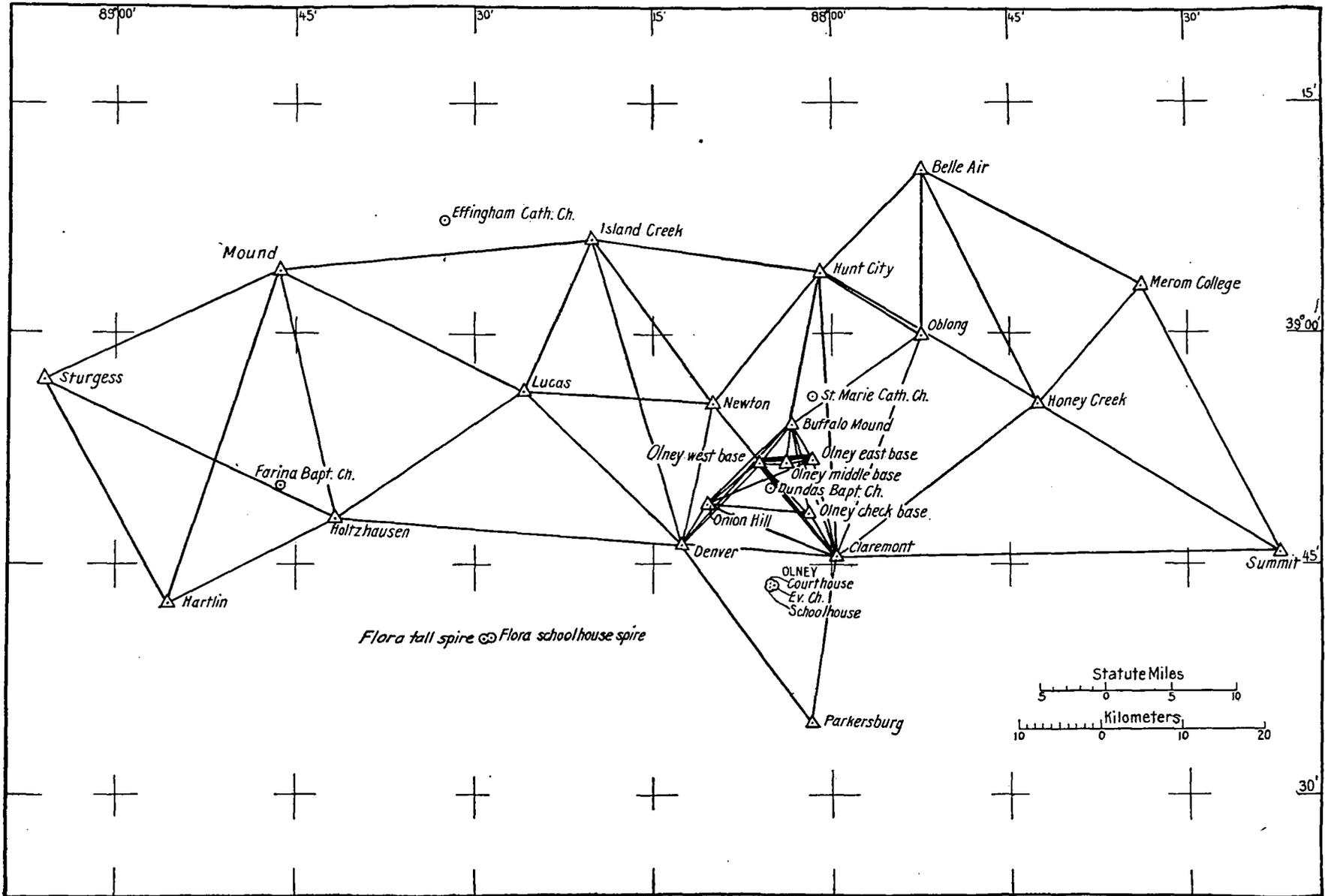


FIG. 9.—TRIANGULATION, THIRTY-NINTH PARALLEL, VINCENNES TO STATIONS STURGESS AND HARTLIN.

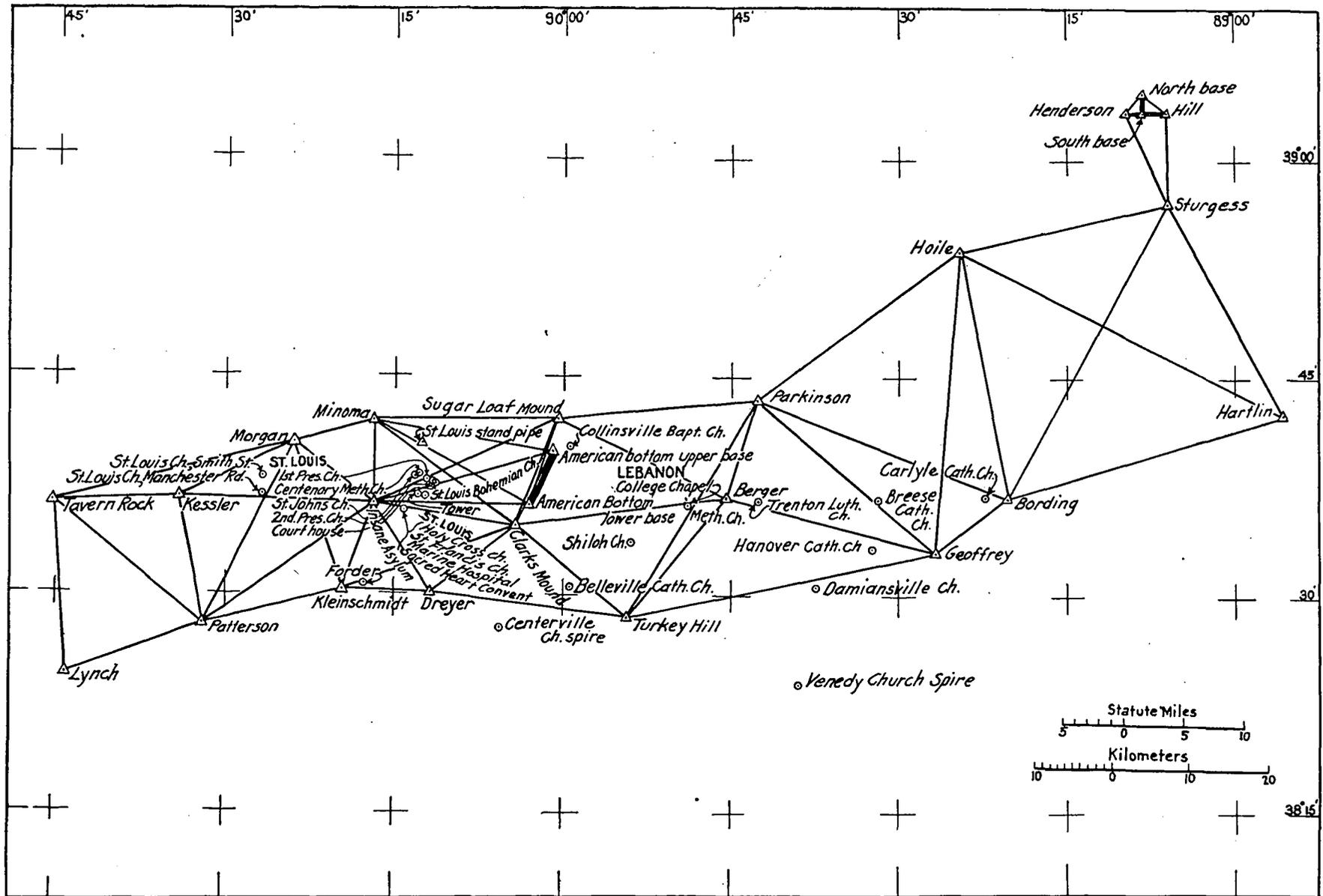


FIG. 10.—TRIANGULATION, THIRTY-NINTH PARALLEL, STATIONS STURGESS AND HARTLIN TO TAVERN ROCK AND LYNCH.

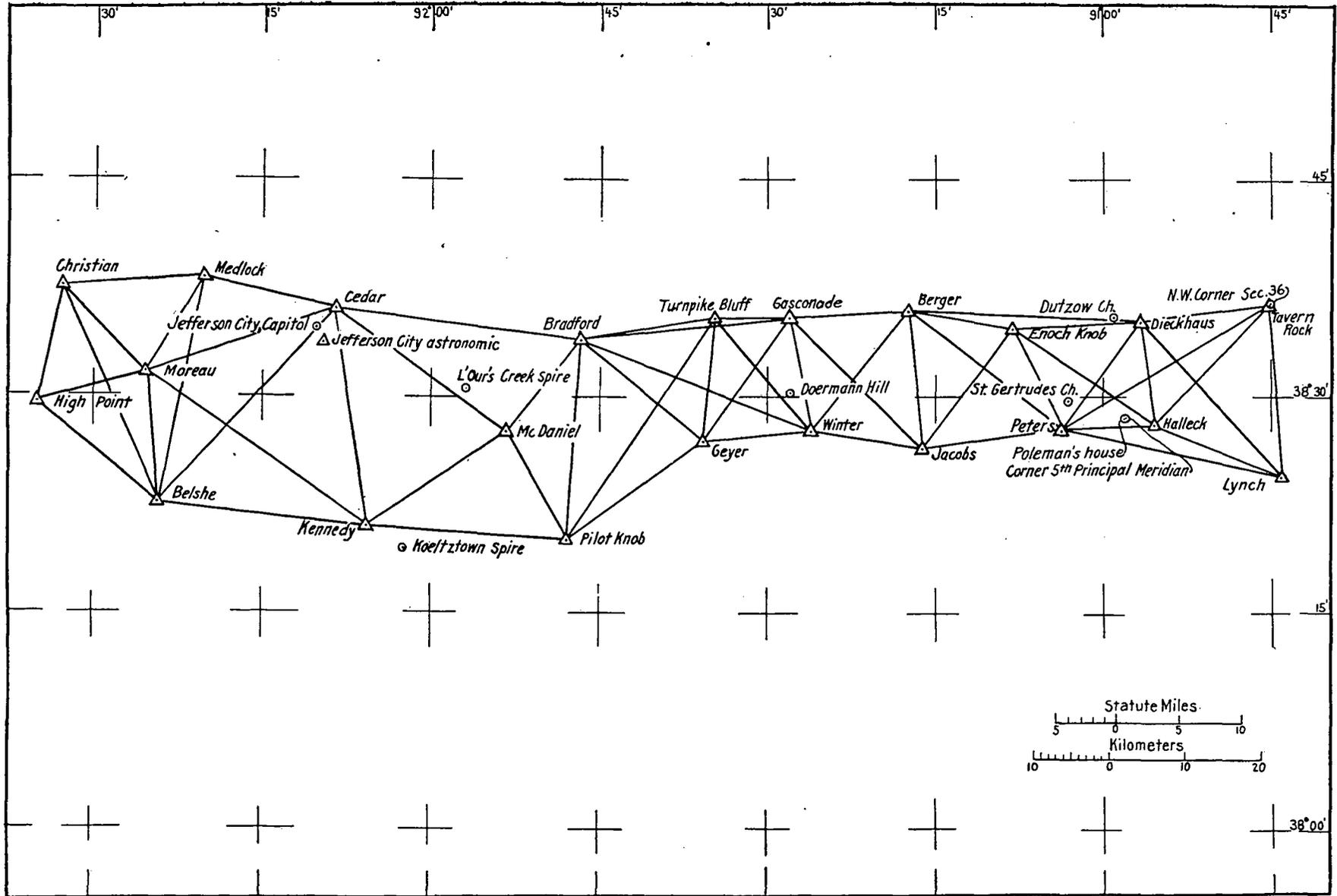


FIG. 11.—TRIANGULATION, THIRTY-NINTH PARALLEL, STATIONS TAVERN ROCK AND LYNCH TO CHRISTIAN, HIGH POINT, AND BELSHE.

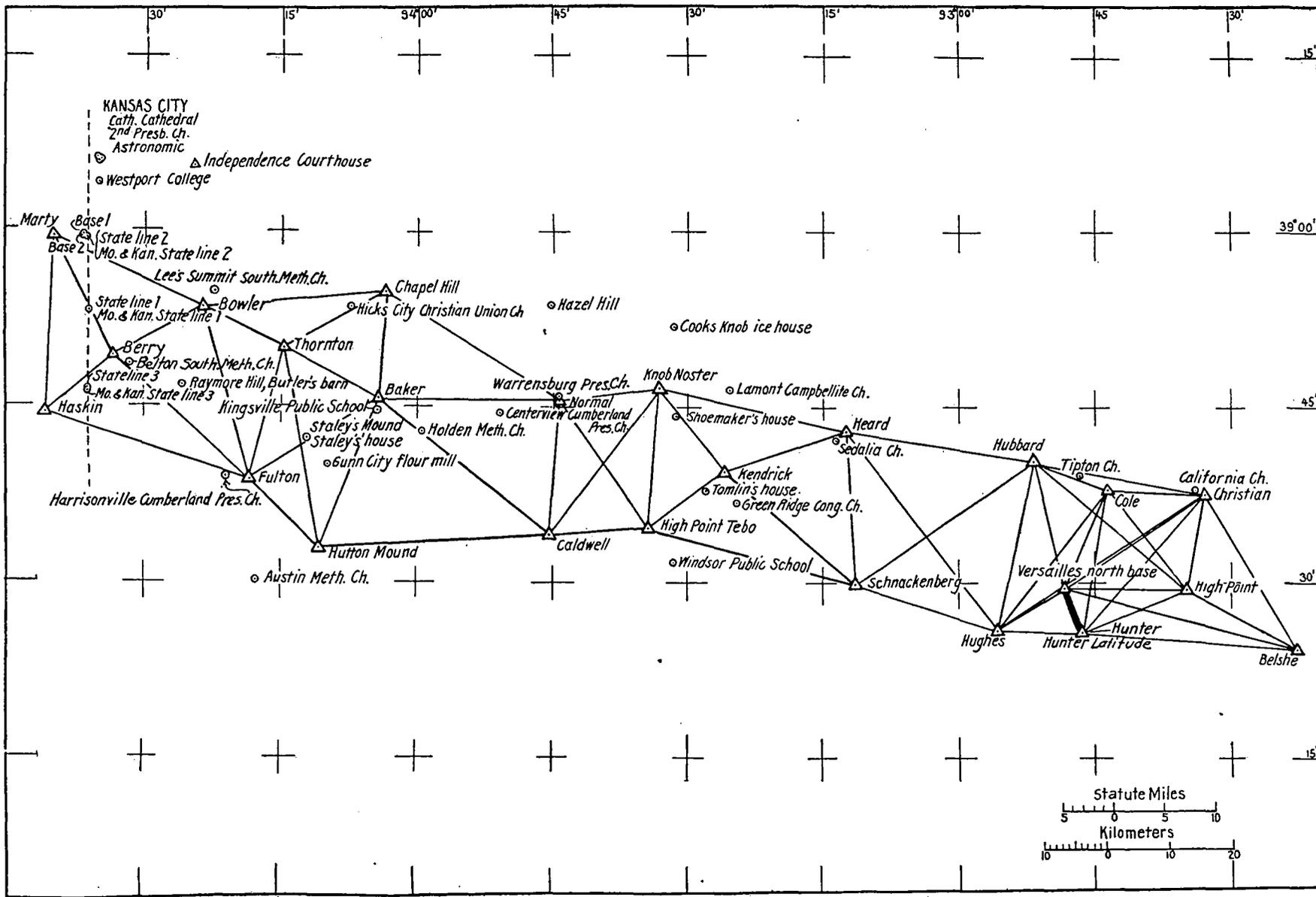


FIG. 12.—TRIANGULATION, THIRTY-NINTH PARALLEL, STATIONS CHRISTIAN, HIGH POINT, AND BELSHE TO KANSAS-MISSOURI BOUNDARY.

## INDEX TO POSITIONS, DESCRIPTIONS, ELEVATIONS, AND SKETCHES.

Station	Position	Description	Elevation	Sketch	Station	Position	Description	Elevation	Sketch
	Page	Page	Page	Number		Page	Page	Page	Number
Alexandria courthouse.....	25			5	Catholic Cathedral, Louisville.....	33	56		8
American Bottom lower base.....	21	45		10	Catholic Church cross, Charleston ..	24			3
American Bottom upper base.....	21	45		10	Cave.....	19	38		4
Anchorage.....	33			8	Cave Hill.....	19	39		4
Ash Ridge.....	19	39		4,5	Cave Hill Cometary, Louisville.....	33	56		8
Astronomic:					Cedar.....	22	47	62	11
Charleston.....	24	50		3	Cedar Glade.....	34	56		8
Kansas City.....	31	52		12	Cedar Grove Academy cupola, Cin-				
Austin Methodist Church spire.....	31		62	12	cinnati.....	27			6
					Centenary Methodist Church, St.				
Baker.....	23	49	62	12	Louis.....	29			10
Bangs.....	32	54	62	8	Centerview Cumberland Presbyte-				
Baptist Church, Louisville.....	33	56		8	rian Church cupola.....	30		62	12
Bardstown Catholic Church spire ..	34	57		8	Centerville Church spire.....	28			10
Bardstown Junction Methodist					Chapel Hill.....	23	49	62	12
Church spire.....	34	56		8	Charleston:				
Bartle.....	33	55		8	Astronomic.....	24	50		3
Base 1.....	31	53		12	Catholic Church cross.....	24			3
Base 2.....	31	53		12	Colored Baptist Church spire.....	24			3
Beard.....	20	41		7	Courthouse spire.....	24			3
Beech.....	18	33	61	3	First Baptist Church spire.....	24			3
Belle Air.....	20	42		9	North Methodist Church spire.....	24			3
Belleville Catholic Church spire.....	28			10	Old Capitol, top of belly.....	24			3
Belshé.....	22	47	62	11,12	Second Presbyterian Church spire	24			3
Belton South Methodist Church spire.	31		62	12	South Methodist Church spire.....	24			3
Berger.....	21	45	62	10	Cherry Ridge.....	19	38		4
Berger.....	22	46	62	11	Chicago Catholic Church spire.....	34	57		8
Berry.....	23	49		12	Christ Church, Louisville.....	33	56		8
Big Clear Creek Mountain.....	23		61	3	Christian.....	22	48	62	11,12
Big Rocks.....	18	37	61	3	Church, corner Manchester and Bal-				
Big Sewall Mountain.....	23		61	3	las Roads, St. Louis.....	29			10
Blind Asylum, Louisville.....	32	54	62	8	Church, corner Smith Street and Bal-				
Blocher.....	32	53	62	8	las Road, St. Louis.....	29			10
Bohemian Church, St. Louis.....	29			10	Church of the Messiah, Louisville....	34	56		8
Bonifacius Church, Louisville.....	33	56		8	Cincinnati:				
Bording.....	21	44	62	10	Brothers Protectory.....	25	50		6
Bowler.....	23	40	62	12	Cedar Grove Academy cupola.....	27			6
Bradford.....	22	47	62	11	Clifton School.....	26	51		6
Breese Catholic Church spire.....	28			10	Cold Spring Church spire.....	25			6
Briery.....	18	35	61	3	Cold Spring larger spire.....	25			5
Britts Knob.....	34	57		8	College Hill Methodist Home.....	26	51		6
Broadway Baptist Church, Louisville	33	53		6	Eden Park water tower.....	25	51		6
Brothers Protectory, Cincinnati.....	25	50		8	Fort Thomas.....	25	50		6
Buena Vista.....	18	38		4	Hughes High School.....	26	51		6
Buffalo Mound.....	20	43		9	Kennedy.....	26	52		6
Burkett.....	32	53		8	Longview.....	26	51		6
Buzzard Roost.....	34	57		8	Lookout House.....	25	50		5,6
					Madisonville School.....	26	51		6
Caldwell.....	23	49	62	12	Madisonville water tower.....	26			6
California Church spire.....	30			12	Mount Adams Convent.....	25	50		5
Calvary.....	20	41		7	Mount Lookout transit pier.....	25	50		5
Carlyle Catholic Church spire.....	28			10	Mount Washington School.....	26	51		6
Catholic Cathedral, Eleventh Street,					Norwood.....	26	51		6
between Broadway and Washing-					Norwood water tower.....	26			6
ton Streets, Kansas City.....	31		62	12	Observatory, 1889.....	25	50		5
					Observatory, 1912.....	26	51		6

## INDEX TO POSITIONS, DESCRIPTIONS, ELEVATIONS, AND SKETCHES—Continued.

Station	Position	Description	Elevation	Sketch	Station	Position	Description	Elevation	Sketch
	Page	Page	Page	Number		Page	Page	Page	Number
Cincinnati—Continued.					Farina Baptist Church.....	27			9
Reading.....	26	52		6	Felicity town hall.....	25			5
St. Clemons Church spire.....	27			6	Ferguson.....	24	50		3
St. Francis de Sales Church spire.....	26			6	Ferrell.....	33	56		8
St. Joe.....	26	52		6	Fifth Meridian, corner.....	29	52		11
St. Lawrence Church spire.....	27			6	Finley.....	32	53	62	8
St. Mary Seminary flagstaff.....	27			6	First Baptist Church, spire, Charleston.....	24			3
Stross.....	26	51		6	First Presbyterian Church, corner Third and Court Streets, Portsmouth.....	25			4
Warsaw School.....	25	51		6	First Presbyterian Church, St. Louis.....	29			10
Westwood Methodist Church spire.....	27			6	Flaugher.....	19	39		5
Westwood School.....	26	51		6	Flora schoolhouse spire.....	27			9
Whittlers School flagstaff.....	27			6	Flora tall spire.....	27			9
City Hall, Louisville.....	33	56		10	Forder.....	28	52		10
Claremont.....	20	42		9	Fort Scammon.....	24	50		3
Clarks Mound.....	21	45	62	3	Fort Thomas, Cincinnati.....	25	50		6
Clifton School, Cincinnati.....	26	51		3	Fountain.....	20	41		7
Coal.....	18	37		3	Fradd.....	18	38		4
Coal River Mountain.....	24		61	3	Fulton.....	23	40	62	12
Coal River Mountain, long flat.....	24		61	6					
Cold Knob.....	23		61	3	Gasconade.....	22	47	62	11
Cold Spring Church spire, Cincinnati.....	25			5	Gebhardt.....	18	37	61	4
Cold Spring larger spire, Cincinnati.....	25			12	Geoffrey.....	21	44		10
Cole.....	22	48	62	10	Georgetown courthouse dome.....	25			5
College Hill Methodist Home, Cincinnati.....	26	51		3	German Catholic Church, west gable of tower, Portsmouth.....	24			4
Collinsville Baptist Church spire.....	28			12	German Methodist Church, Louisville.....	33	56		8
Colored Baptist Church spire, Charleston.....	24			5	Gethsemane La Trappe Monastery spire.....	34	57		8
Cooks Knob.....	30	52	62	8	Geyer.....	22	47	62	11
Corner fifth meridian.....	29	52		11	Glasgow.....	19	40	62	5
Correct.....	19	40		5	Gould.....	18	38		4
Courier-Journal office, pole, Louisville.....	33			8	Grassy Knob.....	23		61	3
Courthouse dome, Olney.....	27			8	Green.....	19	40		5,7
Courthouse, St. Louis.....	28			9	Green Ridge Congregational Church, chimney.....	30			12
Courthouse spire, Charleston.....	24			10	Gun City flouring mill, iron chimney.....	31			12
Cox.....	32	54	62	3					
Creed.....	24	49	61	3	Halleck.....	22	46		11
Culbertson.....	19	40		5	Hanover Catholic Church spire.....	28			10
				10	Harrisonville Cumberland Presbyterian Church spire.....	31		62	12
Damiansville Church spire.....	28			4	Hartlin.....	21	44		9,10
Davis.....	18	37	61	4	Haskin.....	23	49		12
Davis Distillery chimney, Portsmouth.....	25			4	Haystack.....	33	56		8
Davis Steel Works chimney, Portsmouth.....	25			4	Hazel Hill.....	30	52	62	12
Denver.....	20	43		9	Heard.....	23	48	62	12
Dieckhaus.....	22	46		11	Henderson.....	27			10
Dobbins.....	32	55		8	Hicks City Christian Union Church spire.....	30		62	12
Doermann Hill.....	29	52	62	11	High Point.....	22	48	62	11,12
Dreyer.....	21	45	62	10	High Point Tebo.....	23	48	62	12
Dry Knob.....	34	56		8	Hill.....	27			10
Dry Ridge.....	19	39		5	Holle.....	21	44		10
Dundas Baptist Church tower.....	27			9	Holden Methodist Church spire.....	30		62	12
Dutzow Catholic Church, east gable.....	29			11	Holmes.....	18	36	61	8
				4	Holton north base.....	19	40	62	5
Eckmansville Church spire.....	25			6	Holton south base.....	19	40	62	5
Eden Park water tower, Cincinnati.....	25	51		9	Holtzhausen.....	21	44		9
Effingham Catholic Church spire.....	27			9					
Elk.....	24	49	61	3					
Enoch Knob.....	22	46		11					
Evangelical Church spire, Olney.....	27			9					

INDEX TO POSITIONS, DESCRIPTIONS, ELEVATIONS, AND SKETCHES—Continued.

Station	Position	Description	Elevation	Sketch	Station	Position	Description	Elevation	Sketch
	Page	Page	Page	Number		Page	Page	Page	Number
Holy Cross Catholic Church, St. Louis.....	29			10	Louisville—Continued.				
Honey Creek.....	20	42		9	Bonifacius Church.....	33	56		8
Howland.....	19	33		4	Broadway Baptist Church.....	33	56		8
Hubbard.....	23	48	62	12	Catholic Cathedral.....	33	56		8
Hughes.....	23	48	62	12	Cave Hill Cemetery.....	33	56		8
Hughes High School, Cincinnati.....	26	51		6	Christ Church.....	33	56		8
Hunt City.....	20	42		9	Church of the Messiah.....	34	56		8
Hunter latitude.....	30			12	City Hall.....	33	56		8
Hunter or Versailles south base.....	22	48	62	12	Courier-Journal office, pole.....	33			8
Hutton Mound.....	23	49	62	12	German Methodist Church.....	33	56		8
Independence courthouse, high cupola or tower.....	31		62	12	Malt House elevator.....	33	56		8
Indian Knob.....	34	57		8	North base.....	32	54	62	8
Insane Asylum.....	21	45		10	St. Martins Church.....	33	56		8
Ironton, Kelly's house cupola.....	24			4	St. Pauls Church.....	33	56		8
Island Creek.....	21	43		9	Second Presbyterian Church.....	33	56		8
Ivy.....	18	36	61	3	South base.....	32	54	62	8
Jackson.....	32	55		8	Stuart Robinson Church, highest spire.....	34			8
Jacobs.....	22	46	62	11	Waterworks tower.....	33			8
Jefferson City astronomic.....	30	52	62	11	L'OURS Creek spire.....	30	52		11
Jefferson City Capitol, rod on dome.....	30			11	Lucas.....	21	44		9
Jeffersonville Government tower.....	33			8	Lutz.....	32	54	62	8
Jobs Knob.....	23		61	3	Lynch.....	22	46		10, 11
Kansas City astronomic.....	31	52		12	McDaniel.....	22	47	62	11
Kansas City, Catholic Cathedral, Eleventh Street, between Broadway and Washington Streets.....	31		62	12	Madisonville school, Cincinnati.....	26	51		6
Kansas City, Second Presbyterian Church spire.....	31			12	Madisonville water tower, Cincinnati.....	26			6
Keeney.....	18	36	61	3	Malt House elevator, Louisville.....	33	56		8
Keith.....	32	55		8	Marine Hospital, St. Louis.....	29			10
Kendrick.....	23	48	62	12	Martin.....	24	50	61	3
Kennedy.....	22	47	62	11	Marty.....	23	49		12
Kennedy, Cincinnati.....	26	52		6	Marysville.....	32	53	62	8
Kessler.....	21	46		10	Medlock.....	22	47	62	11
Kingsville public-school cupola.....	30		62	12	Merom College.....	20	42		7, 9
Kleinschmidt.....	21	46		10	Methodist Church, Bardstown Junction.....	34	56		8
Knob Noster.....	23	48	62	12	Miller.....	19	41	62	7, 8
Koeltztown spire.....	30	52	62	11	Minerva.....	19	39		4, 5
Lamont Campbellite Church spire.....	30			12	Minoma.....	21	46		10
La Trappe Monastery spire, Gethsemane.....	34	57		8	Missouri and Kansas State line 1, Missouri stone.....	31	53		12
Lebanon Catholic Church spire.....	34	57		8	Missouri and Kansas State line 2, stone.....	31	53		12
Lebanon College chapel spire.....	28			10	Missouri and Kansas State line 3, stone.....	31	52		12
Lebanon Junction Knob.....	34	57		8	Moreau.....	22	47	62	11
Lebanon Methodist Church spire.....	28			10	Morgan.....	21	46		10
Lees Summit South Methodist Church cupola.....	31		62	12	Mound.....	21	44		9
Leonard.....	20	41		7	Mount Adams Convent, Cincinnati.....	25	50		5
Longview, Cincinnati.....	26	51		6	Mountain Top.....	32	55		8
Lookout House, Cincinnati.....	25	50		5, 6	Mount Lookout transit pier, Cincinnati.....	25	50		5
Loretto Convent spire.....	34	57		8	Mount Washington Church spire.....	34	56		8
Louisville:					Mount Washington school, Cincinnati.....	26	51		6
Baptist Church.....	33	56		8	Mud Lick.....	19	40		5
Blind Asylum.....	32	54	62	8	New Albany Second Presbyterian Church.....	33			8
					New Albany waterworks tower.....	33			8
					New Hope Distillery smokestack.....	34	57		8
					Newton.....	20	43		9

## INDEX TO POSITIONS, DESCRIPTIONS, ELEVATIONS, AND SKETCHES—Continued.

Station	Position	Description	Elevation	Sketch	Station	Position	Description	Elevation	Sketch
	Page	Page	Page	Number		Page	Page	Page	Number
Normal.....	23	48	62	12	Rogers.....	18	37		3
North base.....	27			10	Rohan.....	32	50		8
North base, Louisville.....	32	54	62	8	Round Top.....	19	38		4
North Meridian, Portsmouth.....	24	50		4	Ryan.....	18	37		3
North Methodist Church spire, Charleston.....	24			3					
Northwest corner.....	29	52		11	Sacred Heart Convent, St. Louis.....	29			10
Norwood, Cincinnati.....	26	51		6	St. Albans, east base.....	18	37		3
Norwood water tower, Cincinnati.....	26			6	St. Albans, west base.....	18	37	61	3
					St. Charles Catholic Church spire.....	34	57		8
O. & M.....	32	53	62	8	St. Clemons Church spire, Cincinnati.....	27			6
Oakland.....	13	33	61	4	St. Francis Church, St. Louis.....	29			10
Oblong.....	20	42		9	St. Francis de Sales Church spire, Cincinnati.....	26			6
Observatory, Cincinnati, 1889.....	25	50		5	St. Gertrude's Church.....	29			11
Observatory, Cincinnati, 1912.....	26	51		6	St. Joe, Cincinnati.....	26	52		6
Old Capitol, top of belfry, Charleston.....	24			3	St. John's Church, St. Louis.....	29			10
Olney:					St. Lawrence Church spire, Cincinnati.....	27			6
Check base.....	20	43		9	St. Louis:				
Courthouse dome.....	27			9	Bohemian Church.....	29			10
East base.....	20	43		9	Centenary Methodist Church.....	29			10
Evangelical Church spire.....	27			9	Church, corner Manchester and Ballas Roads.....	29			10
Middle base.....	20	43		9	Church, corner Smith Street and Ballas Road.....	29			10
Schoolhouse tower.....	27			9	Courthouse.....	28			10
West base.....	20	43		9	First Presbyterian Church.....	29			10
Onion Hill.....	20	43		9	Holy Cross Church.....	29			10
Osborn.....	20	41		7	Marine Hospital.....	29			10
					Sacred Heart Convent.....	29			10
Paint Creek, east tree.....	24		61	3	St. Francis Church.....	29			10
Parkersburg.....	21	44		9	St. Johns Church.....	29			10
Parkinson.....	21	45		10	Second Presbyterian Church spire.....	29			10
Patterson.....	21	46		10	Standpipe.....	28	52		10
Peach Mount.....	19	38		4	Tower, corner Grand Street and Lafayette Avenue.....	29			10
Penick.....	33	56		8	St. Marie Catholic Church white spire.....	27			9
Peters.....	22	46		11	St. Martin's Church, Louisville.....	33	50		8
Pigeon.....	13	37	61	3,4	St. Mary Seminary flagstaff, Cincinnati.....	27			6
Pilot Knob.....	22	47	62	11	St. Paul's Church, Louisville.....	33	56		8
Piney.....	18	36	61	3,4	Schnackenburg.....	23	48	62	12
Polemann's house.....	29	52		11	Schoolhouse tower, Olney.....	27			9
Popp.....	32	53	62	8	Scioto.....	19	38		4
Portsmouth:					Scioto County courthouse, Portsmouth.....	24			4
Davis Distillery chimney.....	25			4	Second Presbyterian Church spire, Charleston.....	24			3
Davis Steel Works chimney.....	25			4	Second Presbyterian Church, Louisville.....	33	56		8
First Presbyterian Church, corner Third and Court Streets.....	25			4	Second Presbyterian Church, St. Louis.....	29			10
German Catholic Church, west gable of tower.....	24			4	Second Presbyterian Church spire, Kansas City.....	31			12
North Meridian.....	24	50		4	Sedalia Church spire.....	30			12
Scioto County courthouse.....	24			4	Shiloh Church spire.....	28			10
Sixth Street Methodist Church spire.....	24			4	Shoemaker's house, cupola, lightning rod.....	30			12
South Meridian.....	25	50		4	Simms.....	18	37		3
Potts.....	32	55		8	Sims.....	32	54		8
Price Hill.....	25	50		5	Sisson.....	20	42		7
Rariden.....	20	41	62	7					
Raymore Hill, Butler's barn cupola..	31			12					
Reading, Cincinnati.....	26	52		6					
Reizin.....	19	39		5					
Riley.....	32	55	62	8					

INDEX TO POSITIONS, DESCRIPTIONS, ELEVATIONS, AND SKETCHES—Continued.

Station.	Position	Description	Elevation	Sketch	Station	Position	Description	Elevation	Sketch
	Page	Page	Page	Number		Page	Page	Page	Number
Six Mile.....	32	54	62	8	Trenton Lutheran Church spire.....	28			10
Sixth Street Methodist Church spire, Portsmouth.....	24			4	Tripp.....	19	41	62	7
South base, Louisville.....	32	54	62	8	Turkey Hill.....	21	45	62	10
South base, stone A on third principal meridian (U. S. L. S.).....	28			10	Turnpike Bluff.....	22	47	62	11
South meridian, Portsmouth.....	25	50		4	Twin Creek.....	19	38		4
South Methodist Church spire, Charleston.....	24			3	Unity Church spire.....	25			4
Springville.....	24	50		4	Venedy Church tall brown tower, white spire.....	28			10
Staley Mound, Staley's house chimney.....	31		62	12	Versailles north base.....	23	48	62	12
Standpipe, St. Louis.....	28	52		10	Versailles south base or Hunter.....	22	48	62	12
State line 1.....	31	53		12	Vincennes courthouse, center cupola.....	27			7
State line 2.....	31	53		12	Vincennes latitude and longitude.....	27	52		7
State line 3, stake.....	31	52		12					
Stevens.....	19	39		5, 6	Warrensburg Presbyterian Church spire.....	30		62	12
Stout.....	19	40	62	5, 7, 8	Warsaw School, Cincinnati.....	25	51		6
Stow.....	19	39		5	Waterworks tower, Louisville.....	33			8
Stross, Cincinnati.....	26	51		6	Weed Patch.....	20	41		7
Stuart Robinson Church, highest spire, Louisville.....	34			8	Westport, College of the Redemption-ist Fathers.....	31		62	12
Sturgess.....	21	44		9, 10	West Union Children's Home.....	25			4
Sugar Loaf Mound.....	21	45	62	10	West Union courthouse.....	25			4
Summersville.....	18	36	61	3	Westwood Methodist Church spire, Cincinnati.....	27			6
Summit.....	20	42		7, 9	Westwood School flagstaff, Cincinnati.....	26	51		6
Summit.....	32	53	62	8	White Lick.....	32	55		8
					Whittier's School flagstaff, Cincinnati.....	27			6
Table Rock.....	18	36	61	3	Willett.....	32	55		8
Tanner.....	19	39		5, 6	Williams.....	32	54	62	8
Tate.....	19	39		5	Williamstown courthouse.....	25			5
Tavern Rock.....	22	46		10, 11	Windsor public school flagstaff.....	30		62	12
Thompson.....	32	55		8	Winter.....	22	47	62	11
Thornton.....	23	49	62	12	Wolf Hill.....	27			7
Tipton Church spire.....	30			12	Wray.....	18	37	61	4
Tomlin's house, southeast chimney.....	30			12	Wright.....	20	42		7
Tower, corner Grand Street and Lafayette Avenue, St. Louis.....	29			10					
Townsend Mountain.....	24		61	3					