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DEPARTMENT OF COMMERCE

U. S. COAST AND GEODETIC SURVEY

E. LESTER JONES, DIRECTOR

CALIFORNIA-WASHINGTON ARC OF PRECISE TRIANGULATION

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2nd ed.
1922
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Special Publication No. 13
(Second Edition)

By

A. L. BALDWIN

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THE CALIFORNIA-WASHINGTON ARC OF PRECISE TRIANGULATION.

GENERAL STATEMENT.

The arc of precise triangulation, the results of which are here published, extends from latitude 39°, in northern California, to Puget Sound, Wash. The data for this arc, together with a discussion of the least-squares adjustment and other purely scientific matter, were originally published in United States Coast and Geodetic Survey Special Publication No. 13, by A. L. Baldwin, computer. The original publication is now exhausted, and there is reprinted here only that part of the data which is of value to the engineer or surveyor for the control of surveys, namely, the geographic positions, elevations, and descriptions of stations.

FIELD WORK.

Early in 1903 Assistant O. B. French organized a reconnaissance and signal-building party at Eugene, Oreg. With this party Mr. French made a reconnaissance through the Willamette Valley to connect with the triangulation of the Columbia River. He then returned to Eugene with part of the party to do the observing, leaving the rest of the party to build the signals. The observing was carried as far as the reconnaissance had been completed by the latter part of September. Both parties then returned to Eugene, where a base net was laid out and partly observed. Mr. French then made a reconnaissance to the southward to connect with the precise triangulation along the thirty-ninth parallel, which he completed by the middle of November.

In 1904 Assistant J. S. Hill was also assigned to the work, thus allowing Mr. French to devote more time to the reconnaissance without delay to the observing party. The observing started at Marysville Butte soon after May 1, and the season closed about the middle of November. During this time the whole scheme was completed between the transcontinental triangulation along the thirty-ninth parallel and the work of the previous season. Mr. French spent about a month of this season in making a reconnaissance from the Columbia River to Puget Sound.

During the season of 1905 the organization of the parties was the same as in the previous season. The work of this season started in the vicinity of the Columbia River, but though every effort was made, the work was not completed to a connection with the Puget Sound triangulation. This was partly due to the bad weather and to the difficult character of the country, and was partly due to the necessity of revising the reconnaissance in order to eliminate some very high signals and an excessive amount of cutting of timber.

The work of the last season, 1906, was in charge of Assistant J. S. Hill, who organized the party on June 11 and completed the work on July 26.

THE LEAST-SQUARES ADJUSTMENT.

The geographic positions of Snow Mountain West and Mount Helena, together with the length and azimuth of the line between them, was held fixed as determined by the thirty-ninth parallel triangulation. A single least-squares adjustment served for the entire precise scheme. The Willamette base and the Tacoma base required the use of two length equations, and the Laplace azimuths at Gazelle, Willamette, and Tacoma necessitated three azimuth equations. The maximum correction to a direction, from the adjustment, was 2″.03, and the probable error of an observed direction was ±0″.53, The average closing error of the 148 triangles was 1″.22.

ACCORD OF BASES.

There are three bases which serve to fix the lengths in the triangulation discussed in this report.

The Yolo base in the thirty-ninth parallel triangulation fixed the length of the line Snow Mountain West-Mount Helena and also the other two sides of triangle Snow Mountain West-Marysville Butte-Mount Helena. The Willamette and Tacoma bases furnish two important tests of the accuracy of the triangulation.

In solving the normal equations in each section of the figure adjustment the length equation was, as usual, assigned to the last place, so that after all the conditions relating to triangle closures and ratios of length had been satisfied the discrepancy in length became known. In the following table the discrepancies developed between bases are given in terms of the seventh place of logarithms and are also expressed as ratios. A plus sign before the discrepancy expressed in terms of logarithms means that the first base mentioned is longer as measured than as computed through the intervening triangulation from the second base mentioned.

Bases	Discrepancy in seventh place of logarithms	Discrepancy expressed as a ratio
Mount Helena-Snow Mountain West to Willamette base	+79	1-55000
Willamette base to Tacoma base	−19	1-229000

ACCORD OF AZIMUTHS.

True geodetic azimuths were determined at three Laplace stations, viz, at Gazelle astronomic, Eugene astronomic, and Tacoma astronomic. In each case the true geodetic azimuth as held fixed was larger than the azimuth as computed through the triangulation, the direction of the computation being from the south to the north. At Gazelle astronomic the discrepancy was 3″.14, at Eugene astronomic 2″.98, and at Tacoma astronomic 3″.95.

THE NORTH AMERICAN DATUM.

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

Early in the year 1913 the Superintendent of the U. S. Coast and Geodetic Survey was notified by the director of the Comisión Geodésica Mexicana and by the chief astronomer of the Dominion of Canada Astronomical Observatory that the so-called United States standard datum had been adopted as the datum for the triangulation of those organizations. They also reported that the Clarke spheroid of 1866, now used in the United States, would be used by them.

Owing to the international character of the datum adopted by the three countries, the Superintendent of the U. S. Coast and Geodetic Survey changed its designation from the "United States standard datum" to the "North American datum."

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

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

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

The triangulation in the United States was commenced at various points and existed at first as a number of detached portions in each of which the geodetic datum was necessarily dependent only upon the astronomic stations connected with that particular portion. As examples of such detached portions of triangulation there may be mentioned the early triangulation in New England and along the Atlantic coast, a detached portion of the transcontinental triangulation centering on St. Louis and another portion of the same triangulation in the Rocky Mountain region, and three separate portions of triangulation in California, in the latitude of San Francisco, in the vicinity of Santa Barbara Channel and in the vicinity of San Diego. With the lapse of time these separate pieces expanded until they touched.

The transcontinental triangulation, the office computation of which was completed in 1899, joined all the detached portions mentioned and made them one continuous triangulation. As soon as this took place the logical necessity existed of discarding the old geodetic data used in these various pieces and substituting one for the whole country, or at least for as much of the country as is covered by continuous triangulation. To do this was a very tedious piece of work and involved much preliminary study to determine the best datum to be adopted. On March 13, 1901, the superintendent adopted what was known from that time until 1913 as the United States standard datum, but is now known as the North American datum, and it was decided to reduce the positions to that datum as rapidly as possible. The datum adopted was that formerly in use in New England, and therefore its adoption did not affect the positions which had been used for geographic purposes in New England and along the Atlantic coast to North Carolina, nor those

in the States of New York, Pennsylvania, New Jersey, and Delaware. The adopted datum does not agree, however, with that used in the Transcontinental Triangulation and in the Eastern Oblique Arc of the United States, publications which deal primarily with the purely scientific problem of the determination of the figure of the earth and which were prepared for publication before the adoption of the new datum.

As the adoption of such a standard datum was a matter of considerable importance, it is in order here to explain the desirability of this step more fully.

The main objects to be attained by the geodetic operations of the U. S. Coast and Geodetic Survey are, first, the control of the charts published by the Survey; second, the furnishing of the geographic positions (latitudes and longitudes), of accurately determined elevations, and of distances and azimuths, to officers connected with the Survey and to other organizations; third, the determination of the figure of the earth. For the first and second objects it is not necessary that the reference spheroid should be accurately that which most closely fits the geoid within the area covered, nor that the adopted geodetic datum should be absolutely the best that can be derived from the astronomic observations at hand. It is simply desirable that the reference spheroid and the geodetic datum adopted shall be, if possible, such a close approximation to the truth that any correction which may hereafter be derived from the observations which are now, or may become, available shall not greatly exceed the probable errors of such corrections. It is, however, very desirable that one spheroid and one geodetic datum be used for the whole country. In fact, this is absolutely necessary if a geodetic survey is to perform fully the function of accurately coordinating all surveys within the area which it covers. This is the most important function of a geodetic survey. To perform this function, it is also highly desirable that when a certain spheroid and geodetic datum have been adopted for a country they be rigidly adhered to, without change for all time unless shown to be largely in error.

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

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

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

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

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

	°	′	″
ϕ=	39	13	26.686
λ=	98	32	30.506
α to Waldo=	75	28	14.52

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

USE OF HORIZONTAL CONTROL DATA.

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

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

The difficulties of accurately locating and permanently defining the boundaries of a farmer's plantation on land, even with the aid of monuments, public

roads, streams of water, and other points of reference are often great, judging from the disputes frequently arising in connection with boundaries. * * *.

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

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

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

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

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

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

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

While it may be noted in the preceding paragraphs that the azimuth and length of one line and the geographic position of one end of that line constitute the essential data for the complete utilization of old work as a basis for new work, there is always grave danger in depending upon this minimum of data. There may be failure to

identify the true station mark, or the mark, though genuine, may have been tampered with or otherwise disturbed in position. This will, of course, introduce an error into the new work based on these stations. It is the present practice in this Survey, unless unusual conditions render it unnecessary, to establish the integrity of the recovered points by using at least three old stations as a basis for new work, the third station serving as a check for the two stations on which the new work may actually depend.

In local surveys where the area is of limited extent it is usually desirable to use a system of plane coordinates, the origin being connected to some point of the precise or primary triangulation scheme. Tables for computing plane coordinates from geographic positions are found in U. S. Coast and Geodetic Survey Special Publication No. 71.

The U. S. Coast and Geodetic Survey will be glad to give advice on any problem arising out of the use of its control points or on any proposed extension of triangulation from them.

EXPLANATION OF TABLES.

ARRANGEMENT OF TABULATED DATA.

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

The distances between stations are given in both meters and feet. To facilitate further the use of the tables, a column is given of the logarithms of the lengths in meters. It must be remembered that it is the logarithm of the length in meters which is derived first in the computation, the lengths in meters given in this table being derived from the corresponding logarithm and the lengths in feet in turn derived from the lengths in meters by the aid of the conversion tables on pages 37–44. Where further work of considerable extent is contemplated, an accumulation of error in the last two operations can be avoided by using the logarithm.

EXPLANATION OF LENGTHS.

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

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

The maximum value of this correction does not exceed $\frac{1}{2000}$ of the length of any line of the triangulation here published. The error introduced by the use of the above approximate formula does not exceed $\frac{1}{1000000}$ of the length of any portion of this triangulation.

AZIMUTH AND BACK AZIMUTH.

Because of the convergence of the meridians the azimuth and back azimuth of a line do not differ by exactly 180°, the amount of the divergence varying with the latitude and the difference of longitude of the two points. To illustrate from the tables, page 10, the azimuth from Mears to Bally is 16° 28′ 16.″81, while the back azimuth, or the azimuth from Bally to Mears is 196° 20′ 20.″42.

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

ACCURACY OF DATA INDICATED IN TABLES.

The rule followed in recent publications of this office has been to give latitudes and longtitudes to thousandths of seconds for all points, the positions of which are fixed by fully adjusted triangulations. 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 vertical angles 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.

HOW TO FIND THE DATA DESIRED.

Following the index at the back of this publication are seven maps. The first is an index map showing all areas in the United States covered by published triangulation rigidly computed on the North American datum. Following that is an index map showing the boundaries of each of the triangulation sketches. (Figs. 3 to 7.) The other five are detailed maps showing the scheme of triangulation plotted by latitudes and longitudes on a polyconic projection.

Having found from these sketches the names of the points desired, the tables may then be conveniently consulted by using the index at the end of this publication. In the appropriately headed columns opposite the name of each station are given the pages on which may be found its geographic position, description, and elevation above sea level, and the number of the detailed sketch showing the scheme of observed lines from that station.

RELATED PUBLICATIONS.

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

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

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

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

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

Appendix 8 of the Report for 1888,, positions in Connecticut.
Appendix 8 of the Report for 1893, positions in Pennsylvania, Delaware, and Maryland.
Appendix 6 of the Report for 1901, positions and descriptions in Kansas and Nebraska.
Appendix 4 of the Report for 1903, positions and descriptions in Kansas, Oklahoma, and Texas.
Appendix 9 of the Report for 1904, positions and descriptions in California.
Appendix 5 of the Report for 1905, positions and descriptions in Texas.
Appendix 3 of the Report for 1907, positions and descriptions in California.
Appendix 5 of the Report for 1910, positions and descriptions in California.
Appendix 4 of the Report for 1911, positions and descriptions in Nebraska, Minnesota, North Dakota, and South Dakota.
Appendix 5 of the Report for 1911, positions and descriptions in Texas.
Appendix 6 of the Report for 1911, positions and descriptions in Florida.
Special Publication No. 11, positions and descriptions in Texas, New Mexico, Arizona, and California.
Special Publication No. 13, positions and descriptions in California, Oregon, and Washington.
Special Publication No. 16, positions and descriptions in Florida.
Special Publication No. 17, positions and descriptions in Texas.
Special Publication No. 19, positions and descriptions in Colorado, Utah, Nevada, Wyoming, Montana, South Dakota, and North Dakota.
Special Publication No. 24, positions and descriptions in Alabama and Mississippi.
Special Publication No. 30, positions and descriptions in West Virginia, Ohio, Kentucky, Indiana, Illinois, and Missouri.
Specal Publication No. 31, positions and descriptions in Oregon, Washington, and California.
Special Publication No. 43, positions in Georgia.
Special Publication No. 45, descriptions in Georgia.
Special Publication No. 46, positions and descriptions in Maine.
Special Publication No. 54, positions and descriptions in Texas.
Special Publication No. 62, positions and descriptions in Rhode Island.
Special Publication No. 70, positions and descriptions in Kansas.
Special Publication No. 74, positions and descriptions in Idaho, Oregon, and Washington.
Special Publication No. 76, positions and descriptions in Massachusetts.
Special Publication No. 78, positions and descriptions in Texas (Rio Grande arc).
Special Publication No. 79, positions and descriptions in Indiana.
Report on triangulation of Greater New York.
Progress report on a plan of sewerage for the city of Cincinnati.

Appendix EEE, pages 2905-3031, Annual Report of the Chief of Engineers, U. S. Army, 1902, positions of points on and near the Great Lakes.

Professional Paper No. 24, Corps of Engineers, U. S. Army, descriptions of points on and near the Great Lakes.

Publications of the Massachusetts Commission on Waterways and Public Lands.

Various bulletins of the United States Geological Survey.

Geographic positions.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
Principal points.	° ′ ″	° ′ ″	° ′ ″				
Mount Helena, 1876..	38 40 11.080	245 56 18.019	67 22 03.416	Mount Lola...	5.3301564	213873.23	701682.4
	122 37 57.817	324 01 34.822	144 28 18.913	Mount Diablo.	5.0323324	107728.96	353440.8
		269 20 15.615	90 58 57.203	Round Top...	5.3600267	229100.84	751641.7
Marysville Butte, 1876.	39 12 22.361	50 03 28.78	229 32 49.63	Mount Helena	4.9650596	92269.81	302721.9
	121 49 11.540	103 30 30.51	282 54 51.87	Snow Mountain west.	4.9197549	83129.44	272733.8
Snow Mountain west, 1892.	39 22 38.452	352 06 02.01	172 10 45.86	Mount Helena	4.8992657	79298.64	260165.6
	122 45 28.619	18 03 03.98	197 49 26.49	Ross Mountain.	5.0073412	101704.73	333676.3
Snow Mountain east, 1876.	39 23 02.008	283 29 49.08	104 05 12.82	Marysville Butte.	4.9177231	82741.44	271460.9
	122 45 04.847						
		352 34 48.70	172 39 17.60	Mount Helena	4.9027792	79942.78	262278.9
		38 04 15.69	218 04 00.61	Snow Mountain west.	2.9650893	922.76	3027.4
Kent, 1904.....	39 58 01.752	316 41 36.16	137 16 41.00	Marysville Butte.	5.0627330	115540.16	379068.0
	122 44 14.449						
		1 04 01.62	181 03 29.44	Snow Mountain east.	4.8113645	64768.60	212495.0
Lyons, 1904.....	40 18 06.101	7 18 50.85	187 11 54.82	Marysville Butte.	5.0885296	122611.05	402266.4
	121 38 21.007						
		43 24 27.26	222 41 41.92	Snow Mountain east.	5.1444074	139446.43	457500.5
		68 42 27.63	247 59 59.25	Kent.....	5.0030155	100696.76	330369.3
Bally, 1904..... ..	40 36 11.939	291 00 16.70	111 39 38.03	Lyons.....	4.9640936	92064.79	302049.2
	122 39 00.370	6 01 26.68	185 58 03.60	Kent.....	4.8514233	71026.97	233027.6
Round, 1904.....	40 48 19.882	334 10 02.02	154 22 27.03	Lyons.....	4.7931190	62103.91	203752.6
	121 57 26.873	35 40 46.89	215 10 27.70	Kent.....	5.0578276	114242.48	374810.5
		69 14 22.18	248 47 16.01	Bally.....	4.7972334	62695.07	205692.1
Spur, 1904.....	41 24 14.648	339 42 45.15	159 54 13.91	Round.....	4.8501774	70823.50	232360.1
	122 14 54.491	20 56 17.28	200 40 28.60	Bally.....	4.9783111	95128.60	312101.1
Mears, 1904.....	41 07 29.538	208 15 08.51	28 23 01.90	Spur.....	4.5468137	35221.98	115557.4
	122 26 52.260	310 30 15.44	130 49 32.84	Round.....	4.7357813	54422.85	178552.3
		16 28 16.81	196 20 20.42	Bally.....	4.7808671	60376.39	198084.9
Boliver (Calif.), 1904.	41 15 35.575	250 01 14.88	70 22 17.82	Spur.....	4.6745307	47264.02	155065.4
	122 46 46.811	298 11 54.84	118 25 01.56	Mears.....	4.4999381	31618.27	103734.3
		351 26 43.00	171 31 48.60	Bally.....	4.8676103	73724.24	241876.9
Soda (Oreg.), 1904...	42 03 54.670	345 19 52.95	165 29 03.58	Spur.....	4.8801006	75875.33	248934.3
	122 28 41.648	15 46 47.39	195 34 46.02	Boliver.....	4.9680058	92897.87	304782.4
Gazelle astronomic station, 1904.	41 31 36.248	183 13 35.19	3 15 12.92	Soda.....	4.7774286	59900.25	196522.7
	122 31 08.281	300 59 40.18	121 10 24.99	Spur.....	4.4213899	26386.99	86571.3
Sterling (Oreg.), 1904.	42 01 03.864	261 00 09.26	81 16 33.53	Soda.....	4.5341916	34213.03	112247.2
	122 53 11.434	321 51 54.19	142 17 22.56	Spur.....	4.9365221	86401.66	283469.4
		353 55 38.45	173 59 54.01	Boliver.....	4.9275789	84640.63	277691.8
Rust, 1904.....	42 37 10.930	9 58 58.92	189 53 41.33	Soda.....	4.7961114	62533.30	205161.3
	122 20 50.147	33 47 58.14	213 26 11.14	Sterling.....	4.9046802	80293.46	263429.5
Onion, 1904.....	42 41 31.762	276 02 52.70	96 38 45.29	Rust.....	4.8621488	72802.92	238854.2
	123 13 46.921	318 07 09.53	138 37 33.00	Soda.....	4.9692721	93169.15	305672.4
		339 12 19.09	159 26 11.48	Sterling.....	4.9034705	80071.78	262702.2
Black, 1904.....	43 09 37.503	350 59 07.43	171 03 51.98	Rust.....	4.7839902	60812.13	199514.5
	122 27 48.236	50 31 05.83	229 59 46.98	Onion.....	4.9104227	81362.20	266935.8

Geographic positions—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance. Log (meters).	Meters.	Feet.
Principal points—Continued.	° ′ ″	° ′ ″	° ′ ″				
White, 1904	43 07 14.428	264 24 10.96	84 47 44.04	Black	4.6712655	46910.01	153903.9
	123 02 14.761	314 23 02.31	134 51 12.74	Rust	4.8989012	79232.11	259947.3
		18 19 13.10	198 11 21.87	Onion	4.7000681	50126.59	164457.0
Scott, 1904	43 22 21.758	295 36 15.65	116 00 57.67	Black	4.7337520	54169.15	177720.0
	123 03 50.517	355 34 45.07	175 35 50.67	White	4.4484509	28083.48	92137.2
Fairview, 1904	43 35 10.459	341 59 37.72	162 07 24.98	Black	4.6965851	49726.19	163143.3
	122 39 08.622	31 14 40.80	210 58 49.21	White	4.7811331	60413.38	198206.2
		54 40 43.54	234 23 43.86	Scott	4.6116108	40889.41	134151.3
Yellow, 1904	43 32 48.849	265 37 03.17	86 08 04.66	Fairview	4.7836960	60770.94	199379.3
	123 24 09.568	305 06 41.39	125 20 39.92	Scott	4.5250936	33550.08	110072.2
		327 50 53.15	148 05 55.44	White	4.7470519	55853.69	183246.6
Spencer, 1903	43 59 00.715	320 57 05.87	141 15 27.90	Fairview	4.7537056	56716.00	186075.7
	123 05 41.248	27 10 28.02	206 57 41.38	Yellow	4.7362330	54479.49	178738.1
Roman, 1903	43 54 45.041	261 04 53.49	81 31 39.25	Spencer	4.7176307	52195.22	171243.8
	123 44 14.987	292 09 05.10	112 54 06.43	Fairview	4.9759767	94618.63	310428.0
		326 17 38.82	146 31 32.08	Yellow	4.6880983	48763.89	159986.2
Mary, 1903	44 30 17.369	327 37 54.62	147 57 02.02	Spencer	4.8354276	68458.53	224601.0
	123 33 05.732	12 47 13.03	192 39 26.37	Roman	4.8291199	67471.43	221362.5
Peterson, 1903	44 30 38.293	9 50 19.67	189 45 01.69	Spencer	4.7740504	59436.11	195000.0
	122 58 05.537	43 02 28.28	222 30 17.06	Roman	4.9568321	90538.25	297040.9
		89 24 24.75	268 59 52.49	Mary	4.6664822	46396.18	152218.1
Twin, 1905	44 19 31.401	10 57 11.34	190 53 21.59	Spencer	4.5875519	38685.83	126921.8
	123 00 11.426	52 17 07.57	231 46 27.22	Roman	4.8725285	74563.88	244631.7
		114 43 37.75	294 20 36.03	Mary	4.6813809	48015.44	157530.7
		187 41 34.73	7 43 02.86	Peterson	4.3174815	20772.15	68150.0
Ridge, 1905	44 16 02.051	146 33 52.16	326 24 39.71	Mary	4.5005667	31664.07	103884.5
	123 19 55.940	226 52 25.20	47 07 41.87	Peterson	4.5983320	39658.11	130111.6
		256 03 38.80	76 17 26.03	Twin	4.4320513	27042.78	88722.9
		328 50 07.61	149 00 02.67	Spencer	4.5659404	36807.85	120760.4
Rauch, 1903	44 00 50.965	179 22 37.92	359 22 28.32	Ridge	4.4490510	28122.31	92264.6
	123 19 42.158	207 24 34.93	27 39 39.91	Peterson	4.7938886	62214.07	204114.0
		216 50 01.62	37 03 37.36	Twin	4.6362034	43271.64	141967.0
		280 12 45.16	100 22 29.29	Spencer	4.2797227	19042.44	62475.1
Willamette south base, 1903.	44 04 06.905	61 44 15.53	241 38 25.01	Rauch	4.1055673	12751.68	41836.1
	123 11 17.933	149 14 18.50	328 59 05.33	Mary	4.7519303	56484.64	185316.7
		152 30 46.78	332 24 45.86	Ridge	4.3960802	24893.17	81670.3
		199 36 13.85	19 45 27.19	Peterson	4.7173937	52166.74	171150.4
		207 21 02.47	27 28 47.11	Twin	4.5071120	32144.90	105462.1
		321 32 17.88	141 36 11.87	Spencer	4.0814772	12063.61	39578.7
Willamette north base, 1905.	44 11 37.076	25 09 09.08	205 04 16.61	Rauch	4.3428910	22023.74	72256.2
	123 12 41.921	130 22 30.94	310 17 28.19	Ridge	4.1016178	12636.24	41457.4
		228 35 55.72	48 44 39.50	Twin	4.3457607	22169.74	72735.2
		338 06 50.53	158 11 43.21	Spencer	4.4005520	25150.86	82515.8
		352 20 18.07	172 21 16.55	Willamette south base.	4.1467287	14019.38	45995.2
Seavies 2, 1908	44 06 24.663	28 21 03.50	208 17 12.93	Spencer	4.1921494	15565.01	51066.2
	123 00 09.593	74 06 22.54	253 58 37.54	Willamette south base.	4.1893425	15464.74	50737.2
Pisgah, 1908	44 00 19.836	76 54 39.61	256 49 13.38	Spencer	4.0312723	10746.63	35257.9
	122 57 51.568	111 24 00.79	291 14 40.27	Willamette south base.	4.2849731	19274.05	63234.9
		164 45 06.65	344 43 30.67	Seavies 2	4.0671380	11671.80	38293.2
Eugene astronomic station, 1894.	44 03 30.319	232 47 15.95	52 50 57.77	Seavies 2	3.9495852	8904.00	29212.5
	123 05 28.438	299 58 42.95	120 04 00.50	Pisgah	4.0700458	11750.21	38550.5
		1 57 54.04	181 57 45.14	Spencer	3.9204384	8326.04	27316.3
Yam, 1903	45 03 44.993	347 14 12.38	167 21 35.33	Peterson	4.7984079	62864.86	206249.1
	123 08 34.292	27 42 30.71	207 25 14.16	Mary	4.8445219	69907.19	229353.8

Geographic positions—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
Principal points—Continued.	° ′ ″	° ′ ″	° ′ ″				
Hult, 1903	44 57 48.151	22 00 26.69	201 49 39.13	Peterson	4.7342429	54230.41	177920.9
	122 42 45.524	52 48 55.91	232 13 30.19	Mary	4.9229453	83742.39	274744.8
		108 08 46.40	287 50 31.00	Yam	4.5521619	35658.40	116989.3
Barnes (Oreg.), 1903	45 31 36.526	357 18 16.35	177 19 51.87	Hult	4.7971754	62686.70	205664.6
	122 45 00.031	30 59 06.87	210 42 21.69	Yam	4.7789013	60103.71	197190.3
Larch (Oreg.), 1903	45 31 59.615	38 01 16.39	217 34 36.71	Hult	4.9038918	80147.83	262951.7
	122 05 13.018	58 05 53.27	237 20 51.35	Yam	4.9910591	97962.33	321398.1
		89 26 53.40	268 58 29.97	Barnes	4.7143480	51802.18	169954.3
Star (Wash.), 1906	45 44 47.711	333 33 31.93	153 40 00.32	Larch	4.4227804	26471.61	86848.9
	122 14 16.246	58 43 49.19	238 21 51.02	Barnes	4.6703557	46811.84	153581.8
Davis (Wash.), 1906	45 59 37.452	314 32 26.39	134 47 51.18	Star	4.5918990	39075.00	128198.6
	122 35 44.667	13 04 37.13	192 57 59.25	Barnes	4.7264533	53266.40	174758.2
Red (Wash.), 1906	45 56 07.249	25 01 17.31	204 49 49.37	Larch	4.6927096	49284.42	161694.0
	121 49 12.344	57 16 07.55	236 58 08.64	Star	4.5870908	38644.78	126787.1
		96 26 22.46	275 52 55.02	Davis	4.7815631	60473.22	198402.6
Warren (Oreg.), 1903	45 48 33.229	225 52 07.84	46 03 54.50	Davis	4.4698843	29504.23	96798.5
	122 52 08.679	296 26 15.40	116 59 49.58	Larch	4.8339771	68230.27	223852.1
		343 29 22.08	163 34 28.69	Barnes	4.5149689	32731.73	107387.3
Lam, 1906	46 07 57.903	293 35 59.64	114 03 42.24	Red	4.7348430	54305.40	178167.0
	122 27 42.295	33 54 34.32	213 48 46.96	Davis	4.2696939	18607.75	61048.9
Len, 1906	46 18 45.173	329 52 16.76	150 05 49.99	Red	4.6850313	48420.72	158860.3
	122 08 00.508	45 23 14.48	225 03 14.29	Davis	4.7016486	50309.34	165056.6
		51 50 33.78	231 36 20.49	Lam	4.5087061	32263.10	105849.9
Toutle, 1905	46 17 10.419	264 39 01.27	84 57 07.49	Len	4.5090454	32288.32	105932.6
	122 33 02.971	338 01 14.03	158 05 05.52	Lam	4.2640430	18392.59	60343.0
		6 06 34.19	186 04 37.60	Davis	4.5144954	32696.06	107270.3
Huck, 1905	46 42 45.136	332 25 33.37	152 38 39.90	Len	4.6999310	50110.83	164405.3
	122 26 04.593	10 42 13.91	190 37 10.43	Toutle	4.6832391	48221.32	158206.1
Bel, 1905	46 47 04.983	15 52 53.95	195 44 27.47	Len	4.7368025	54550.97	178972.6
	121 56 22.841	40 27 22.81	220 00 45.94	Toutle	4.8608486	72585.28	238140.2
		78 12 07.24	257 50 29.50	Huck	4.5872792	38661.55	126842.1
Hal, 1905	46 43 52.344	261 10 35.73	81 33 00.02	Bel	4.5978304	39612.33	129961.5
	122 27 08.201	326 55 58.87	146 56 45.18	Huck	3.3937882	2476.21	8124.0
Rain, 1905	46 50 07.065	275 21 54.89	95 54 33.66	Bel	4.7576825	57237.74	187787.5
	122 41 09.422	302 52 33.79	123 02 46.85	Hal	4.3277217	21267.75	69775.9
		305 18 57.41	125 29 56.74	Huck	4.3720505	23553.23	77274.2
Hurst, 1905	47 05 02.549	307 07 42.31	127 32 48.86	Bel	4.7392818	54863.28	179997.3
	122 30 44.966	351 47 38.64	171 51 03.36	Huck	4.6203825	41723.67	136888.4
		353 18 25.73	173 21 04.03	Hal	4.5965035	39491.49	129565.0
		25 35 08.72	205 27 32.32	Rain	4.4863335	30643.15	100535.1
Pen, 1905	47 02 05.064	20 34 48.68	200 27 33.28	Hal	4.5566543	36029.17	118205.7
	122 17 11.732	54 03 04.74	233 45 34.39	Rain	4.5755995	37635.66	123476.3
		107 47 37.81	287 37 42.47	Hurst	4.2556667	18016.84	59108.6
Tacoma south base, 1905.	47 04 38.837	292 48 20.30	112 54 50.97	Pen	4.0872032	12223.72	40104.0
	122 26 05.422	1 59 00.26	181 58 14.43	Hal	4.5856276	38514.80	126360.6
		35 28 04.55	215 17 03.88	Rain	4.5187312	33016.51	108321.7
		97 06 24.06	277 02 59.34	Hurst	3.7739623	5942.41	19496.1
Tacoma north base, 1905.	47 11 09.189	326 29 52.90	146 36 18.63	Pen	4.3040283	20138.56	66071.3
	122 25 58.206	0 43 24.61	180 43 19.32	Tacoma south base.	4.0811877	12055.570	39552.32
		1 41 03.08	181 40 11.93	Hal	4.7038770	50508.14	165905.6
		26 22 29.54	206 11 23.00	Rain	4.6381786	43468.90	142614.2
		28 07 11.39	208 03 41.21	Hurst	4.1083677	12834.17	42106.8

Geographic positions—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance. Log (meters).	Meters.	Feet.
Principal points—Continued.	° ′ ″	° ′ ″	° ′ ″				
Burn, 1905	47 13 50.673	316 25 07.53	136 27 52.88	Tacoma north base.	3.8376905	6881.62	22577.4
	122 29 43.535						
		323 54 05.60	144 03 16.62	Pen	4.4304238	26941.63	88391.0
		344 53 16.94	164 55 56.86	Tacoma south base.	4.2467477	17650.12	57907.1
		4 32 34.29	184 31 49.25	Hurst	4.2137976	16360.54	53676.2
Kin, 1905	47 14 02.319	13 30 16.14	193 29 31.38	Tacoma north base.	3.7402404	5498.45	18039.5
	122 24 57.219						
		86 36 43.07	266 33 12.88	Burn	3.7805720	6033.54	19795.0
Wash, 1905	47 16 14.398	308 06 03.35	128 09 04.85	Kin	3.8199767	6606.58	21675.1
	122 29 04.374	337 25 01.77	157 27 18.42	Tacoma north base.	4.0088869	10206.74	33486.6
		10 30 52.80	190 30 24.04	Burn	3.6545858	4514.25	14810.5
Bos, 1905	47 15 59.493	33 54 32.01	213 53 07.11	Kin	3.6394393	4359.53	14302.9
	122 23 01.599	93 29 27.78	273 25 01.31	Wash	3.8830851	7639.85	25065.1
Gull, 1891	47 17 52.574	313 53 29.85	133 55 36.67	Bos	3.7020410	5035.48	16520.6
	122 25 54.219	350 25 44.00	170 26 25.88	Kin	3.8579978	7211.04	23658.2
		52 49 52.33	232 47 32.62	Wash	3.7003670	5016.11	16457.0
Dron, 1905	47 18 00.812	310 43 39.16	130 46 11.18	Bos	3.7588960	5739.79	18831.3
	122 26 28.511	345 23 09.48	165 24 16.54	Kin	3.8814482	7611.11	24970.8
		44 55 13.27	224 53 18.75	Wash	3.6665016	4639.82	15222.5
Smelt, 1905	47 17 46.283	265 53 53.35	85 57 33.87	Dron	3.8007266	6320.14	20735.3
	122 31 28.575	313 06 11.23	133 07 57.18	Wash	3.6182138	4151.58	13620.6
Neill 2, 1905	47 19 55.014	312 55 19.83	132 57 32.48	Dron	3.7140833	5177.06	16985.1
	122 29 28.963	355 39 41.56	175 39 59.63	Wash	3.8345920	6832.69	22416.9
		32 18 07.50	212 16 39.57	Smelt	3.6723549	4702.78	15429.0
Tacoma astronomic station, 1892.	47 15 47.911	156 34 15.80	336 32 20.05	Neill 2	3.9200079	8317.79	27289.3
	122 26 51.446	197 20 35.49	17 21 17.53	Gull	3.0056668	4033.36	13232.8
Supplementary points.							
Mount St. John, 1904[1]	39 26 03.17	176 16 31	356 14 48	Kent	4.773030	59290.6	194542
	122 41 32.14	288 19 10	108 52 20	Marysville	4.899689	79376.0	260419
				Butte.			
Corning tower, 1904	39 55 40.774	95 23 05.04	275 01 34.16	Kent	4.6805528	47923.97	157230.6
	122 10 44.008	227 46 57.18	48 07 49.11	Lyons	4.7921037	61958.90	203276.8
		338 49 44.76	159 03 28.06	Marysville	4.9338347	85868.67	281720.8
				Butte.			
Corning astronomic station, 1908.	39 55 40.48	247 24 10	67 24 11	Corning tower.	1.36933	23.41	76.8
	122 10 44.92						
Mount Linn, top of peak, 1904.	40 02 12.617	195 17 14.5	15 25 07.8	Bally	4.814440	65228.9	214005
	122 51 11.855	253 44 09.8	74 31 09.3	Lyons	5.031505	107523.9	352768
		315 46 22.4	136 25 54.9	Marysville	5.107132	127977.0	419871
				Butte.			
Lassen Peak, 1904	40 29 18.614	10 50 33.3	190 38 25.4	Marysville	5.161103	144911.5	475430
	121 30 15.513			Butte.			
		28 56 28.7	208 51 14.1	Lyons	4.374630	23693.5	77734
		61 31 03.3	240 43 16.5	Kent	5.078644	119851.7	393213
Bully Choop, 1904	40 33 20.346	241 41 39.9	61 46 12.1	Bally	4.048286	11176.0	36667
	122 45 58.884	286 03 36.6	106 47 28.1	Lyons	4.998792	99722.2	327172
		357 49 40.2	177 50 47.7	Kent	4.815526	65392.2	214541
Redding courthouse, 1908.	40 34 58.278	96 06 13.3	275 56 17.2	Bally	4.335680	21661.1	71066
	122 23 44.281	236 07 45.1	56 24 53.6	Round	4.648670	44531.8	146101
Redding astronomic station, 1904.	40 34 19.354	99 11 08.7	279 01 09.1	Bally	4.341461	21951.3	72019
	122 23 38.684	173 44 41.4	353 44 37.8	Redding courthouse.	3.082013	1207.8	3963
		234 46 13.9	55 03 18.7	Round	4.654218	45104.3	147980

[1] Checked by vertical angles only.

Geographic positions—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
Supplementary points—Continued.	° ′ ″	° ′ ″	° ′ ″				
Redding south base, 1908.	40 34 28.152 122 23 24.911	50 02 58.9	230 02 49.9	Redding astronomic station.	2.625930	422.6	1386
		91 29 00.2	271 28 50.5	Hill	2.545762	351.4	1153
		153 53 14.2	333 53 01.6	Redding courthouse.	3.014915	1034.9	3395
Redding north base, 1908.	40 34 42.167 122 23 27.340	352 28 22.7	172 28 24.2	Redding south base.	2.639542	436.1	1431
		20 46 04.0	200 45 56.6	Redding astronomic station.	2.876541	752.6	2469
		34 47 58.0	214 47 49.9	Hill	2.712126	515.4	1691
		141 17 01.8	321 16 50.8	Redding courthouse.	2.804122	637.0	2090
Hill, 1908	40 34 28.446 122 23 39.845	354 26 27.4	174 26 28.2	Redding astronomic station.	2.449913	281.8	925
		173 31 58.0	353 31 55.1	Redding courthouse.	2.966656	926.1	3038
Crater Peak, 1904	40 41 54.374 121 37 05.274	2 19 29.9	182 18 40.7	Lyons	4.644353	44091.3	144656
		83 26 10.3	262 45 50.1	Bally	4.944089	87920.3	288452
		124 23 11.6	303 50 35.4	Mears	4.926513	84433.2	277011
Thompson Peak, 1904.[1]	40 56 37.67 122 52 19.33	225 27 58	45 52 36	Spur	4.864213	73149.8	239992
		240 26 59	60 43 42	Mears	4.612243	40949.0	134347
Saw Tooth, 1904	40 58 21.995 123 00 05.396	232 35 06.1	53 04 51.4	Spur	4.899168	79280.8	260102
		249 52 27.8	70 14 16.7	Mears	4.694762	49517.9	162460
		324 01 15.2	144 15 01.6	Bally	4.704374	50626.0	166095
Mount Eddy, cairn, 1904.	41 19 12.449 122 28 42.470	75 14 54.3	255 02 58.9	Boliver	4.416695	26103.3	85641
		180 00 47.0	0 00 47.6	Soda	4.917772	82750.8	271492
		244 04 37.5	64 13 44.6	Spur	4.330090	21384.1	70153
Black Butte, cairn, 1904.	41 22 00.307 122 20 49.936	148 20 23.9	327 58 52.5	Sterling	4.929970	85107.9	279225
		141 07 26.9	321 00 37.6	Gazelle astronomic station.	4.358721	22841.3	74938
		243 19 08.0	63 23 03.0	Spur	3.965684	9240.3	30316
		172 02 30.6	351 57 16.6	Soda	4.893957	78335.2	257005
Mount Shasta, top, 1904.	41 24 33.797 122 11 38.482	343 25 01.5	163 34 21.4	Round	4.844749	69943.8	229474
		23 21 05.6	203 03 08.3	Bally	4.988525	97392.4	319528
		34 01 48.5	213 51 45.8	Mears	4.580807	38089.6	124966
		71 28 59.0	251 05 46.5	Boliver	4.713995	51760.1	169816
		139 46 03.1	319 18 24.3	Sterling	4.948444	88806.4	291359
		162 06 35.9	341 55 14.8	Soda	4.884108	76578.7	251242
China Mountain, not the cairn, 1904.	41 22 41.420 122 34 31.102	4 12 29.0	184 09 32.3	Bally	4.935906	86279.2	283068
		52 33 09.7	232 25 03.9	Boliver	4.333907	21572.8	70777
		186 00 38.1	6 04 30.6	Soda	4.884968	76730.5	251740
		263 53 09.2	84 06 07.2	Spur	4.439125	27486.9	90180
Russian Peak, north point, 1904.	41 16 59.106 122 57 03.164	183 44 19.2	3 46 53.2	Sterling	4.912596	81770.4	268275
		256 53 40.8	77 21 31.2	Spur	4.780366	60306.8	197857
		280 07 36.0	100 14 22.5	Boliver	4.163622	14575.5	47820
Russian Peak, south point, 1904.[2]	41 16 58.70 122 57 03.24	256 53 00	77 20 51	Spur	4.780398	60311.2	197871
		292 25 38	112 45 31	Mears	4.659934	45701.9	149940
Marble Mountain, 1904.	41 34 46.625 123 05 27.947	199 11 35.3	19 19 46.2	Sterling	4.712199	51546.5	169115
		223 09 00.2	43 33 31.4	Soda	4.870229	74170.1	243340
		285 12 26.0	105 45 55.8	Spur	4.863427	73017.5	239558
Little Shasta, 1904	41 43 14.240 122 13 18.490	42 30 04.4	222 07 53.9	Boliver	4.840115	69201.4	227038
		121 06 02.3	300 39 25.2	Sterling	4.808209	64299.7	210957
		151 00 27.3	330 50 10.8	Soda	4.641374	43789.9	143667

[1] Checked by vertical angles only.

[2] No check on this position.

Geographic positions—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
Supplementary points—Continued.	° ′ ″	° ′ ″	° ′ ″				
Goose Nest, tall tree (Cal.), 1904.	41 48 58.928 122 14 19.005	36 03 53.7	215 52 42.6	Gazelle astronomic station.	4.599314	39747.9	130406
		36 19 45.5	215 58 13.8	Bolivar	4.883890	76540.3	251116
		144 21 42.8	324 12 06.2	Soda	4.531977	34039.0	111676
		112 48 33.3	292 22 35.1	Sterling	4.765054	58217.6	191002
Preston Peak (Cal.), 1904.	41 50 07.03 123 36 39.82	198 10 15	18 25 38	Onion	5.000947	100218.3	328800
		251 08 55	71 37 58	Sterling	4.802197	63415.7	208056
Greyback (Oreg.), 1904.	42 06 37.101 123 18 41.721	185 55 39.3	5 58 58.1	Onion	4.812796	64982.4	213196
		210 31 32.8	31 06 01.1	Black	5.132966	135820.7	445605
		286 08 49.7	106 25 54.9	Sterling	4.564137	36655.3	120260
Pilot Rock, 1904	42 01 51.653 122 33 36.073	12 08 01.3	191 59 15.8	Bolivar	4.942399	87578.8	287331
		86 59 17.2	266 46 10.4	Sterling	4.432656	27080.5	88847
		240 41 59.1	60 45 16.4	Soda	3.889986	7762.2	25466
		339 28 26.6	159 40 53.0	Spur	4.871003	74302.4	243774
Siskiyou, 1904 [1]	42 03 44.11 122 45 49.09	151 24 26	331 05 35	Onion	4.902040	79806.8	261833
		269 06 50	89 18 18	Soda	4.373372	23625.0	77510
Kerby, 1904 [1]	42 13 14.81 123 27 36.84	199 49 51	19 59 12	Onion	4.745767	55688.7	182705
		243 48 38	64 33 41	Rust	5.007567	101757.6	333850
Ashland Peak, cairn, 1904	42 04 52.547 122 42 57.867	148 14 12.4	327 53 25.9	Onion	4.902873	79960.0	262335
		206 48 39.6	27 03 34.1	Rust	4.826635	67086.5	220100
		275 06 14.9	95 15 48.7	Soda	4.295873	19763.9	64842
		332 29 50.9	152 48 31.8	Spur	4.927763	84676.5	277809
		3 20 37.4	183 18 05.3	Bolivar	4.960854	91380.6	299805
Wagner, 1904	42 07 05.737 122 46 24.287	149 38 40.8	329 20 13.1	Onion	4.869186	73992.2	242756
		192 16 58.1	12 29 34.1	Black	5.073816	118526.6	388866
		212 04 35.7	32 21 49.6	Rust	4.818477	65838.1	216004
		283 28 19.0	103 40 11.4	Soda	4.400065	25122.6	82423
Aspen Peak, 1904	42 18 57.286 122 05 12.427	49 23 40.7	229 07 54.2	Soda	4.630179	42675.5	140011
		114 22 07.9	293 35 47.8	Onion	5.012074	102819.1	337332
		147 40 45.0	327 30 11.8	Rust	4.601743	39970.8	131138
Mount Pitt, 1904	42 26 41.964 122 18 54.365	17 45 10.0	197 38 35.2	Soda	4.646239	44283.2	145286
		110 23 28.0	289 46 20.7	Onion	4.902873	79960.0	262335
		171 22 17.4	351 16 14.7	Black	4.905232	80395.6	263765
		172 15 27.2	352 14 09.0	Rust	4.291956	19586.5	64260
Lost Peak, 1904 [1]	42 30 50.92 122 08 42.90	102 53 37	282 09 35	Onion	4.959834	91166.2	299101
		125 19 26	305 11 14	Rust	4.307793	20313.9	66647
Central Point astronomic station, 1904.	42 23 51.581 122 56 23.451	242 56 29.8	63 20 31.3	Rust	4.7371413	54593.6	179113
		313 56 45.8	134 15 22.8	Soda	4.7248137	53065.7	174100
Central Point latitude station, 1904.	42 23 51.512 122 56 23.265	116 41	296 41	Central Point astronomic station.	0.6785	4.77	15.6
Union Peak, 1903	42 49 53.546 122 13 21.078	23 30 40.6	203 25 35.9	Rust	4.409163	25654.5	84168
		79 42 19.8	259 01 18.0	Onion	4.923689	83885.9	275216
		157 31 38.4	337 13 58.9	Fairview	4.958228	90829.7	297997
Mount Scott, 1904	42 55 24.019 122 00 55.549	38 57 11.5	218 43 40.3	Rust	4.636536	43304.8	142076
		75 54 57.5	255 05 26.9	Onion	5.011101	102589.1	336578
		125 57 47.4	305 39 26.7	Black	4.653341	45013.3	147681
Liao Rock, 1904	42 57 08.096 122 10 06.336	21 40 13.7	201 32 56.4	Rust	4.599165	39734.3	130362
		71 56 52.6	251 13 35.6	Onion	4.961284	91471.1	300101
		105 05 45.2	284 30 10.1	White	4.864805	73249.6	240320
		134 00 04.6	313 47 59.6	Black	4.523112	33351.2	109420
		151 00 38.6	330 40 44.3	Fairview	4.906616	80652.2	264606
High Rock, 1904	43 03 02.950 122 29 05.670	99 58 29.9	279 35 51.2	White	4.659501	45656.3	149791
		188 10 33.8	8 11 26.2	Black	4.089936	12300.9	40357
		346 43 45.8	166 49 22.7	Rust	4.691934	49196.5	161406

[1] No check on this position.

Geographic positions—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
Supplementary points—Continued.	° ′ ″	° ′ ″	° ′ ″				
Old Bailey, 1904	43 09 19.956	58 22 56.4	237 41 39.0	Onion	4.987860	97243.4	319039
	122 13 09.098	86 56 58.3	266 23 24.2	White	4.824026	66684.7	218781
		91 38 41.9	271 28 40.6	Black	4.298188	19869.5	65189
		143 52 40.2	323 34 49.3	Fairview	4.773418	59349.6	194716
Walker Peak, 1904 [1]	43 11 33.68	84 13 22	263 55 55	Black	4.540868	34743.1	113986
	122 02 18.18	131 31 15	311 05 56	Fairview	4.821075	66233.1	217300
Dodson (U.S.G.S.), 1904.	43 07 10.136	127 39 24.7	307 36 20.1	Burg	3.886832	7706.1	25282
	123 14 35.150	207 16 30.9	27 23 52.6	Scott	4.500640	31669.4	103902
		269 28 35.0	89 37 01.2	White	4.223711	16738.3	54916
Rose, 1904	43 14 09.038	233 53 46.81	54 04 23.33	Scott	4.4126232	25859.68	84841.3
	123 19 18.555	298 51 36.64	119 03 17.19	White	4.4220406	26426.56	86701.1
Burg, 1904	43 09 42.607	177 54 02.44	357 53 53.30	Rose	3.9152697	8227.53	26993.2
	123 19 05.198	221 16 38.67	41 27 05.61	Scott	4.4943632	31214.99	102411.2
		281 13 40.24	101 25 11.18	White	4.3671347	23288.13	76404.5
Roseburg latitude station, 1904.	43 12 40.769	223 40 38.71	43 41 57.67	Rose	3.5759994	3767.03	12359.0
	123 21 13.849	332 08 06.89	152 09 34.93	Burg	3.7936802	6218.42	20401.6
Quartz, 1904	43 09 51.770	80 52 53.4	260 37 50.6	White	4.480385	30226.3	99167
	122 40 14.595	181 48 31.6	1 49 16.9	Fairview	4.671093	46891.4	153843
		271 25 29.2	91 33 59.7	Black	4.227036	16866.9	55337
Diamond Peak, 1904.	43 31 16.014	32 36 47.1	212 23 49.1	Black	4.676843	47516.3	155893
	122 08 54.659	100 14 59.1	279 54 09.2	Fairview	4.616[illegible]25	41354.7	135678
		109 18 18.1	288 12 24.7	Roman	5.131085	135233.7	443679
		124 18 40.2	303 39 24.4	Spencer	4.963379	91913.4	301553
Mount Zion, 1903 [1]	43 47 29.576	99 42 38.7	279 00 29.5	Roman	4.917183	82638.6	271123
	122 43 24.335	125 41 05.6	305 25 38.8	Spencer	4.564457	36682.3	120349
Russian Church, cross, 1908.	44 03 18.487	148 04 20.1	328 03 51.0	Willamette south base.	3.245722	1760.8	5777
	123 10 36.088						
		247 32 11.5	67 39 27.3	Seavies 2	4.178324	15077.3	49466
		287 52 19.2	108 01 10.6	Pisgah	4.252746	17895.6	58712
		320 26 05.3	140 29 30.3	Spencer	4.013515	10316.1	33845
Springfield, Methodist Church, 1908.	44 02 53.545	39 01 16.7	218 58 15.1	Spencer	3.965968	9246.3	30336
	123 01 20.032	101 37 24.9	281 34 32.2	Eugene astronomic station.	3.751653	5644.9	18520
		193 31 04.2	13 31 53.2	Seavies 2	3.826199	6701.9	21988
Springfield, Christian Church, 1908.	44 02 51.552	40 13 27.9	220 10 10.0	Spencer	3.969699	9326.1	30597
	123 01 11.024	101 49 52.3	281 46 43.3	Eugene astronomic station.	3.767444	5853.9	19206
		191 43 56.5	11 44 39.2	Seavies 2	3.827305	6719.0	22044
Eugene, Deady Hall, west tower, 1908.	44 02 49.475	135 34 35.0	315 33 56.4	Eugene astronomic station.	3.246821	1765.3	5792
	123 04 32.924						
		221 23 39.0	41 26 42.1	Seavies 2	3.947284	8856.9	29058
		12 10 13.9	192 09 26.3	Spencer	3.858699	7222.7	23696
Eugene, Geary School spire, 1908.	44 03 22.161	101 29 14.4	281 25 41.5	Willamette south base.	3.842110	6952.0	22808
	123 06 11.803						
		255 22 35.7	75 23 05.8	Eugene astronomic station.	2.998939	997.6	3273
		296 45 11.7	116 50 59.3	Pisgah	4.096223	12480.2	40945
		355 10 34.6	175 10 55.8	Spencer	3.908378	8098.0	26568
Eugene, United Brethren Church, 1908.	44 02 53.966	105 07 28.9	285 03 08.1	Willamette south base.	3.936928	8648.2	28373
	123 05 02.786						
		153 01 50.8	333 01 33.1	Eugene astronomic station.	3.100014	1259.0	4131
		225 03 47.3	45 07 11.3	Seavies 2	3.964328	9211.4	30221
		296 18 37.8	116 23 37.6	Pisgah	4.030071	10716.9	35160

[1] No check on this position.

Geographic positions—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance. Log (meters).	Meters.	Feet.
Supplementary points—Continued.	° ′ ″	° ′ ″	° ′ ″				
Eugene, Patterson School spire, 1908.	44 02 47.636	9 51 58.2	189 51 20.2	Spencer	3.851794	7108.8	23323
	123 04 46.593	144 44 27.6	324 43 58.6	Eugene astronomic station.	3.207756	1613.5	5294
		222 35 32.0	42 38 44.7	Seavies 2	3.959172	9102.7	29864
Eugene, Baptist Church spire, 1908.	44 03 05.830	103 18 42.4	283 14 32.7	Willamette south base.	3.914232	8207.9	26929
	123 05 19.023	164 30 09.1	344 30 02.6	Eugene astronomic station.	2.894509	784.3	2573
		228 15 28.8	48 19 04.1	Seavies 2	3.964873	9223.0	30259
		297 10 01.0	117 15 11.9	Pisgah	4.049392	11204.5	36760
Eugene, W. O. W. Hall spire, 1908.	44 03 05.553	207 25 29.7	27 25 42.1	Eugene astronomic station.	2.935103	861.2	2825
	123 05 46.259						
		230 36 09.7	50 40 03.9	Seavies 2	3.986290	9689.2	31789
		295 46 25.7	115 51 55.6	Pisgah	4.069796	11743.5	38528
Eugene, courthouse, flagpole, 1908.	44 03 06.273	103 23 55.9	283 19 49.7	Willamette south base.	3.908272	8096.0	26562
	123 05 24.041	172 29 22.8	352 29 19.7	Eugene astronomic station.	2.874247	748.6	2456
		228 46 41.9	48 50 20.6	Seavies 2	3.968374	9297.7	30504
		296 58 08.6	117 03 23.0	Pisgah	4.053471	11310.2	37107
Eugene, Methodist Church, 1908.	44 02 56.857	105 41 44.6	285 37 43.6	Willamette south base.	3.903543	8008.4	26274
	123 05 31.498	183 46 22.9	3 46 25.0	Eugene astronomic station.	3.014948	1035.0	3396
		228 07 33.9	48 11 17.8	Seavies 2	3.982933	9614.6	31544
		295 16 37.7	115 21 57.2	Pisgah	4.054279	11331.3	37176
Seavies (U. S. G. S.), 1908.[1]	44 06 31.970	29 01 13.7	208 57 12.7	Spencer	4.202007	15922.3	52238
	122 59 54.656	73 39 13.6	253 31 18.2	Willamette south base.	4.199933	15846.5	51990
Ball Butte, 1903	43 58 47.550	60 56 47.4	240 16 44.4	Fairview	4.950000	89125.1	292405
	121 41 15.765	88 06 26.2	266 41 05.0	Roman	5.216758	164724.4	540433
		90 41 41.0	269 43 03.5	Spencer	5.052670	112893.8	370386
St. Mary Butte, 1903	44 05 00.402	54 34 20.3	233 54 42.2	Fairview	4.975587	94533.8	310150
	121 41 54.992	84 05 04.6	262 40 05.7	Roman	5.216529	164637.6	540149
		84 49 15.3	263 51 01.6	Spencer	5.051040	112470.9	368998
South Sister, 1903	44 06 14.251	51 18 35.7	230 41 52.5	Fairview	4.960995	91410.3	299902
	121 46 08.254	83 00 38.4	261 38 34.5	Roman	5.202201	159294.6	522619
		83 17 03.4	262 21 45.1	Spencer	5.029801	107102.8	351386
		115 41 46.4	294 51 30.7	Peterson	5.024583	105823.7	347190
Middle Sister, 1903	44 08 55.768	48 29 01.0	227 52 52.6	Fairview	4.971957	93746.9	307568
	121 46 59.750	80 32 32.2	259 37 48.4	Spencer	5.028044	106670.4	349968
		81 09 56.6	259 48 26.5	Roman	5.200978	158846.6	521149
		113 27 24.0	292 37 43.2	Peterson	5.011607	102708.7	336970
North Sister, 1903	44 10 01.464	47 57 31.4	227 20 53.1	Fairview	4.981379	95803.0	314314
	121 46 17.183	79 34 17.3	258 39 03.3	Spencer	5.033231	107952.1	354173
		80 30 32.5	259 08 32.0	Roman	5.204400	160103.2	525272
		112 13 06.1	291 22 55.0	Peterson	5.011964	102793.1	337247
Nebo, 1903[1]	44 09 27.05	356 25 48	176 27 50	Fairview	4.803430	63596.0	208648
	122 42 05.14	58 36 38	238 20 13	Spencer	4.567857	36970.6	121294
Herman Peak, wooded summit, 1903.[1]	44 07 29.14	220 51 52	41 11 10	Mary	4.748023	55978.7	183657
	124 00 43.71	316 51 55	137 03 22	Roman	4.508753	32266.6	105861
Prairie Peak, west tree, 1903.	44 16 42.307	14 21 17.1	194 15 52.7	Roman	4.622824	41958.9	137660
	123 36 28.771	190 06 28.8	10 08 50.8	Mary	4.407496	25556.2	83846
		308 24 09.5	128 45 35.9	Spencer	4.720497	52540.8	172378

[1] Checked by vertical angles only.

Geographic positions—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance. Log (meters).	Meters.	Feet.
Supplementary points—Continued.	° ′ ″	° ′ ″	° ′ ″				
Alsea Peak, partly cleared wooded summit, 1904.	44 25 27.821	227 11 02.2	47 16 08.3	Mary	4.119275	13160.6	43178
	123 40 22.746	260 03 23.6	80 33 01.0	Peterson	4.755084	56896.3	186667
		5 12 21.3	185 09 39.5	Roman	4.756721	57111.2	187372
Cannibal Peak highest wooded summit 1903[1].	44 28 33.48	261 49 41	82 01 38	Mary	4.358638	22836.9	74924
	123 50 09.03	352 48 28	172 52 35	Roman	4.800029	63099.9	207020
Mount Washington, 1903.	44 19 57.346	38 32 25.7	217 58 29.8	Fairview	5.023694	105607.3	346480
	121 50 15.638	69 20 51.5	248 28 18.8	Spencer	5.032546	107781.9	353614
		73 35 56.4	252 16 34.7	Roman	5.201576	159065.5	521867
		98 34 49.1	277 22 50.5	Mary	5.139352	137832.6	452206
		102 47 18.1	281 59 49.4	Peterson	4.964639	92180.5	302429
Hayrick, 1903	44 28 46.040	33 29 07.0	212 55 19.5	Fairview	5.074123	118610.5	389141
	121 50 31.724	61 36 02.5	240 43 36.8	Spencer	5.057844	114246.8	374825
		68 05 14.2	246 45 57.3	Roman	5.215083	164090.3	538353
		91 47 12.2	270 35 19.1	Mary	5.133540	136000.3	446194
Left Nipple, 1903	44 29 49.672	36 09 59.1	215 48 15.8	Spencer	4.848359	70527.6	231389
	122 34 33.718	90 58 23.5	270 17 21.8	Mary	4.889812	77591.1	254563
		92 54 31.7	272 37 01.5	Peterson	4.494486	31223.8	102440
		144 40 08.0	324 16 10.6	Yam	4.887624	77201.2	253284
Lebanon, tall brick chimney, 1903[1].	44 32 58.43	49 46 03	229 43 21	Peterson	3.825683	6694.0	21962
	122 54 14.18	84 42 42	264 15 27	Mary	4.713697	51724.6	169700
Corvalis closed cupola, 1903[1].	44 33 59.92	284 17 14	104 30 04	Peterson	4.398558	25035.6	82138
	123 16 23.92	72 50 39	252 38 56	Mary	4.364754	23160.8	75987
Corvalis open cupola, 1903[1].	44 33 55.89	283 44 22	103 57 28	Peterson	4.406228	25481.7	83601
	123 16 46.16	72 46 27	252 35 00	Mary	4.355167	22655.2	74328
Albany courthouse cupola, 1903[1].	44 38 05.82	321 24 27	141 30 17	Peterson	4.247040	17662.0	57946
	123 06 24.31	67 54 06	247 35 22	Mary	4.581843	38180.6	125264
Forest Peak, tallest trees, 1903.	44 40 22.978	40 55 31.0	220 46 56.5	Mary	4.392952	24714.5	81084
	123 20 52.841	200 27 53.5	20 36 34.5	Yam	4.664792	46215.9	151627
		237 04 37.3	57 31 29.5	Hult	4.776125	59720.7	195934
Round Peak, 1903	44 37 52.709	66 32 19.8	246 16 03.4	Peterson	4.525021	33498.2	109902
	122 34 54.345	80 00 05.7	259 19 15.6	Mary	4.893838	78313.7	256934
		137 24 19.3	317 00 34.8	Yam	4.814898	65297.7	214231
		172 28 37.1	352 21 28.2	Barnes	5.001722	100397.3	329387
Thomas, cairn, 1903.	44 38 10.938	66 11 53.3	245 55 12.3	Peterson	4.536950	34431.0	112962
	122 34 19.315	79 42 15.8	259 01 01.0	Mary	4.898576	79172.8	259753
		136 34 51.0	316 10 41.7	Yam	4.815663	65412.8	214608
Mount Jefferson, 1903.	44 40 29.156	53 50 37.1	232 56 16.5	Spencer	5.109880	128789.4	422537
	121 47 55.280	79 17 59.6	258 28 43.7	Peterson	4.976073	94639.6	310497
		82 53 24.4	261 39 34.1	Mary	5.147584	140470.1	460859
		112 33 05.6	291 36 11.6	Yam	5.059309	114632.8	376091
		141 59 59.6	321 19 33.6	Barnes	5.081770	120717.4	396054
		166 43 20.4	346 31 14.3	Larch	4.991509	98063.9	321731
Monmouth Peak, 1903.	44 47 51.810	226 50 08.6	47 07 03.9	Yam	4.634728	43124.9	141486
	123 32 31.994	254 01 14.1	74 36 21.4	Hult	4.833036	68082.6	223368
		1 18 42.3	181 18 18.6	Mary	4.512641	32556.7	106813
Salem Capitol, dome, 1903[1].	44 56 19.47	146 50 53	326 46 02	Yam	4.215764	16434.8	53920
	123 01 43.50	263 37 32	83 50 56	Hult	4.399597	25095.6	82334
Chemawa tank, 1903.[1]	45 00 11.41	119 19 23	299 13 03	Yam	4.129850	13485.0	44242
	122 59 36.91	281 11 15	101 23 10	Hult	4.354021	22595.5	74132
Table Rock, cairn, 1903.	44 58 14.226	62 41 39.8	241 49 11.6	Mary	5.046064	111189.6	364795
	122 18 33.078	88 41 38.0	268 24 31.6	Hult	4.502985	31840.9	104465
		99 07 35.3	278 32 12.5	Yam	4.822846	66503.7	218188
		150 54 46.0	330 35 59.0	Barnes	4.850287	70841.4	232419
Arquett, cairn, 1903.	45 04 19.542	71 29 32.7	251 10 17.5	Hult	4.576875	37746.4	123840
	122 15 32.310	89 23 06.6	238 48 33.9	Yam	4.842732	69319.7	228411
		142 51 42.3	322 30 45.8	Barnes	4.803044	63539.5	208463

[1] Checked by vertical angles only.

Geographic positions—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
Supplementary points—Continued.	° ′ ″	° ′ ″	° ′ ″				
White church spire, west of Brooks, 1903.[1]	45 07 25.83 122 56 30.05	314 34 45 66 46 53	134 44 28 246 38 20	Hult Yam	4.404325 4.236586	25370.3 17241.9	83236 56568
Fairdale Peak, 1903.[1]	45 15 09.97 123 14 10.05	307 47 30 340 50 21	128 09 44 160 54 19	Hult Yam	4.718211 4.349885	52265.0 22381.3	171473 73429
Sheridan Peak, highest green tree, 1903.[1]	45 16 53.64 123 26 49.37	301 12 17 315 24 22	121 43 31 135 37 19	Hult Yam	4.830874 4.533082	67744.5 34125.7	222258 111961
Squaw, cairn, 1903	45 13 51.206 122 02 24.710	78 12 49.8 120 51 29.4 173 47 48.4	257 25 55.7 300 21 10.6 353 45 48.7	Yam Barnes Larch	4.948008 4.810210 4.528919	88717.2 64596.7 33800.2	291066 211931 110893
Eagle cairn, 1903 [1]	45 16 25.38 122 04 54.19	118 29 55.3 179 11 18.5	298 01 22.3 359 11 05.1	Barnes Larch	4.773837 4.460062	59406.9 28844.4	194904 94634
Mount Hood, peak, 1903.	45 22 27.122 121 41 48.696	73 33 10.7 102 00 29.2 102 50 31.3 120 13 06.7	252 31 35.7 281 15 27.4 282 07 15.7 299 56 25.9	Yam Barnes Balch Larch	5.074616 4.924867 4.908772 4.547322	118745.2 84113.8 81053.5 35263.2	389583 275963 265923 115693
Fir, 1903	45 31 23.055 122 44 46.238	295 11 01.5 8 09 29.8	115 11 39.9 188 09 23.5	Cem Hill	3.111594 3.128313	1293.0 1343.7	4242 4408
Monument, General Land Survey, 1903.	45 31 11.933 122 44 34.806	23 58 29.5 144 09 14.0	203 58 15.0 324 09 05.8	Hill Fir	3.033393 2.626968	1079.9 423.6	3543 1390
Hill, 1903	45 30 39.970 122 44 55.023	176 26 18.0 240 10 43.2	356 26 14.4 60 11 27.9	Barnes Cem	3.242892 3.195468	1749.4 1568.4	5739 5146
Cem, 1903	45 31 05.230 122 43 52.328	123 20 05.0 198 44 43.5	303 19 16.7 18 45 53.8	Barnes River	3.245153 3.822185	1758.5 6640.3	5769 21786
River, 1903	45 34 28.891 122 42 13.910	285 42 28.7 34 07 13.5	105 48 25.4 214 05 14.9	Rocky Butte Barnes	4.0514797 3.8079902	11258.5 6426.7	36937 21085
Oregonian, 1903	45 31 13.209 122 40 38.967	161 11 03.4 251 11 25.6	341 09 55.6 71 16 14.4	River Rocky Butte	3.8050088 3.9672517	6382.8 9273.7	20941 30425
Portland longitude station, 1887.	45 31 08.82 122 40 39.75						
Portland latitude station, 1887.	45 31 08.83 122 40 39.84	187 56 52	7 56 53	Oregonian	2.13537	136.6	448
Portland bench mark (U. S. G. S.), 1903.	45 31 09.07 122 40 39.77	.....	.....	Oregonian	2.10969	128.7	422
Rocky Butte (Oreg.) 1889.	45 32 49.861 122 33 54.303	81 09 27.93 140 59 23.21 177 15 37.04	261 01 32.80 320 46 20.20 357 14 17.96	Barnes Warren Davis	4.1649670 4.5744937 4.6962679	14620.66 37539.95 49089.84	47967.9 123162.3 163024.1
Harney (Wash.), 1881.	45 37 21.734 122 37 53.538	328 15 53.08 40 59 24.33	148 18 43.96 220 54 19.74	Rocky Butte Barnes	3.9941643 4.1495337	9866.53 14110.22	32370.4 46293.3
Balch (Oreg.), 1881	45 31 54.574 122 42 30.763	80 15 16.28 210 43 44.61 261 17 15.30	260 13 29.77 30 47 02.60 81 23 23.91	Barnes Harney Rocky Butte	3.5167584 4.0701684 4.0543981	3286.69 11753.53 11334.39	10783.1 38561.4 37186.2
Vancouver Barracks flagstaff west, 1903.[2]	45 37 37.91 122 39 36.04	282 39 59.2 32 13 36.7	102 41 12.5 212 09 45.3	Harney Barnes	3.357196 4.120055	2276.1 13184.2	7468 43255
Warren schoolhouse cupola, 1903.[2]	45 48 47.53 122 51 13.32	345 42 09.3 69 43 50.8	165 47 36.3 249 43 11.1	Barnes Warren	4.516405 3.105229	32840.1 1274.2	107743 4180
Mitchell, 1903 [1]	46 01 53.00 122 11 31.94	37 55 27 65 03 29	217 31 27 244 34 18	Barnes Warren	4.850660 4.763619	70902.3 58025.5	232619 190372
Mount Adams, 1903	46 12 12.133 121 29 24.899	32 05 53.1 52 09 53.4 52 54 14.0 152 03 49.2	211 40 11.3 231 17 41.3 231 59 59.1 331 44 15.5	Larch Balch Barnes Bel	4.943096 5.080990 5.091261 4.864850	87719.5 120500.8 123384.6 73257.2	287793 395343 404804 240345

[1] Checked by vertical angles only.

[2] No check on this position.

Geographic positions—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
Supplementary points—Continued.	° ′ ″	° ′ ″	° ′ ″				
Mount St. Helens, 1903.	46 11 53.028	353 45 05.3	173 49 32.9	Larch	4.871174	74331.7	243870
	122 11 25.864	30 24 56.9	210 00 51.4	Barnes	4.936196	86336.8	283257
		161 21 14.0	341 09 50.7	Hal	4.796451	62582.2	205322
		196 21 43.7	16 32 38.5	Bel	4.832490	67997.0	223087
Min, 1906	46 18 55.031	36 54 48.26	216 54 40.53	Len	2.5805528	380.7	1249
	122 07 49.822	195 35 51.98	15 44 10.73	Bel	4.7339685	54196.2	177809
Deschutes Peak, 1905.	46 39 25.252	141 03 59.3	321 00 10.8	Hal	4.025608	10607.4	34801
	122 21 54.262	166 44 01.2	346 37 33.9	Hurst	4.688278	48784.1	160052
		246 15 51.1	66 34 26.0	Bel	4.550058	35486.1	116424
Mineral Peak, 1905[1]	46 38 56.26	150 54 20	330 38 47	Hurst	4.743674	55420.9	181827
	122 09 27.44	227 45 19	47 54 50	Bel	4.351832	22481.8	73759
High Rock, 1905	46 41 05.848	97 08 52.2	276 44 46.4	Hal	4.628450	42506.0	139455
	121 54 01.859	133 47 15.3	313 20 27.1	Hurst	4.808714	64374.5	211202
		164 54 33.5	344 52 50.9	Bel	4.060194	11486.7	37686
Goat Mountain, 1905[2]	46 46 23.95	83 54 44	263 30 26	Hal	4.630698	42726.6	140179
	121 53 47.26	111 01 08	290 59 15	Bel	3.548435	3535.4	11599
Mount Rainier, high peak, 1905.	46 51 09.215	75 59 36.2	255 29 12.0	Hal	4.738514	54766.4	179679
	121 45 25.562	114 23 27.3	293 50 19.5	Hurst	4.799232	62984.3	206641
Mount Rainier, bare summit, 1905.	46 51 11.106	75 48 48.0	255 18 39.5	Hal	4.735119	54339.9	178280
	121 45 47.001	114 30 34.9	293 57 42.7	Hurst	4.796203	62546.5	205205
Sharp peak, 1905	47 01 04.392	8 27 57.5	188 25 44.7	Bel	4.418390	26205.4	85976
	121 53 20.964	53 37 01.4	233 12 21.8	Hal	4.728080	53466.3	175414
		99 03 14.7	278 35 52.2	Hurst	4.680627	47932.2	157258
Tacoma City Hall, 1905.	47 15 28.463	177 53 26.9	357 53 20.8	Dron	3.672844	4708.1	15446
	122 26 20.264	187 00 33.5	7 00 52.6	Gull	3.651667	4484.0	14711
		257 03 27.6	77 05 53.5	Bos	3.631972	4285.2	14059
		326 42 26.2	146 43 27.2	Kin	3.502740	3182.3	10441
Tacoma courthouse, 1905.	47 15 12.780	122 44 24.8	302 42 41.3	Wash	3.546524	3519.8	11548
	122 26 43.527	191 51 19.7	11 51 55.9	Gull	3.702643	5042.5	16544
		314 12 45.2	134 14 03.3	Kin	3.494135	3119.9	10236
Smelter stack, 300 feet high, 1905.	47 17 51.813	196 41 00.6	16 41 40.6	Neill 2	3.509017	3972.1	13032
	122 30 23.274	247 07 19.4	67 10 45.5	Dash	3.805562	6390.9	20967
		331 07 48.6	151 08 46.6	Wash	3.535934	3435.1	11270
Brown Point Lighthouse, 1906.	47 18 23.031	38 04 48.2	218 02 59.4	Wash	3.702914	5045.6	16554
	122 26 36.330	128 05 49.9	308 03 43.0	Neill 2	3.603308	4005.8	15111
		169 04 31.7	349 04 03.4	Piner 2	3.630626	4271.9	14015
Dash, 1857	47 19 12.171	37 39 18.36	217 36 50.30	Wash	3.8408923	6932.54	22744.5
	122 25 42.896	105 35 50.58	285 33 04.37	Neill 2	3.6926708	4928.00	16167.9
Piner 2, 1905	47 20 38.852	324 10 34.26	144 11 41.91	Dash	3.5186600	3301.11	10830.4
	122 27 14.898	15 44 13.69	195 42 53.22	Wash	3.9286282	8484.54	27836.4
		64 19 31.98	244 17 53.39	Neill 2	3.4945984	3123.19	10246.7
Robinson 2, 1867	47 23.11.720	28 27 36.29	208 25 15.86	Dash	3.9249652	8413.28	27602.6
	122 22 31.984	51 32 05.89	231 28 37.75	Piner 2	3.8799391	7584.71	24884.2

[1] No check on this position.

[2] Checked by vertical angles only.

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, and of which the elevations are subject to a probable error varying from ±0.15 to ±0.3 meter; second, the stations in the main scheme fixed by reciprocal measures of vertical angles and which are subject to probable errors varying from ±0.2 to ±1.1 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 whose elevations are subject to probable errors which may be as great as ±3 meters in some cases.

The accuracy with which each elevation in the main scheme is determined depends mainly upon the remoteness of that station from the nearest one of which the elevation is fixed by spirit leveling, as indicated in class 1 of the following table. Station Snow Mountain west is probably least accurately determined of all the stations in the main scheme.

Table of elevations.

THIRTY-NINTH PARALLEL TO WILLAMETTE BASE.

Station.	Point to which elevation refers.	Elevation.		Station.	Point to which elevation refers.	Elevation.	
Class 1.		*Meters.*	*Feet.*	*Class 2*—Contd.		*Meters.*	*Feet.*
Redding astronomic station.	Station mark	202.16	663.3	Roman	Station mark	872.3	2862
Gazelle astronomic station.	do	848.28	2783.1	Spencer	do	626.2	2054
Central Point astronomic station.	do	369.92	1213.6	Mary	do	1248.8	4097
Roseburg latitude station.	do	165.24	542.1	Peterson	do	437.2	1434
Willamette north base.	do	101.36	332.5	Twin	do	389.8	1279
Willamette south base.	do	116.59	382.5	Ridge	do	361.0	1184
Class 2.				Rauch	do	202.2	663
Mount Helena	do	1322.1	4338	*Class 3.*			
Snow Mountain, west.	Top of pier	2145.7	7040	Lassen Peak	Top	3189.9	10466
Snow Mountain, east.	Station mark	2150.6	7056	Mount Linn	do	2463.8	8083
Marysville Butte	do	638.0	2093	Mount St. John	do	2057.6	6751
Kent	do	2032.9	6670	Bully Choop	do	2126.8	6978
Lyons	do	2031.4	6665	Crater Peak	do	2646.5	8683
Bally	do	1892.4	6209	Saw Tooth	Summit	2717.4	8915
Round	do	1043.4	3423	Thompson Peak	Top	2555.0	8383
Spur	do	2766.9	9078	Russian Peak, north point.	Highest summit.	2494.3	8183
Bolivar	do	2451.5	8043	Pilot Rock	Summit	1803.9	5918
Mears	do	2174.1	7133	China Mountain	do	2606.2	8551
Sterling	do	2239.3	7347	Ashland Peak	do	2296.7	7535
Soda	do	1857.4	6094	Marble Mountain	do	2533.3	8311
Onion	do	1597.1	5240	Mount Eddy	do	2754.8	9038
Rust	do	1891.2	6205	Mount Shasta	Top of peak	4316.3	14161
White	do	1222.7	4011	Goose Nest	Tree-top	2398.5	7869
Black	do	1874.1	6149	Redding Courthouse.	Tangent to roof.	198.2	650
Scott	do	1294.6	4247	Little Shasta	Top of peak	2532.9	8310
Burg	do	608.7	1997	Black Butte	Top of cairn	1933.8	6344
Rose	do	453.3	1487	Preston Peak	Top of peak	2232.2	7323
Fairview	do	1806.3	5926	Greyback	do	2149.5	7052
Yellow	do	746.3	2448	Siskiyou	do	2178.4	7147
				Wagner	Highest summit.	2211.4	7255
				Kerby	Top	1689.5	5543
				Mount Pitt	Summit	2893.6	9493
				Lost Peak	Top	2446.2	8026

THIRTY-NINTH PARALLEL TO WILLAMETTE BASE—Continued.

Station.	Point to which elevation refers.	Elevation.		Station.	Point to which elevation refers.	Elevation.	
Class 3—Contd.		*Meters.*	*Feet.*	*Class 3*—Contd.		*Meters.*	*Feet.*
Aspen Peak	Top	2502.0	8209	Prairie Peak	Top of peak	1047.6	3437
Mount Scott	Top of peak	2717.7	8916	Alsea Peak	do	1100.8	3612
Liao Rock	Top	2484.0	8150	Cannibal Peak	do	869.4	2852
High Rock (Oreg.)	do	1893.8	6213	Herman Peak	do	634.7	2082
Union Peak	do	2347.9	7703	Seavies (U.S.G.S.)	do	607.3	1992
				Mount Jefferson	do	3207.2	10522
Old Bailey	do	2548.3	8361	Left Nipple	do	1243.4	4079
Dodson (U. S. G. S.)	Top of peak	984.5	3230				
Diamond Peak	do	2679.7	8792	Corvallis closed cupola.	Bottom of cupola, top of roof.	96.3	316
Quartz	do	1686.4	5533				
Mount Washington	do	2368.0	7769	Corvallis open cupola.	do	98.2	322
Mount Zion	Top of peak	1406.4	4614	Albany courthouse.	Base, large cupola.	88.1	289
North Sister	do	3068.4	10067				
Hayrick	do	2375.2	7793	Lebanon	Top of tall brick chimney.	135.3	444
Middle Sister	do	3059.6	10038				
Nebo	do	1037.4	3404				
South Sister	do	3155.2	10352	Salem, Capitol	Top, large part of dome.	100.4	329
Ball Butte	do	2756.6	9044				
St. Mary Butte	do	2789.6	9152				

WILLAMETTE BASE NET TO TACOMA BASE.

Class 1.				*Class 3.*			
Oregonian	Top of tower.	69.22	227.1	Round Peak	Top of peak.	1312.8	4307
				Thomas	do	1320.5	4332
Class 2.				Forest Peak	do	671.9	2204
Yam	Station mark.	354.4	1163	White church spire.	Top of square part.	72.0	236
Hult	do	383.3	1258				
Barnes	do	383.5	1258	Monmouth Peak	Top of peak.	984.6	3230
Larch	do	1234.9	4052				
Warren	do	38.9	128	Table Rock	do	1487.8	4881
				Arquett, cairn	do	1417.4	4650
Rocky Butte	do	185.3	608	Squaw	do	1455.9	4777
River	do	50.2	165	Chemawa tank	Foot of tank, top of tower.	77.0	253
Harney	do	38.7	127				
Davis	do	900.3	2954	Sheridan Peak	Top of peak.	941.1	3088
Star	do	1328.7	4359				
				Fairdale	do	780.5	2561
Red	do	1517.3	4978	Mount Hood, peak	do	3421.2	11224
Lam	do	1383.1	4538	Mount Adams	do	3757.0	12326
Len	do	1785.6	5858	Mount St. Helens	do	2955.6	9697
Toutle	do	1001.7	3286	Deschutes Peak	do	1318.8	4327
Huck	do	1160.9	3809				
				High Rock (Wash.)	do	1733.5	5687
Hal	do	1107.5	3634	Sharp Peak	do	1769.4	5805
Bel	do	1669.1	5476	Mineral Peak	do	1446.5	4746
Rain	do	538.0	1765	Mount Rainier	Bare summit	4389.5	14401
Pen	do	282.1	926	Mount Rainier	Highest point	4410.7	14471
Cem	do	325.8	1069				
				Goat Mountain	Top of peak.	1847.8	6062
Hill (Oreg.)	do	296.8	974	Mitchell	do	1213.7	3982
Fir	do	345.9	1135	Eagle, cairn	do	1283.0	4209
Monument, General Land Survey.	do	289.7	950				

TACOMA BASE TO PUGET SOUND.

Class 1.				*Class 2*—Contd.			
Tacoma city hall	U. S. G. S. B. M.	33.52	110.0	Tacoma astronomic	Station mark	94.79	311.0
Class 2.				Tacoma north base	do	124.70	409.1
				Burn	do	122.14	400.7
Gull	Station mark.	51.67	169.5	Tacoma south base	do	122.57	402.1
Dron	do	27.59	90.5	Hurst	do	129.20	423.9
Bos	do	2.59	8.5				
Kin	do	102.46	336.2	*Class 3.*			
Wash	do	115.86	380.1				
				Smelter stack	Top of stack.	132.7	435
Smelt	do	96.14	315.4	Brown Point Lighthouse.	Top of light shaft.	8.5	28
Neill 2	do	4.02	13.2				
Dash	do	2.38	7.8	Tacoma courthouse	Top of cupola	153.1	502
Piner 2	do	12.24	40.2				

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 the descriptions are reckoned continuously from true south around by west to 360°, south being 0°, west 90°, north 180°, and east 270°. Where magnetic azimuths are given they are indicated as such. The distance between the station and reference mark is measured horizontally unless otherwise stated in the description.

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

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

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

MARKING OF STATIONS.

The old type of station mark referred to in the following notes and descriptions consists of a disk and shank made of brass and cast in one piece. The disk is about 85 mm. in diameter and has a polished center surrounded by the raised letters "U. S. C. & G. S." and a raised flange around the edge. The shank is 25 mm. in diameter and 75 mm. 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 so hold the mark securely in place.

GENERAL NOTES IN REGARD TO STATION MARKS.

Note 1.—A three-eighths-inch copper bolt 3 inches long is cemented into a drill hole in the rock, and directly above the bolt in the same drill hole is cemented an old-type station mark, described in the preceding paragraph. A cross in the top of the copper bolt and another in the polished center of the disk mark the station.

Note 2.—This marking is similar to that described in note 1, except that the copper bolt and the disk are in separate bowlders and the bowlder containing the bolt is at some distance beneath the surface. The cross on the disk is directly above the one on the bolt. The dimensions of the bowlders are given in the description of the station.

Note 3.—The station is marked by an old-type station mark, described above, cemented into a drill hole in the rock. No underground mark was used.

REFERENCE MARK.

Note 4.—This mark is a drill or punch hole in the top of a three-eighths-inch copper bolt 3 inches long, which is leaded or cemented into a drill hole in a rock with the top of the bolt flush with the surface.

PRINCIPAL POINTS.

Mount Helena (Napa County, Calif., W. Eimbeck, 1876; 1908).—On the summit of Mount Helena, about 12 miles to the northward of Calistoga. The

station was originally marked by a fine drill hole and cross in the top of a one-half-inch copper bolt 5 inches long, which was cemented in a drill hole in bedrock, and by a brick pier 3 bricks square and 43 inches high, built over the bolt. When visited in 1908 it was found that the pier had been dynamited. Other instrument piers are at the following distances and directions from the station: Collimator pier, 2 bricks square and 61 inches high, 2.27 meters northwest; transit pier, 2 by 3 bricks and 39 inches high, 17.04 meters southwest; latitude pier, 2 by 2½ bricks and 36 inches high, 17.74 meters southwest of the station, and 1.68 meters east of the transit pier; vertical angle pier, 2 bricks square and 44 inches high, 33.31 meters southwest of the station and 16.92 meters a little south of east of the latitude pier. A boundary mark between Lake and Napa Counties, a large drill hole in a basaltic rock, is 2.18 meters northwest of the station.

Marysville Butte (Sutter County, Calif., W. Eimbeck, 1876; 1904).—About 15 miles west of Marysville on the southeastern summit of the south butte of the Marysville Buttes, about 6 meters northeast of the highest part of the summit, and near the steep cliff on the north side. The station is marked by an old-type station mark, described on page 23, set in a drill hole in a small rock embedded in the concrete that fills a depression in the solid rock. Below the concrete and directly under the station mark is a three-eighths-inch copper bolt 3 inches long set in a drill hole in the solid rock. Three reference marks, each of which is a three-eighths-inch copper bolt 3 inches long set in a drill hole in the rock, are at the following distances and azimuths from the station: 2.470 meters, 246° 48′; 2.635 meters, 5° 06′; and 2.915 meters, 103° 07′.

Snow Mountain west (Glenn and Lake Counties, Calif., E. F. Dickens, 1892; 1904).—On the highest point of the southwest summit of Snow Mountain. The summit is about 300 meters long in a northwest and southeast direction and about 50 meters wide at the station and is covered with small broken stones. There are a few scrub pines just below the pitch of the ridge about 100 meters southeast of the station. The station is marked by a one-half-inch brass bolt 3 inches long in a drill hole in the solid outcropping rock, and by a concrete pier 12 inches square and 44 inches high having embedded in its top a brass bolt directly above the one in the solid rock.

Snow Mountain east (Glenn County, Calif., W. Eimbeck, 1876; 1904).—On the northernmost rock-croppings at the edge of the summit of the eastern peak of Snow Mountain, about 5 miles south of Mount St. John and near the corner of Lake, Colusa, and Glenn Counties. The station is marked by a half inch copper bolt cemented in a drill hole in a hollow at about the middle of the highest point of rocks, with the top of the bolt about a half inch above the surface and marked by a cross. The reference marks are all drill holes in rocks, the first being distant 5.16 meters in azimuth 59° 57′, the second 3.33 meters in azimuth 165° 39′, and the third 6.89 meters in azimuth 248° 38′.

Kent (Tehama County, Calif., O. B. French, 1904.)—On a high ridge about 8 or 10 miles east by south from Mount Linn and about 18 miles by road in a northwesterly direction from Paskenta, on a peak locally known as Bald Rock, on a ledge on the east side of the summit and about 8 or 9 feet lower than its highest part. Four or five hundred feet to the westward of the station and about 50 or 60 feet lower is a large, prominent, rocky knob. The station is marked according to note 1. The reference marks are described in note 4. The first one is in a large rock distant 5.01 meters in azimuth 212° 40′, the second in a flat ledge distant 70.19 meters in azimuth 285° 50′, and the third on the largest part of the ledge distant 47.72 meters in azimuth 5° 17′.

Lyons (Tehama County, Calif., O. B. French, 1904).—About 5 miles east of Lyonsville post office on a ridge known locally as Bald Hill, about 300 yards from the summit of the ridge on the shoulder extending toward Lyonsville and in the middle of a large group of bowlders. A lone fir tree stands about 50 meters south by east from the station. The station is marked according to note 1. Two reference marks described in note 4, are in large rocks and at the following distances and azimuths from the station: 29.69 meters, 126° 59′; and 20.22 meters, 332° 22′.

Bally (Shasta County, Calif., O. B. French, 1904; 1920).—On the northernmost of the two main peaks on the summit of Bally Mountain, a prominent and well-known mountain about 15 miles by road west of Redding. The station mark, described in note 1, is in the top of a rock on the north side of the most prominent group of rocks on the peak and 5 or 6 feet below the top of the

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group. Two reference marks, described in note 4, are at the following distances and azimuths from the station; 4.29 meters, 247° 07′; and 10.62 meters, 154° 49′.

Round (Shasta County, Calif., O. B. French, 1904; 1919).—On the highest part of what is known as Round Mountain just north of the post office of the same name. The station mark, described in note 1, is in a large bowlder which projects about 6 inches out of the ground. Two reference marks, described in note 4, are at the following distances and azimuths from the station: 28.72 meters, 345° 30′; and 6.43 meters, 57° 13′. The south reference mark is in the most eastern rock of a prominent group of rocks near the south end of the summit.

Spur (Siskiyou County, Calif., O. B. French, 1904; 1919).—On the west slope of Mount Shasta at an elevation of about 9,100 feet, in a position best identified by approaching the summit from Igema, by the road leading through Kite Canyon. In ascending this route several prominent peaks are discerned ahead and from the right-hand one a narrow shoulder extends in a westerly direction, or toward Black Butte. The station is about 50 meters below an abrupt change of slope of the ridge of this shoulder, and about 1 mile from the peak mentioned above. The station mark, described in note 1, is in the top of a large rock flush with the ground. Two reference marks, described in note 4, are at the following distances and azimuths from the station: 13.77 meters, 165° 53′; and 8.10 meters, 228° 47′.

Mears (Shasta County, Calif., O. B. French, 1904; 1920).—About 4 or 5 miles west by south from Castella and about southwest from Castle Crags, on the southern summit of the highest rocky peaks in the region known locally as Gray Rocks. The station is about 20 feet below the highest part of the peak and near the bluff on the south and east sides, with a ledge 3 or 4 feet higher about 10 feet distant toward the southeast. The peak was approached from the south and the 30-foot bluff near the station surmounted by means of ladders. The station is marked according to note 1. Two reference marks, described in note 4, are located as follows: The first in a bowlder near the trail to the station, and distant 7.92 meters in azimuth 70° 50′; and the second, on a low bowlder east of a high pointed rock, and distant 17.77 meters in azimuth 143° 03′.

Boliver (Siskiyou County, Calif., O. B. French, 1904; 1920).—On the north side of a large group of bowlders about 60 yards northeast of the highest part of the summit of Mount Scott, known locally as Old Craggy or Boliver, which is the high peak about 5 miles in a southerly direction from Callahan. The station is marked according to note 1. Two reference marks, described in note 4, are at the following distances and azimuths from the station: 6.57 meters, 272° 41′; and 9.88 meters, 107° 47′.

Soda (Jackson County, Oreg., O. B. French, 1904).—On a peak known locally as Old Baldy, in the Siskiyou Range of mountains, about 20 miles by road and trail southeast of Ashland and 5 miles east by north from Pilot Rock, a prominent peak in the same range. The best approach is from Ashland via Soda Springs and Davis's ranch. The station mark, described in note 1, is in a large rock whose upper surface is flush with the ground. Two reference marks, described in note 4, are in bowlders whose tops are but slightly above ground and at the following distances and azimuths from the station: 12.91 meters, 299° 53′; and 23.95 meters, 35° 36′.

Gazelle astronomic station (Siskiyou County, Calif., O. B. French; 1904; 1908).—About 250 yards north by east from the Gazelle railroad station near the center of the top of a very prominent knoll and about 40 feet northeast of the largest bowlder on the knoll. The station mark, described in note 1, is in a rock below the surface of the ground. Three reference marks, described in note 4, are at the following distances and azimuths from the station: 19.20 meters, 290° 12′; and 6.40 meters, 137° 39′. There is a concrete longitude pier, 7.330 meters east and 0.186 meter north of the station. This pier was recovered in 1919.

Sterling (Jackson County, Oreg., O. B. French, 1904).—In the Siskiyou range of mountains, about 25 miles southwest of Ashland and 2 miles west of Mount Sterling, on the northernmost summit of a ridge just south of the Silver Fork basin and at the western end of the long east-and-west valley which is just north of Mount Sterling. The station is about 80 or 90 meters southeast of the highest point of the summit in the center of a group of small bowlders. The station mark, described in note 1, is in the top of a large rock. Two reference marks, described in note 4, are at the following distances and azimuths from the station: 34.85 meters, 18° 13′; and 20.44 meters, 136° 03′.

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Rust (Jackson County, Oreg., O. B. French, 1904).—On the highest summit of the peaks known locally as the Black Buttes (Rustler on U. S. Geological Survey maps), about 20 miles north of Mount Pitt and 26 miles by road and trail from Big Butte post office via Parker's ranch. The station is marked according to note 1. Two reference marks, described in note 4, are at the following distances and azimuths from the station: 11.995 meters, 264° 33′; and 10.12 meters, 337° 53′.

Onion (Douglas County, Oreg., O. B. French, 1904).—On the highest part of the bare summit of Onion Springs Mountain, about 1 mile south of the Onion Springs, and best reached from Glendale via Galesville and Gilpatrick's ranch. The station mark, described in note 1, is in a rocky ledge. Two reference marks, described in note 4, are located as follows: One in a prominent ledge and 24.62 meters from the station in azimuth 91° 50′, and the other in an inconspicuous, low bowlder at the western edge of the summit and distant 47.22 meters in azimuth 182° 47′.

Black (Douglas County, Oreg., O. B. French, 1904).—Near the northeast corner of the highest part of the summit of Black Rock, a high, prominent, rocky peak about 40 miles in a direct line east of Roseburg and north and northwest of some near-by higher wooded peaks. The station mark, described in note 1, is in the solid rock of the summit. Two reference marks, described in note 4, are also in solid rock and at the following distances and azimuths from the station: 13.78 meters, 4° 55′; and 6.47 meters, 297° 45′.

White (Douglas County, Oreg., O. B. French, 1904).—On the highest part of the summit of White Rock, a prominent peak about 15 miles east of Roseburg. The station mark, described in note 1, is in a large bowlder. A reference mark, described in note 4, is in a large bowlder just east of a prominent ledge and is 34.44 meters from the station, in azimuth 353° 11′.

Scott (Douglas County, Oreg., O. B. French, 1904).—On the highest part of the summit of Mount Scott, about 20 miles northeast of Roseburg. The station mark, described in note 1, is in a large bowlder. Two reference marks, described in note 4, are located as follows: One in a white rock at about the middle of a prominent ledge and 32.71 meters from the station in azimuth 195° 02′; and the other in a rocky ledge near the edge of the brush and 18.17 meters distant in azimuth 305° 42′.

Fairview (Lane County, Oreg., O. B. French, 1904).—On the west side of the summit of Fairview Peak in the Bohemia Mountains, about 25 miles southeast of Cottagegrove and 6 miles by road from Mineral post office. The station mark, described in note 1, is in a bowlder. Three reference marks, described in note 4, are in rock ledges and at the following distances and azimuths from the station: 6.69 meters, 74° 29′; 2.92 meters, 181° 39′; and about 175 feet, 266° 09′.

Yellow (Douglas County, Oreg., O. B. French, 1904).—On the highest summit of the timbered ridge about 10 miles west of Yoncalla. The station is marked according to note 2, the subsurface mark in a bowlder 8 by 12 by 16 inches placed 18 inches beneath the surface, and the surface mark in a bowlder 10 by 20 by 30 inches, the top of which is flush with the surface of the ground. A reference mark, described in note 4, is in a rock ledge and 22.62 meters from the station in azimuth 334° 37′. Two other reference marks, consisting of three-sixteenths inch copper wires 3 inches long set in bowlders, are at the following distances and azimuths from the station: 21.04 meters, 197° 31′; and 20.70 meters, 107° 02′.

Spencer (Lane County, Oreg., O. B. French, 1903).—This station is near a United States Geological Survey station. It is on the south end and highest point of the summit of Spencer Butte, about 4 miles south of Eugene. Two trees used by the Geological Survey are at the north end of the summit, which is in the form of a ridge. The station is marked according to note 1. Two reference marks, described in note 4, are in rocks near the station, one distant 5.338 meters in azimuth 175° 02′, and the other 4.570 meters in azimuth 328° 51′. The Geological Survey station is 7.970 meters from the station in azimuth 176° 12′.

Roman (Douglas County, Oreg., O. B. French, 1903; 1908).—On the most westerly of the two summits of the highest peak of the Coast Range, known as Roman Nose or Saddle Mountain, situated near the north line of Douglas County about 5 miles southwest of the junction of Wild Cat Creek with the Siuslaw River. It is on the highest point of the summit, about 6 feet from the southern edge of the bluff and 20 feet from the steep part of the slope east of the

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station. The peak is bare except for a few low shrubs, and has a steep bluff on the south side and a gentle grassy slope on the north side. The station is marked according to note 2, the subsurface mark in a bowlder 12 by 12 by 24 inches, 18 inches below the surface, set with the axis east and west, and the surface mark in a bowlder measuring about a foot on each side. Two reference marks, described in note 4, are located as follows: One in the nearest outcropping of the solid rock 14.760 meters from the station in azimuth 148° 06′, and the other in a projecting bowlder 6.775 meters from the station in azimuth 205° 33′. Arrows pointing to the reference marks are cut in the rock near each mark. An old burned stump is about 5 feet from the station in azimuth 232°.

Mary (Benton County, Oreg., O. B. French, 1903; 1908).—On the highest point of the grassy summit of Mary Peak, about south-southwest from Corvallis. The station is marked according to note 2, the subsurface mark in a flat stone 4 inches thick and 10 inches in diameter, 22 inches below the surface, and the surface mark in a bowlder 16 by 18 by 30 inches, the top of which is flush with the surface of the ground. Two reference marks, described in note 4, are in bowlders, and at the following distances and azimuths from the station: 13.77 meters, 326° 22′; and 29.36 meters, 58° 11′.

Peterson (Linn County, Oreg., O. B. French, 1903).—About 4 miles southwest of Lebanon on the highest part of the most westerly of the two summits known as Peterson Butte. The station is marked according to note 1. Two reference marks, described in note 4, are located as follows: One in the lower part of the northerly sloping face of the largest rock on the south side of the summit, and 4.645 meters from the station in azimuth 7° 30′; and the other in the ledge just east of the largest rock on the north side of the summit, and 3.270 meters distant in azimuth 185° 00′.

Twin (Linn County, Oreg., O. B. French, 1905).—On the farm of Mr. Gentry near the southwest corner of sec. 24, T. 14, R. 3 W., about 6 or 7 miles from Rowland. It is on the highest summit of a partly wooded ridge, the south slope being bare and the north slope wooded, and about 8 or 10 meters southeast of the highest point of the summit. The station is marked according to note 2, the underground mark in a stone about 2 feet below the surface and the surface mark in a large stone about 6 inches below the surface. Three reference marks, described in note 4, are at the following distances and azimuths from the station: 6.66 meters, 314° 42′; 6.39 meters, 53° 57′; and 6.87 meters, 155° 44′. The last-mentioned reference mark is near the highest point of the summit.

Ridge (Lane County, Oreg., O. B. French, 1905).—On the highest part of a ridge on land owned by Mr. J. J. Winn, about 1½ miles north of his residence, and about 10 miles by road in a northwesterly direction from Junction City. The station is marked according to note 2, with the subsurface mark 1.5 feet below the surface. Three reference marks, described in note 4, are in inconspicuous bowlders flush with the surface of the ground, and at the following distances and azimuths from the station: 4.86 meters, 164° 32′; 30.69 meters, 278° 43′; and 9.73 meters, 356° 15′. A triangular blaze in a large maple tree is 11.63 meters from the station in azimuth 92° 16′, and a similar blaze in a large fir tree is 8.45 meters distant in azimuth 213° 33′.

Rauch (Lane County, Oreg., O. B. French, 1903).—About 12 miles west by south from Eugene, 2½ miles southwest of Llewellyn post office and about one-half mile west of the road leading from Llewellyn to Crow post office, on land belonging to Mrs. Frances Rauch. It is about 150 meters east of the summit on the north side of a sloping ridge about 300 feet higher than the valley through which the road runs, the first prominent ridge encountered in going from Llewellyn to Crow and the only ridge in the vicinity from which *Willamette south base* can be seen. The station is about 200 feet west of a point where the ridge becomes steeper. The station was marked according to note 2, the underground mark in a small, flat stone 2 feet below the surface and the surface mark in a rock about 12 by 12 by 18 inches flush with the surface. Two reference marks, described in note 4, are located as follows: One in a rock 10 by 10 by 18 inches on the highest part of the ridge and 11.96 meters from the station in azimuth 286° 02′, and the other in a rock 6 by 8 by 14 inches distant 12.22 meters in azimuth 51° 46′.

Willamette south base (Lane County, Oreg., O. B. French, 1903; 1908).—About 5 miles from Eugene and 220 meters south of the Eugene-Elmira road on land belonging to William Nelson. It is about 100 meters north of a large

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gravel pit, 78 meters from the line fence between William Nelson and M. Nelson, and about in line with the west face of the barn belonging to William Nelson which is 86.79 meters north of the station. The station is marked with old-type station mark described on page 23, placed in the center of a 6-inch drain tile and both embedded in a pillar of concrete 2 feet long, 36 inches in diameter at the base, 18 inches in diameter at the top, and set in the ground so that the tops of the pillar and tile and station mark are all flush with the surface of the ground. Six inches below the foot of this pillar a cross in the top of a ½-inch copper bolt, embedded in a block of concrete 10 by 24 by 24 inches, forms the subsurface mark. In 1906 a concrete pillar 2½ feet high, 18 inches square at the base and 12 inches square at the top, with the letters "U.S.C.S." on the south side, was set over the surface mark. The first reference mark is a ½-inch copper bolt in a concrete block 12 by 12 by 18 inches, the top of which is flush with the ground, with a similar block and bolt directly beneath it as subsurface mark, distant 212.29 meters from the station in azimuth 177° 32′ 02″. The second mark, similar to the first, is at the junction of the road fence and that dividing the farms of William Nelson and M. Nelson, and 225.16 meters from the station in azimuth 200° 19′ 30″. The third reference mark, similar to the preceding two but with no subsurface mark, is in the line of the boundary fence 78.38 meters from the station in azimuth 265° 16′ 42″. The fourth mark is a ½-inch copper bolt leaded into a drill hole in a large stone in the southwest corner of the foundation of the main part of William Nelson's barn, and is 86.79 meters from the station in azimuth 181° 30′ 16″.

Willamette north base (Lane County, Oreg., O. B. French, 1905; 1908).—One and one-half miles south and one-half mile west of Junction City in the east center of sec. 7, T. 16, R. 4 W., on land owned by Mr. William M. Pittney of Junction City. It is in the northeast corner of a field on the south side of the main east-and-west road, about 71 yards from the north-and-south fence to the east and 4 or 5 yards from the fence on the south side of the road, and almost opposite the main gate which leads into the barnyard corral of the farm across the road. The subsurface station mark is a three-eighths inch copper bolt 6 inches long, set in a block of concrete 3½ by 4 feet and 10 inches deep, placed 3 feet below the surface. The surface mark is an old-type station mark described on page 23, set in the top of a concrete pier 3½ feet square at the base, 1½ feet square at the top, and 2 feet 5 inches deep, the top of which is flush with the surface of the ground. Surrounding the station mark and embedded in the concrete is an 8-inch drain tile 1 foot long with its rim about flush with the top of the pier. Each of the three reference marks consists of two three-eighths inch copper bolts, 3 inches long, each set in the top of a concrete post 1 foot square, the subsurface post being 9 inches long and 2½ to 3 feet below the surface, and the surface mark about 2 feet long, with its top 4 inches below the surface. The first reference mark is 6 inches south of the fence on the south side of the road and about in the prolongation of the fence line on the west side of the corral mentioned above, and is 32.058 meters from the station in azimuth 97° 10′. The second mark is in the corral across the road, about 10 inches from the road fence and 6 or 8 feet east of the east end of the main road gate, and is 19.876 meters from the station in azimuth 186° 24′. The third mark is on the south side of the main road, 12 or 15 feet from the road fence, and 6 inches west of the north-and-south fence, at a distance from the station of 65.076 meters in azimuth 271° 26′.

Seavies 2 (Lane County, Oreg., W. H. Burger, 1908).—In the same locality as *Seavies* (*U. S. G. S.*). (See p. 35.) It is on the south slope of the peak near the lower edge of the first timber from the top and almost in line with *Spencer* (see p. 26) and the tangent line to the west bank of the McKensie River at the big curve in the flat below the station. The station is marked by a drill hole in the rock and by piles of rock around the tripod erected at the station.

Pisgah (Lane County, Oreg., W. H. Burger, 1908).—Located north and east from Goshen on a hill known as Mount Pisgah, about 200 feet southwest, or toward Spencer Butte, from the highest point of the hill. The station is on top of a rock about 4 by 6 feet in area, projecting 16 inches above the ground, the largest one of a cluster of rocks, and, with the exception of a large rock on the west slope about 175 feet to the north, the largest rock in the vicinity. Station is marked by a one-half inch drill hole 1¼ inches deep, 6 inches from the west edge of the rock and 23 inches from its south point.

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Eugene astronomic station (Lane County, Oreg., O. B. French, 1904: 1908).—This station is identical with the United States Geological Survey station. It is on the east end of Skinners Butte, near Eugene, Oreg., just above the reservoir and north of the railroad station, on the site of the old observatory of Oregon State University. It was learned in 1908 that the land was to be converted into a park and that the station would be demolished, so two marble reference stones, projecting 2 inches above the surface and bearing on the top the letters "U. S.," with a cross between, were set to preserve the station. The first, 5 by 5 by 18 inches, is 18.294 meters from the station in azimuth 119° 59′, and the second, 4 by 7 by 14 inches in size, is on the south brow of the hill 12.211 meters from the station in azimuth 52° 47′. A large concrete "O" on the brow of the hill overlooking the railroad station is in azimuth 2° from the station. The distance between the two reference marks is 17.625 meters, and from the first reference mark the Patterson School spire is in azimuth 315° 28′, and the spire of the Humphrey Memorial Methodist Church is in azimuth 353° 53′.

Yam (Polk County, Oreg., O. B. French, 1903; 1908).—On the highest point of the highest of a group of hills about 12 miles northwest of Salem, and about 10 meters south of a wire fence which passes over the summit. A slightly lower wooded hill is about a half mile northwest of the station and a group of hills is about halfway between the station and Salem. The station is marked according to note 2, the surface mark in a bowlder 15 by 18 by 18 inches with its top flush with the surface of the ground, and the subsurface mark in a bowlder 8 by 16 by 16 inches and 23 inches below the surface mark. Two reference marks, described in note 4, are in bowlders about 14 by 18 by 18 inches with their tops flush with the surface of the ground, and with a few loose stones piled about them for identification. One is in the line of the wire fence, 11.06 meters from the station in azimuth 197° 10′, and the other 8.59 meters from the station in azimuth 329° 07′.

Hult (Marion County, Oreg., O. B. French, 1903).—On a prominent bare hill about 6 miles by road and 4 miles in a straight line southeast of Silverton, just south of the road from Silverton to Hult post office and on the farm of Al Porter. It is on the northeast side of the hill and slightly lower than the summit, 17 feet from a line fence on the west, and 8 feet from another fence on the south. The surface and underground marks at this station are crosses cut in the tops of one-half inch copper bolts embedded in bowlders, the underground mark being in a bowlder about 12 by 14 by 14 inches, with its top 1.9 feet below the surface mark, which is in a bowlder about 14 by 18 by 24 inches, with its axis north and south. Two reference marks, described in note 4, are located as follows: One in a bowlder about 14 by 16 by 16 inches, set in the fence line 5.79 meters from the station in azimuth 108° 55′, and the other in a bowlder about 14 by 16 by 24 inches, set in the fence line 7.125 meters from the station

Barnes (Multnomah County, Oreg., O. B. French, 1903).—On a cleared hill in azimuth 304° 40′.
about 4 miles west of Portland, between the Barnes and Cornell roads, and just east of the highest hill in this range, which hill is still densely wooded. It is on the south edge of the hill about 100 feet southeast of a fir tree and some small maple trees, and close to the north side of a large stump. The station is marked according to note 2, the surface mark in a stone 8 by 14 by 18 inches with its top flush with the surface of the ground, and the subsurface mark in a stone 6 by 12 by 18 inches 1¼ feet below the surface mark. Two reference marks, described in note 4, and set at the roots of stumps on the sides facing the station are located as follows: One in a bowlder 15 inches in diameter, distant 15.80 meters from the station in azimuth 156° 11′; and the other in a bowlder 12 inches in diameter 7.02 meters from the station in azimuth 233° 23′. A third reference mark consists of a cross in the top of a bowlder 10 inches in diameter buried 15 inches beneath the surface and of a copper bolt directly above the cross in a bowlder 14 by 14 by 18 inches set with its top flush with the surface of the ground. It is about 3 feet north of the main east-and-west fence line, about 30 feet east of where this fence crosses the highest part of the ridge, about 3 feet east of a fence extending northward from this fence and 44.95 meters from the station in azimuth 184° 35′.

Larch (Multnomah County, Oreg., O. B. French, 1903; 1916).—Southeast of Bridal Veil, a town on the Columbia River, on the highest peak of Larch Mountain and on the west point of a small rock ledge which is on the north end of a spur from the main summit. The ledge is about 20 feet higher than

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the spur of which it forms the end, and descends abruptly on the north in a cliff about 100 feet high. It can be reached either from Bridal Veil or Latourell via Donahue's logging camp. The station is marked according to note 1. Two reference marks, described in note 4, are in the east summit of the ledge, one in rather a low place 10.89 meters from the station in azimuth 298° 51′, and the other near the east end of the summit 15.01 meters from the station in azimuth 287° 02′.

Star (Clark County, Wash., J. S. Hill, 1906; 1916).—On the most southerly of the two summits of Silver Star Mountain, on the line between Clark and Skamania Counties, about 35 miles northeast of Vancouver. The station was marked according to note 3. Two reference marks, described in note 4 are at the following distances and azimuths from the station: 5.910 meters, 305° 43′; and 5.160 meters, 26° 11′.

Davis (Cowlitz County, Wash., J. S. Hill, 1906).—About 14 miles northeast of Woodland on the highest point of a hill on a north-and-south ridge which may be reached from Woodland by following the road up the Lewis River to the Fisher place and packing from there. The station is marked according to note 3. Two reference marks, described in note 4, are at the following distances and azimuths from the station: 5.61 meters, 15° 02′; and 5.37 meters, 96° 51′.

Red (Skamania County, Wash., J. S. Hill, 1906).—On the highest point of a bald, red hill near the sources of the Little White Salmon and Lewis Rivers and not far from Klickitat Pass. It is best reached from White Salmon on the Columbia River via Guler post office, Ice Cave, Peterson's prairie, Goose Lake, Steamboat Lake, and the Indian race track, being about 1 mile southwest from the last place and 1½ miles west of Steamboat Lake. There is a Forest Service lookout station with its south wall about 2 meters north of the station mark. The station is marked according to note 3. Two reference marks, described in note 4, are at the following distances and azimuths from the station: 7.400 meters, 96° 14′; and 5.422 meters, 188° 46′.

Warren (Columbia County, Oreg., O. B. French, 1903).—About a mile southwest of Warren, a station on the Northern Pacific Railway, on a slight elevation or ridge near the west side of a pasture owned by Mr. E. Harnes and about 250 meters north of an east-and-west road. The station is marked according to note 2, the surface mark in a bowlder 8 by 24 by 24 inches with the letters "U. S." cut *in the north side and the subsurface mark in a stone* 6 by 12 by 18 inches buried 18 inches below the ground. Three reference marks, described in note 4, are in the north-and-south fence line to the west of the station. The middle reference mark of the three is 246.7 meters north of the north road fence and the other two are each about 30 meters distant from the middle mark, one north and the other south. They are at the following distances and azimuths from the station: 23.67 meters, 93° 15′; 37.46 meters, 41° 26′; and 37.95 meters, 142° 46′.

Lam (Cowlitz County, Wash., J. S. Hill, 1906).—On the highest part of the heavily wooded summit of Elk Mountain, about 35 miles northeast of Woodland. The station is marked according to note 3. Two reference marks, described in note 4 are at the following distances and azimuths from the station: 6.28 meters, 36° 56′; and 10.84 meters, 319° 02′.

Len (Skamania County, Wash., J. S. Hill, 1906).—In the northwestern part of Skamania County, about 10 miles north of Mount St. Helens and a short distance northeast of Spirit Lake. Spirit Lake can be reached by stage road from Castle Rock via Toutle and St. Helens, and from the south landing on this lake the peak on which the station is located appears as a rocky summit through a gap almost due north. The station is marked according to note 3. Two reference marks, described in note 4, are at the following distances and azimuths from the station: 3.260 meters, 215° 15′; and 12.220 meters, 188° 04′.

Toutle (Cowlitz County, Wash., O. B. French, 1905).—On the top of a conical hill, the highest point of a long ridge, known locally as Gum Mountain, between the north and south forks of the Toutle River and about 20 miles east of Castle Rock. The summit was heavily timbered in 1905 and lines of sight were cleared. The station is reached from Castle Rock via Toutle and St. Helens and the main road left at a point about 2½ miles east of St. Helens at Muniker's place, from where the station is about 3 miles distant in a southerly direction. The station is marked according to note 2, the underground mark in a stone 12 inches in diameter 2 feet below the ground and the surface

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mark in a bowlder 12 by 18 by 24 inches. The reference marks are copper bolts set in the center of triangular blazes on each of three stumps on the sides facing the station, the first being 9.24 meters from the station in azimuth 104° 22′, the second 9.13 meters, in azimuth 165° 16′, and the third 7.90 meters, in azimuth 345° 34′. Two blazed trees are at the following distances and azimuths from the station: 18.24 meters, 152° 52′; and 26.44 meters, 257° 50′.

Huck (Lewis County, Wash., O. B. French, 1905).—On a high, bald summit, known locally as Huckleberry Mountain, and about 8 miles northwest of the highest point of the Deschutes Mountains in this region. The station is on a level place on the summit and about 60 feet north of a sharp rocky point of about the same height. The station is marked by a one-half inch drill hole 1 inch deep in the top of a bowlder 8 by 8 by 10 inches set flush with the surface of the ground. The reference marks, three in number, are similar drill holes in solid ledges along the west side of the ridge a little below its top, and at the following distances and azimuths from the station: 13.65 meters, 40°; 7.30 meters, 60°; and 5.60 meters, 136°.

Bel (Pierce County, Wash., O. B. French, 1905).—On a high rocky peak known as "Bel Jacket," about 10 or 12 miles a little south of west of Mount Rainier, and about 9½ miles by road from Ashford. From Ashford there is a wagon road leading to Messler's place about 5 miles distant, then a trail in the direction of Bald Rock and Eagle Rock, which leads to a small lake from where the peak may be seen about one-half mile distant a little to the west of north. The station is marked according to note 3. Three reference marks, described in note 4, are at the following distances and azimuths from the station: 7.26 meters, 328° 46′; 5.24 meters, 16° 22′; and 5.94 meters, 188° 29′. A drill hole is 16.89 meters from the station in azimuth 15° 01′.

Hal (Lewis County, Wash, O. B. French, 1905).—On the highest point of the most western one of the high, bald summits of the Deschutes Mountains near the northern line of Lewis County and due south of Tacoma. From the north the mountain appears as a symmetrical cone and is best approached from Yelm, a town on the Northern Pacific Railway, via Peter Stone's ranch, which is about 14 miles southeast of Yelm and a short distance north of the station. The station is near the south point of the hilltop and marked according to note 3. Three reference marks, described in note 4, are located as follows: The first in a large bowlder, 10.55 meters from the station in azimuth 166° 24′, the second in a broad sloping ledge 4.81 meters distant in azimuth 333° 35′, and the third in about the highest point of rocks 2.71 meters distant in azimuth 13° 07′.

Rain (Thurston County, Wash., O. B. French, 1905).—About 10 meters northwest of the highest point of a prominent high hill about 4 miles south-southeast of the town of Rainier, about 1,200 feet above it, and just visible over the top of the timber from the town. It is probably in sec. 33, T. 16, R. 1 E., and it is about a mile west-northwest of the ranch on the top of the ridge owned by N. N. Bungard. The station is marked according to note 2, the subsurface mark in a bowlder about 10 by 12 by 12 inches and 15 inches below the surface of the ground, and the surface mark in a bowlder 12 by 20 by 20 inches. Two reference marks, described in note 4, are located as follows: One in a large bowlder at the highest part of the hill, 8.75 meters from the station in azimuth 8° 54′, and the other in a bowlder at some distance down the slope of the hill and 13.78 meters from the station in azimuth 218° 42′.

Hurst (Pierce County, Wash., O. B. French, 1905).—Near the north end and highest part of the timbered hill about 400 meters slightly south of west from the railroad station at Hillhurst, a town on the Northern Pacific Railway, and about one-half mile southwest of the store and post office. The hill is across the road south from the Cottage Grove Farm, owned by Mr. Bucholtz. The station is marked at the surface with an old-type station mark, described on page 23, set in a concrete block 12 inches square and 18 inches deep, and underground by a one-half inch copper bolt 4 inches long set in the solid ground or native cement 3 feet beneath the surface. There are two reference marks, one of which is a copper bolt set in the only large rock in the neighborhood, 40.34 meters from the station in azimuth 252° 40′, and the other is a similar copper bolt in a bowlder 10 by 12 by 12 inches flush with the surface of the ground, with a smaller bowlder 8 by 10 by 10 inches directly below it, and is 13.52 meters from the station in azimuth 150° 41′.

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Pen (Pierce County, Wash., O. B. French, 1905).—About one-half mile south of Graham, a station on the Tacoma Eastern Railroad, about one-half mile northwest of Mr. Hansen's house, and 75 or 100 meters to the westward of the highest part of a flat, partly cleared summit. The station is marked according to note 2. Three reference marks, described in note 4, are at the following distances and azimuths from the station: 18.93 meters, 242° 50′; 17.80 meters, 37° 58′; and 23.15 meters, 160° 53′.

Tacoma south base (Pierce County, Wash., O. B. French, 1905).—About 10 miles south of Tacoma and 2 miles south of Spanaway Lake, on land belonging to William Sekor, in the prolongation of Pacific Avenue of Tacoma. From the top of the hill in South Tacoma this street is nearly a straight line and Tacoma base line lies along it. The station is on the highest bench near the south side of Sekor's property and near the highest point of the bench, being about 10 feet west of a small but prominent knoll. It is 178.5 meters from the fence on the south side of the field and 154.8 meters from the fence on the west side. The station is marked underground by a cross in the head of a one-half inch copper bolt 3 inches long set in a block of concrete 2½ feet square and 6 inches thick 3 feet beneath the surface, and at the surface by an old-type station mark, described on page 23, set in the top of a concrete cube 2½ feet on an edge which has a 4-inch drain tile 2 feet long at the center with its top flush with the surface of the concrete. There are three reference marks, each consisting of a copper bolt set in a concrete block 18 inches square and 6 inches thick buried 3 feet below the surface, and of a similar bolt above it in a concrete block 18 inches square and 30 inches deep, its top 2 inches below the surface of the ground. They are at the following distances and azimuths from the station: 49.658 meters, 263° 50′; 38.938 meters, 347° 25′; and 61.153 meters, 173° 25′.

Tacoma north base (Pierce County, Wash., O. B. French, 1905).—On Fern Hill, 4 miles south of Tacoma and about one-fourth mile north of the crossing of Pacific Avenue and the Puyallup Electric Railway. It is on a prominent knoll just south of the house owned and occupied by H. A. Wilhelmi, 8.5 meters south of his south line and 19 meters east of the east line of Pacific Avenue. The subsurface mark at the station is a cross in the head of a one-half inch copper bolt 3 inches long set in a block of concrete 30 by 30 inches and 6 inches thick, 3 feet beneath the surface. The surface mark is an old-type station mark, described on page 23, set in a concrete cube 2½ feet on an edge which has a 4-inch drain tile 2 feet long at the center with its top flush with the surface of the concrete. There are three reference marks, each consisting of a one-eighth inch copper wire embedded in an underground block of concrete 14 by 14 inches and 6 inches thick set 3 feet below the surface, and of a surface mark consisting of a similar wire in a block 14 by 14 by 30 inches set with the top flush with the surface of the ground. They are located as follows: The first, just north of Dr. Rynning's north fence and 4 feet east of the east line of Pacific Avenue, 92.325 meters from the station in azimuth 10° 19′; the second, south of the back part of Wilhelmi's house and just south of his south fence, 47.757 meters from the station in azimuth 259° 51′; and the third just south of Wilhelmi's south fence and 2 feet east of the east line of Pacific Avenue, 19.672 meters from the station in azimuth 117° 04′.

Burn (Pierce County, Wash., O. B. French, 1905; 1919).—On a prominent ridge 2 or 3 miles southwest of the central part of the city of Tacoma, in a section of the city called Oakland, west of that part of the valley which is traversed by the Northern Pacific Railway in an east-and-west direction and almost in line with the east-and-west portion of the track, about three-fourths of a mile from its western end. It is on a summit about one-half mile west of a prominent schoolhouse, about 300 meters southeast of a house, and about 30 meters north of a private road leading from the house to the schoolhouse, which road is a continuation of Proctor Street. The station can be reached by the American Lake south car to Proctor Street. The station is marked according to note 2, with the subsurface bowlder about 2 feet below the surface. Three reference marks, described in note 4, are located as follows: The first near a trail along the ridge and 23.53 meters from the station, in azimuth 160° 44′; the second on the north edge of the road 25.13 meters distant, in azimuth 320° 00′; and the third near the beginning of a slope 25.47 meters distant, in azimuth 85° 34′.

Kin (Pierce County, Wash., O. B. French, 1905).—On the top of a prominent hill in the southeastern part of Tacoma, just south of McKinley Park, in the

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block between Thirty-second Street and Wright Avenue and K and L Streets and very nearly halfway between Thirty-second Street and Wright Avenue. It is directly in line with the gable ends of the N. P. B. A. Hospital, a large brick building a couple of hundred yards to the westward of the station. The station is marked according to note 2. Two reference marks, described in note 4, are at the following distances and azimuths from the station: 24.55 meters, 215° 48′; and 18.47 meters, 294° 50′. This station has probably been lost, due to local improvements.

Wash (Pierce County, Wash., O. B. French, 1905).—Lost.

Bos (Pierce County, Wash., O. B. French, 1905; 1919).—In the flat about 2 miles east of Tacoma and one-third of a mile south of the trestle leading from the city across the marsh to the mills on the east side of the valley. It is about 75 meters northeast of a small white house at the north end of the strip of fast land which extends farthest into the marsh and on a very slight elevation, clear of trees and buildings, on the edge of a slough. The station is marked according to note 2, the lower mark in a small bowlder 15 inches below the surface and the upper mark in a bowlder about 10 inches in diameter projecting 3 inches above the surface of the ground. There are no reference marks, but a broken-topped fir tree is about 60 meters from the station, in azimuth 331° 44′, and the west corner of the small white house is 77.72 meters distant, in azimuth 13° 54′.

Gull (Pierce County, Wash., J. J. Gilbert, 1891; 1921).—On Commencement Bay, north of Tacoma, and about 1 mile southeast from Brown Point Lighthouse, on the bold bluff about 125 feet high, which is conspicuous on approaching the point from Tacoma. The station is about 15 feet from the edge of the bluff and in range with the tower of the Lowell School in Tacoma and the left tangent of the tall, dark, cylindrical building with a dome roof, which belongs to the Tacoma Lumber Co.'s mill, and bears about southwest from the station. The station is marked by a standard bronze tablet set in concrete and stamped on the face "Gull 1921," and the underground mark is a bottle buried 2½ feet below the surface. There is a standard bronze reference mark set in a concrete post 7.347 meters from the station in azimuth 255° 03′.

Dron (Pierce County, Wash., O. B. French, 1905; 1921).—On Commencement Bay, about one-half mile southeast of Brown Point Lighthouse and about one-half mile west of station *Gull*. It is on the highest part of a bluff point about 60 feet above the water and 20 or 25 feet inland from the edge of the bluff, in a thicket of madrona trees, some of which were felled to clear the line to station *Neill*. The station is marked by a standard bronze station mark set in a mass of concrete and stamped on the face "Dron 1921," and the underground mark is a cross in the top of a copper bolt set in a bowlder. There is a standard bronze reference mark set in a rock 4.42 meters from the station in azimuth 175° 08′.

Smelt (Pierce County, Wash., O. B. French, 1905; 1921).—On a ridge in the extreme northwestern part of Tacoma just south of Point Defiance Park. To reach the station take the Point Defiance Park car to North Forty-ninth Street, walk about 5 blocks west and climb the hill at the end of the street, the station is on the projection of North Forty-ninth Street, not far from the west edge of the main ridge, considerably below the highest point, and at about the same elevation as the small knoll some 300 feet west of the station. The station is marked as described in note 2, except that the top of the mark has been torn away leaving only the shank in the concrete. The reference mark is a copper slug set in a stone in place 53.16 meters from the station in azimuth 236° 33′.

Neill 2 (Pierce County, Wash., O. B. French, 1905).—Lost.

Tacoma astronomic station (Pierce County, Wash., J. F. Pratt, 1892; 1905).—A stone pier near the north end of Wrights Park, Tacoma. A brick pier 17 inches square and 5½ feet long, used for latitude observations in 1894, is 12 feet 3 inches due east of the station.

SUPPLEMENTARY POINTS.

Corning tower (Tehama County, Calif., O. B. French, 1904).—The tower at the south end of the Maywood Colonization Building, a wood and plaster structure, just across the street from the Maywood Hotel and southwest from the railroad station.

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Corning astronomic station (Tehama County, Calif., W. H. Burger, 1908).—On the vacant lot just west of the Maywood Colonization Building at Corning. (See Corning tower, above.) The station is not marked but the following distances and azimuths to different parts of the Maywood Colonization Building were measured. Tower, 23.40 meters, 247° 24′.2; northwest corner of the porchlike part of the building known as the Arcade, 31.40 meters, 207° 55′2; and southwest corner of the same Arcade, 16.64 meters, 242° 17′.8.

Redding courthouse (Shasta County, Calif., O. B. French, 1904; 1908).—The center of the top of the dome of the courthouse upon which stands the statue of justice. The statue is eccentric to the center of the dome by about 1½ feet. A triangle with a small hole at the center is cut in the floor of the dome directly below the center of the dome and may be used as the station.

Redding astronomic station (Shasta County, Calif., O. B. French, 1904; 1908).—On a prominent hill about three-fourths of a mile south by west from the railroad station at Redding. To reach the station follow the railroad track south to milepost 259, which is marked at present by a board nailed to a telegraph pole, where will be found a United States Geological Survey bench mark, a metal tube with a brass top, and from here the station is west about one-fourth of a mile. The station is on the brow of a hill somewhat toward the south edge and not quite at the highest point. A live oak about 6 inches in diameter is on the edge of the hill just north of the line to the Geological Survey bench mark and a leaning pine tree about a quarter of a mile distant is in line with the Redding courthouse. The station is marked according to note 1, in the top of a large bowlder projecting 4 inches above the ground. Two reference marks, described in note 4, are at the following distances and azimuths from the station: 20.22 meters, 115° 49′; and 9.99 meters, 188° 17′.

Redding south base (Shasta County, Calif., W. H. Burger, 1908).—About 15 feet east of the railroad track at Redding and opposite a large steel oil tank. The station is marked only by a nail in the top of a wooden stub and by the three instrument stubs.

Redding north base (Shasta County, Calif., W. H. Burger, 1908).—Near the northwest corner of the cemetery south of the railroad station at Redding and about 15 feet east of the track. The station is marked only by a nail in a wooden stub and by the three instrument stubs around it.

Hill (Shasta County, Calif., W. H. Burger, 1908).—On the east brow of a ridge just north of the ridge on which *Redding astronomic station* is located (see above), and almost on the line between that station and the courthouse at Redding. The station is marked only by a wooden stub and the three instrument stubs surrounding it.

Central Point astronomic station (Jackson County, Oreg., O. B. French, 1904; 1908).—About 2 miles north of Central Point, near the intersection of the Southern Pacific Railway and the county road and in the northwest corner of the field which is just east of the county road and south of the private road leading to the house occupied by George Mims. The station is about 30 meters from the railroad. (See *Central Point latitude station*, below). The underground mark at the station is a three-fourths inch drill hole in the top of a triangular granite rock, set in cement 15 inches below the surface of the ground. The surface mark is an old-type station mark, described on page 23, set in the top of a granite rock which projects 2 inches above the surface and which is embedded in a mass of concrete 30 inches square and 12 inches deep. The reference mark, a United States Geological Survey bench mark, is at the intersection of the railroad and the county road, just east of the rail on the east side of the road and 28.15 meters from the station in azimuth 31° 55′.

Central Point latitude station (Jackson County, Oreg., W. H. Burger, 1908).—Near *Central Point astronomic station* (see above) and marked only by a wooden pier. The following distances and azimuths were measured: Astronomic station, 4.77 meters, 116° 41′; United States Geological Survey bench mark (reference mark of astronomic station), 28.82 meters, 41°18′. The north and west fences of the field are, respectively, 6.18 meters and 15.55 meters from the station.

Rose (Douglas County, Oreg., O. B. French, 1904).—On the highest point of the highest bald summit of a ridge about 1½ miles north of Roseburg. The station is marked according to note 2, the underground mark in a mass of concrete 1 foot below the surface and the surface mark in a bowlder 9 by 14 by 18 inches flush with the surface of the ground. Two reference marks, described in note

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4, are at the following distances and azimuths from the station: 16.71 meters, 12° 24′; and 7.49 meters, 125° 23′.

Burg (Douglas County, Oreg., O. B. French, 1904).—On a high, bald summit about 3 miles southeast of Roseburg. As seen from the iron bridge over the river just west of the railroad station, it is the highest and most distant peak visible up a small valley. The station is marked according to note 2, the underground mark in a mass of concrete 13 inches below the surface, and the surface mark in a bowlder 10 by 12 by 14 inches set flush with the surface of the ground. The reference mark, described in note 4, is in a bowlder just over the edge of the hill, 10.24 meters from the station in azimuth 112° 45′.

Roseburg latitude station (Douglas County, Oreg., O. B. French, 1904).—On the point of a spur across the river from the town of Roseburg, about 100 feet west from the end of the bridge and 60 feet above it. The station is marked according to note 1, set in a ledge of rock. Two reference marks, described in note 4, are located as follows: One in a prominent ledge 18.18 meters from the station in azimuth 30° 17′, and the other in the side of a ledge flush with the ground, 32.30 meters from the station in azimuth 109° 05′.

Springfield Methodist Church (Lane County, Oreg., W. H. Burger, 1908).—The lower and less prominent of the two churches at Springfield.

Springfield Christian Church (Lane County, Oreg., W. H. Burger, 1908).—The taller and more prominent of the two churches at Springfield.

Deady Hall, west tower (Lane County, Oreg., W. H. Burger, 1908).—Deady Hall is one of the two larger buildings of the University of Oregon at Eugene and has large square towers at both the east and west ends.

Geary School spire, Eugene (Lane County, Oreg., W. H. Burger, 1908).—The Geary School is the public school located at West Fourth and Madison Streets, Eugene.

United Brethren Church spire, Eugene (Lane County, Oreg., W. H. Burger, 1908).—At East Eleventh and Ferry Streets, Eugene.

Patterson School spire, Eugene (Lane County, Oreg., W. H. Burger, 1908).—The public school located one block west of the southwest corner of the campus of the University of Oregon, at Eugene.

Baptist Church spire, Eugene (Lane County, Oreg., W. H. Burger, 1908).—At East Eighth and Pearl Streets, Eugene.

W. O. W. Hall spire, Eugene (Lane County, Oreg., W. H. Burger, 1908).—The old Episcopal Church located at West Eighth and Lincoln Streets, Eugene, which is now being used as a hall by the Woodmen of the World.

Courthouse flagpole (Lane County, Oreg., W. H. Burger, 1908).—At East Eighth and Oak Streets, Eugene.

Methodist Church spire (Lane County, Oreg., W. H. Burger, 1908).—The Humphrey Memorial M. E. Church located at West Tenth and Willamette Streets, Eugene.

Seavies (U. S. G. S.) (Lane County, Oreg., O. B. French, 1904).—This station is identical with the United States Geological Survey station of the same name. It is on the most southern of the high hills, about 6 miles northeast of Eugene and about 30 or 40 feet southwest of and slightly lower than the highest part of the hill. The station is marked by a square stone 4 by 4 by 24 inches with its top a little below the surface. The old Geological Survey signal was still standing in 1904, anchored in place by rocks, and was not disturbed.

Monument, General Land Survey (Multnomah County, Oreg., O. B. French, 1903).—The initial intersection of the First Standard Parallel and the Willamette Meridian, a short distance southeast of *Barnes*. (See p. 29.) The station is in a fence corner and is marked by a stone post projecting 1½ feet above the ground.

River (Multnomah County, Oreg., O. B. French, 1903).—Near the junction of the two suburbs of Portland known as Arbor Lodge and Peninsula, on the east bank of the Willamette River about a mile east of Columbia University. It is on a slight elevation, the highest in the vicinity, and in the fence line on the north side of the boulevard along the river bank. It was placed as far east as possible and still keep the Oregonian Building in view. The station is marked by crosses cut in the tops of two bowlders, one placed near the surface of the ground and the other directly beneath at a depth of 1.7 feet, each stone bearing the letters "U. S. C. S." cut in the top.

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Oregonian (Multnomah County, Oreg., O. B. French, 1903).—The tall iron pole at the southeast corner of the tower of the Oregonian Building, at the northwest corner of Sixth and Adler Streets, Portland.

Portland longitude station (Multnomah County, Oreg., C. H. Sinclair, 1887; 1905).—This station has been destroyed.

Portland latitude station (Multnomah County, Oreg., C. H. Sinclair, 1887; 1905).—This station has been destroyed.

Rocky Butte (Multnomah County, Oreg., C. Rockwell, 1889; 1903).—On the north side of the highest part of the brush-covered summit of the butte, about 2 miles northeast of Montavilla. The station is marked by a hole drilled in a large round-topped bowlder.

Harney (Clarke County, Wash., C. Rockwell, 1881; 1903).—On the north bank of the Columbia River, about 1½ miles above the United States wharf at Vancouver, on the sloping bare bluff immediately above the road leading from Vancouver up the river. It is almost in front of the "Harney House," on land formerly owned by Gen. Harney, and about 80 meters east of the fence inclosing the race track. The underground mark consists of a glass bottle placed 3 feet below the surface, with the neck up, the center of the neck marking the station, and three other bottles placed on their sides at a depth of about 1 foot and at distances of about 6 feet from the center, with the necks of the bottles pointing toward the center. The surface mark is a small drill hole 2 inches deep in a basaltic bowlder, weighing about 350 pounds, placed with its top flush with the surface of the ground. The following bearings to the right of magnetic north were read at the station: East chimney of Harney House, 27° 05′; triangle on tree, 74° 28′; white house on south side of river, 172° 55′; ventilator on barn, 220° 06′; and corner of race track fence, 276° 47′.

Balch (Multnomah County, Oreg., C. Rockwell, 1881; 1906).—This station was occupied for azimuth in 1886. It is immediately northwest of the city limits of Portland, about a mile south of the Willamette River, on the first small level bench of the spur making out from the ridge west of the Cornell road, and about 255 feet above the road. The station is marked underground by a broken-necked bottle placed neck up 2 feet below the surface, and by a cross in the top of a copper bolt set in concrete 6 inches above the bottle, and at the surface by a cross on an old-type station mark described on page 23, set in concrete, which is inscribed with the letters "C. & G. S." The reference marks are the remains of two brick piers built in line to the west of the station, with their foundation about 20 inches below the surface, the nearest edge of the first pier being about 1 meter west of the station.

Dash (Pierce County, Wash., G. Davidson, 1857; 1905).—Lost.

Piner 2 (King County, Wash., O. B. French, 1905; 1913).—On the southeast point of Maury Island, about 25 feet above high tide and 30 or 40 feet inland from high-water mark. A group of four piles is 30 or 40 meters east of the station, and a large rock, the largest in the vicinity, is in the water 50 or 60 meters south and a little west from the station. The station is marked by a three-fourths inch drill hole in a large stone set flush with the surface, and underground by a similar drill hole in a stone 2 feet below the surface of the ground. Two reference marks, each consisting of surface and subsurface stones, are at the following distances and azimuths from the station: 4.61 meters, 86° 55′; and 4.65 meters, 167° 45′. This station could not be found in 1919 and the evidence seemed to be that it had slid over the bank.

Robinson 2 (King County, Wash., J. S. Lawson, 1867; 1919).—On Robinson Point, on Maury Island, about 300 meters southwest of the scaffold light, on a bluff about 20 feet above high tide and 30 feet inland from high-water mark. The station is 95 meters southwest of the light keeper's dwelling, 42 meters southwest from the southeast corner of the light keeper's shed or barn, and about 2 meters west of the fence which extends southwest from the corner of the shed. A large madrona tree at the top of the bluff is 15 or 20 meters southwest of the station. The station is marked underground by a one-half inch drill hole in a stone buried 1 foot deep and at the surface by a similar hole in a stone, directly above the lower mark, set with its top flush with the surface of the ground. One reference mark is a one-half inch drill hole in a solid stone which is in line with the fence running southwest from the shed, and is 2.93 meters from the station in azimuth 26° 25′. The other reference mark consists of surface and subsurface stones, the lower one 1½ feet beneath the surface, and is 10.62 meters from the station in azimuth 185° 06′.

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CONVERSION TABLES.

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

[Reduction factor: 1 foot=0.3048006096 meter.]

Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.
0	0.0	50	15.24003	100	30.48006	150	45.72009	200	60.96012
1	0.30480	1	15.54483	1	30.78486	1	46.02489	1	61.26492
2	0.60960	2	15.84963	2	31.08966	2	46.32969	2	61.56972
3	0.91440	3	16.15443	3	31.39446	3	46.63449	3	61.87452
4	1.21920	4	16.45923	4	31.69926	4	46.93929	4	62.17932
5	1.52400	5	16.76403	5	32.00406	5	47.24409	5	62.48412
6	1.82880	6	17.06883	6	32.30886	6	47.54890	6	62.78893
7	2.13360	7	17.37363	7	32.61367	7	47.85370	7	63.09373
8	2.43840	8	17.67844	8	32.91847	8	48.15850	8	63.39853
9	2.74321	9	17.98324	9	33.22327	9	48.46330	9	63.70333
10	3.04801	60	18.28804	110	33.52807	160	48.76810	210	64.00813
1	3.35281	1	18.59284	1	33.83287	1	49.07290	1	64.31293
2	3.65761	2	18.89764	2	34.13767	2	49.37770	2	64.61773
3	3.96241	3	19.20244	3	34.44247	3	49.68250	3	64.92253
4	4.26721	4	19.50724	4	34.74727	4	49.98730	4	65.22733
5	4.57201	5	19.81204	5	35.05207	5	50.29210	5	65.53213
6	4.87681	6	20.11684	6	35.35687	6	50.59690	6	65.83693
7	5.18161	7	20.42164	7	35.66167	7	50.90170	7	66.14173
8	5.48641	8	20.72644	8	35.96647	8	51.20650	8	66.44653
9	5.79121	9	21.03124	9	36.27127	9	51.51130	9	66.75133
20	6.09601	70	21.33604	120	36.57607	170	51.81610	220	67.05613
1	6.40081	1	21.64084	1	36.88087	1	52.12090	1	67.36093
2	6.70561	2	21.94564	2	37.18567	2	52.42570	2	67.66574
3	7.01041	3	22.25044	3	37.49047	3	52.73051	3	67.97054
4	7.31521	4	22.55525	4	37.79528	4	53.03531	4	68.27534
5	7.62002	5	22.86005	5	38.10008	5	53.34011	5	68.58014
6	7.92482	6	23.16485	6	38.40488	6	53.64491	6	68.88494
7	8.22962	7	23.46965	7	38.70968	7	53.94971	7	69.18974
8	8.53442	8	23.77445	8	39.01448	8	54.25451	8	69.49454
9	8.83922	9	24.07925	9	39.31928	9	54.55931	9	69.79934
30	9.14402	80	24.38405	130	39.62408	180	54.86411	230	70.10414
1	9.44882	1	24.68885	1	39.92888	1	55.16891	1	70.40894
2	9.75362	2	24.99365	2	40.23368	2	55.47371	2	70.71374
3	10.05842	3	25.29845	3	40.53848	3	55.77851	3	71.01854
4	10.36322	4	25.60325	4	40.84328	4	56.08331	4	71.32334
5	10.66802	5	25.90805	5	41.14808	5	56.38811	5	71.62814
6	10.97282	6	26.21285	6	41.45288	6	56.69291	6	71.93294
7	11.27762	7	26.51765	7	41.75768	7	56.99771	7	72.23774
8	11.58242	8	26.82245	8	42.06248	8	57.30251	8	72.54255
9	11.88722	9	27.12725	9	42.36728	9	57.60732	9	72.84735
40	12.19202	90	27.43205	140	42.67209	190	57.91212	240	73.15215
1	12.49682	1	27.73686	1	42.97689	1	58.21692	1	73.45695
2	12.80163	2	28.04166	2	43.28169	2	58.52172	2	73.76175
3	13.10643	3	28.34646	3	43.58649	3	58.82652	3	74.06655
4	13.41123	4	28.65126	4	43.89129	4	59.13132	4	74.37135
5	13.71603	5	28.95606	5	44.19609	5	59.43612	5	74.67615
6	14.02083	6	29.26086	6	44.50089	6	59.74092	6	74.98095
7	14.32563	7	29.56566	7	44.80569	7	60.04572	7	75.28575
8	14.63043	8	29.87046	8	45.11049	8	60.35052	8	75.59055
9	14.93523	9	30.17526	9	45.41529	9	60.65532	9	75.89535

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

Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.
250	76.20015	300	91.44018	350	106.68021	400	121.92024	450	137.16027
1	76.50495	1	91.74498	1	106.98501	1	122.22504	1	137.46507
2	76.80975	2	92.04978	2	107.28981	2	122.52985	2	137.76988
3	77.11455	3	92.35458	3	107.59462	3	122.83465	3	138.07468
4	77.41935	4	92.65939	4	107.89942	4	123.13945	4	138.37948
5	77.72416	5	92.96419	5	108.20422	5	123.44425	5	138.68428
6	78.02896	6	93.26899	6	108.50902	6	123.74905	6	138.98908
7	78.33376	7	93.57379	7	108.81382	7	124.05385	7	139.29388
8	78.63856	8	93.87859	8	109.11862	8	124.35865	8	139.59868
9	78.94336	9	94.18339	9	109.42342	9	124.66345	9	139.90348
260	79.24816	310	94.48819	360	109.72822	410	124.96825	460	140.20828
1	79.55296	1	94.79299	1	110.03302	1	125.27305	1	140.51308
2	79.85776	2	95.09779	2	110.33782	2	125.57785	2	140.81788
3	80.16256	3	95.40259	3	110.64262	3	125.88265	3	141.12268
4	80.46736	4	95.70739	4	110.94742	4	126.18745	4	141.42748
5	80.77216	5	96.01219	5	111.25222	5	126.49225	5	141.73228
6	81.07696	6	96.31699	6	111.55702	6	126.79705	6	142.03708
7	81.38176	7	96.62179	7	111.86182	7	127.10185	7	142.34188
8	81.68656	8	96.92659	8	112.16662	8	127.40665	8	142.64669
9	81.99136	9	97.23139	9	112.47142	9	127.71146	9	142.95149
270	82.29616	320	97.53620	370	112.77623	420	128.01626	470	143.25629
1	82.60097	1	97.84100	1	113.08103	1	128.32106	1	143.56109
2	82.90577	2	98.14580	2	113.38583	2	128.62586	2	143.86589
3	83.21057	3	98.45060	3	113.69063	3	128.93066	3	144.17069
4	83.51537	4	98.75540	4	113.99543	4	129.23546	4	144.47549
5	83.82017	5	99.06020	5	114.30023	5	129.54026	5	144.78029
6	84.12497	6	99.36500	6	114.60503	6	129.84506	6	145.08509
7	84.42977	7	99.66980	7	114.90983	7	130.14986	7	145.38989
8	84.73457	8	99.97460	8	115.21463	8	130.45466	8	145.69469
9	85.03937	9	100.27940	9	115.51943	9	130.75946	9	145.99949
280	85.34417	330	100.58420	380	115.82423	430	131.06426	480	146.30429
1	85.64897	1	100.88900	1	116.12903	1	131.36906	1	146.60909
2	85.95377	2	101.19380	2	116.43383	2	131.67386	2	146.91389
3	86.25857	3	101.49860	3	116.73863	3	131.97866	3	147.21869
4	86.56337	4	101.80340	4	117.04343	4	132.28346	4	147.52350
5	86.86817	5	102.10820	5	117.34823	5	132.58827	5	147.82830
6	87.17297	6	102.41300	6	117.65304	6	132.89307	6	148.13310
7	87.47777	7	102.71781	7	117.95784	7	133.19787	7	148.43790
8	87.78258	8	103.02261	8	118.26264	8	133.50267	8	148.74270
9	88.08738	9	103.32741	9	118.56744	9	133.80747	9	149.04750
290	88.39218	340	103.63221	390	118.87224	440	134.11227	490	149.35230
1	88.69698	1	103.93701	1	119.17704	1	134.41707	1	149.65710
2	89.00178	2	104.24181	2	119.48184	2	134.72187	2	149.96190
3	89.30658	3	104.54661	3	119.78664	3	135.02667	3	150.26670
4	89.61138	4	104.85141	4	120.09144	4	135.33147	4	150.57150
5	89.91618	5	105.15621	5	120.39624	5	135.63627	5	150.87630
6	90.22098	6	105.46101	6	120.70104	6	135.94107	6	151.18110
7	90.52578	7	105.76581	7	121.00584	7	136.24587	7	151.48590
8	90.83058	8	106.07061	8	121.31064	8	136.55067	8	151.79070
9	91.13538	9	106.37541	9	121.61544	9	136.85547	9	152.09550

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

Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.
500	152.40030	550	167.64034	600	182.88037	650	198.12040	700	213.36043
1	152.70511	1	167.94514	1	183.18517	1	198.42520	1	213.66523
2	153.00991	2	168.24994	2	183.48997	2	198.73000	2	213.97003
3	153.31471	3	168.55474	3	183.79477	3	199.03480	3	214.27483
4	153.61951	4	168.85954	4	184.09957	4	199.33960	4	214.57963
5	153.92431	5	169.16434	5	184.40437	5	199.64440	5	214.88443
6	154.22911	6	169.46914	6	184.70917	6	199.94920	6	215.18923
7	154.53391	7	169.77394	7	185.01397	7	200.25400	7	215.49403
8	154.83871	8	170.07874	8	185.31877	8	200.55880	8	215.79883
9	155.14351	9	170.38354	9	185.62357	9	200.86360	9	216.10363
510	155.44831	560	170.68834	610	185.92837	660	201.16840	710	216.40843
1	155.75311	1	170.99314	1	186.23317	1	201.47320	1	216.71323
2	156.05791	2	171.29794	2	186.53797	2	201.77800	2	217.01803
3	156.36271	3	171.60274	3	186.84277	3	202.08280	3	217.32283
4	156.66751	4	171.90754	4	187.14757	4	202.38760	4	217.62764
5	156.97231	5	172.21234	5	187.45237	5	202.69241	5	217.93244
6	157.27711	6	172.51715	6	187.75718	6	202.99721	6	218.23724
7	157.58192	7	172.82195	7	188.06198	7	203.30201	7	218.54204
8	157.88672	8	173.12675	8	188.36678	8	203.60681	8	218.84684
9	158.19152	9	173.43155	9	188.67158	9	203.91161	9	219.15164
520	158.49632	570	173.73635	620	188.97638	670	204.21641	720	219.45644
1	158.80112	1	174.04115	1	189.28118	1	204.52121	1	219.76124
2	159.10592	2	174.34595	2	189.58598	2	204.82601	2	220.06604
3	159.41072	3	174.65075	3	189.89078	3	205.13081	3	220.37084
4	159.71552	4	174.95555	4	190.19558	4	205.43561	4	220.67564
5	160.02032	5	175.26035	5	190.50038	5	205.74041	5	220.98044
6	160.32512	6	175.56515	6	190.80518	6	206.04521	6	221.28524
7	160.62992	7	175.86995	7	191.10998	7	206.35001	7	221.59004
8	160.93472	8	176.17475	8	191.41478	8	206.65481	8	221.89484
9	161.23952	9	176.47955	9	191.71958	9	206.95961	9	222.19964
530	161.54432	580	176.78435	630	192.02438	680	207.26441	730	222.50445
1	161.84912	1	177.08915	1	192.32918	1	207.56922	1	222.80925
2	162.15392	2	177.39395	2	192.63399	2	207.87402	2	223.11405
3	162.45872	3	177.69876	3	192.93879	3	208.17882	3	223.41885
4	162.76353	4	178.00356	4	193.24359	4	208.48362	4	223.72365
5	163.06833	5	178.30836	5	193.54839	5	208.78842	5	224.02845
6	163.37313	6	178.61316	6	193.85319	6	209.09322	6	224.33325
7	163.67793	7	178.91796	7	194.15799	7	209.39802	7	224.63805
8	163.98273	8	179.22276	8	194.46279	8	209.70282	8	224.94285
9	164.28753	9	179.52756	9	194.76759	9	210.00762	9	225.24765
540	164.59233	590	179.83236	640	195.07239	690	210.31242	740	225.55245
1	164.89713	1	180.13716	1	195.37719	1	210.61722	1	225.85725
2	165.20193	2	180.44196	2	195.68199	2	210.92202	2	226.16205
3	165.50673	3	180.74676	3	195.98679	3	211.22682	3	226.46685
4	165.81153	4	181.05156	4	196.29159	4	211.53162	4	226.77165
5	166.11633	5	181.35636	5	196.59639	5	211.83642	5	227.07645
6	166.42113	6	181.66116	6	196.90119	6	212.14122	6	227.38125
7	166.72593	7	181.96596	7	197.20599	7	212.44602	7	227.68606
8	167.03073	8	182.27076	8	197.51080	8	212.75083	8	227.99086
9	167.33553	9	182.57557	9	197.81560	9	213.05563	9	228.29566

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

Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.
750	228.60046	800	243.84049	850	259.08052	900	274.32055	950	289.56058
1	228.90526	1	244.14529	1	259.38532	1	274.62535	1	289.86538
2	229.21006	2	244.45009	2	259.69012	2	274.93015	2	290.17018
3	229.51486	3	244.75489	3	259.99492	3	275.23495	3	290.47498
4	229.81966	4	245.05969	4	260.29972	4	275.53975	4	290.77978
5	230.12446	5	245.36449	5	260.60452	5	275.84455	5	291.08458
6	230.42926	6	245.66929	6	260.90932	6	276.14935	6	291.38938
7	230.73406	7	245.97409	7	261.21412	7	276.45415	7	291.69418
8	231.03886	8	246.27889	8	261.51892	8	276.75895	8	291.99898
9	231.34366	9	246.58369	9	261.82372	9	277.06375	9	292.30378
760	231.64846	810	246.88849	860	262.12852	910	277.36855	960	292.60859
1	231.95326	1	247.19329	1	262.43332	1	277.67336	1	292.91339
2	232.25806	2	247.49809	2	262.73813	2	277.97816	2	293.21819
3	232.56287	3	247.80290	3	263.04293	3	278.28296	3	293.52299
4	232.86767	4	248.10770	4	263.34773	4	278.58776	4	293.82779
5	233.17247	5	248.41250	5	263.65253	5	278.89256	5	294.13259
6	233.47727	6	248.71730	6	263.95733	6	279.19736	6	294.43739
7	233.78207	7	249.02210	7	264.26213	7	279.50216	7	294.74219
8	234.08687	8	249.32690	8	264.56693	8	279.80696	8	295.04699
9	234.39167	9	249.63170	9	264.87173	9	280.11176	9	295.35179
770	234.69647	820	249.93650	870	265.17653	920	280.41656	970	295.65659
1	235.00127	1	250.24130	1	265.48133	1	280.72136	1	295.96139
2	235.30607	2	250.54610	2	265.78613	2	281.02616	2	296.26619
3	235.61087	3	250.85090	3	266.09093	3	281.33096	3	296.57099
4	235.91567	4	251.15570	4	266.39573	4	281.63576	4	296.87579
5	236.22047	5	251.46050	5	266.70053	5	281.94056	5	297.18059
6	236.52527	6	251.76530	6	267.00533	6	282.24536	6	297.48539
7	236.83007	7	252.07010	7	267.31013	7	282.55017	7	297.79020
8	237.13487	8	252.37490	8	267.61494	8	282.85497	8	298.09500
9	237.43967	9	252.67971	9	267.91974	9	283.15977	9	298.39980
780	237.74448	830	252.98451	880	268.22454	930	283.46457	980	298.70460
1	238.04928	1	253.28931	1	268.52934	1	283.76937	1	299.00940
2	238.35408	2	253.59411	2	268.83414	2	284.07417	2	299.31420
3	238.65888	3	253.89891	3	269.13894	3	284.37897	3	299.61900
4	238.96368	4	254.20371	4	269.44374	4	284.68377	4	299.92380
5	239.26848	5	254.50851	5	269.74854	5	284.98857	5	300.22860
6	239.57328	6	254.81331	6	270.05334	6	285.29337	6	300.53340
7	239.87808	7	255.11811	7	270.35814	7	285.59817	7	300.83820
8	240.18288	8	255.42291	8	270.66294	8	285.90297	8	301.14300
9	240.48768	9	255.72771	9	270.96774	9	286.20777	9	301.44780
790	240.79248	840	256.03251	890	271.27254	940	286.51257	990	301.75260
1	241.09728	1	256.33731	1	271.57734	1	286.81737	1	302.05740
2	241.40208	2	256.64211	2	271.88214	2	287.12217	2	302.36220
3	241.70688	3	256.94691	3	272.18694	3	287.42697	3	302.66701
4	242.01168	4	257.25171	4	272.49174	4	287.73178	4	302.97181
5	242.31648	5	257.55652	5	272.79655	5	288.03658	5	303.27661
6	242.62129	6	257.86132	6	273.10135	6	288.34138	6	303.58141
7	242.92609	7	258.16612	7	273.40615	7	288.64618	7	303.88621
8	243.23089	8	258.47092	8	273.71095	8	288.95098	8	304.19101
9	243.53569	9	258.77572	9	274.01575	9	289.25578	9	304.49581

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

[Reduction factor: 1 meter=3.280833333 feet.]

Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.
0		50	164.04167	100	328.08333	150	492.12500	200	656.16667
1	3.28083	1	167.32250	1	331.36417	1	495.40583	1	659.44750
2	6.56167	2	170.60333	2	334.64500	2	498.68667	2	662.72833
3	9.84250	3	173.88417	3	337.92583	3	501.96750	3	666.00917
4	13.12333	4	177.16500	4	341.20667	4	505.24833	4	669.29000
5	16.40417	5	180.44583	5	344.48750	5	508.52917	5	672.57083
6	19.68500	6	183.72667	6	347.70833	6	511.81000	6	675.85167
7	22.96583	7	187.00750	7	351.04917	7	515.09083	7	679.13250
8	26.24667	8	190.28833	8	354.33000	8	518.37167	8	682.41333
9	29.52750	9	193.56917	9	357.61083	9	521.65250	9	685.69417
10	32.80833	60	196.85000	110	360.89167	160	524.93333	210	688.97500
1	36.08917	1	200.13083	1	364.17250	1	528.21417	1	692.25583
2	39.37000	2	203.41167	2	367.45333	2	531.49500	2	695.53667
3	42.65083	3	206.69250	3	370.73417	3	534.77583	3	698.81750
4	45.93167	4	209.97333	4	374.01500	4	538.05667	4	702.09833
5	49.21250	5	213.25417	5	377.29583	5	541.33750	5	705.37917
6	52.49333	6	216.53500	6	380.57667	6	544.61833	6	708.66000
7	55.77417	7	219.81583	7	383.85750	7	547.89917	7	711.94083
8	59.05500	8	223.09667	8	387.13833	8	551.18000	8	715.22167
9	62.33583	9	226.37750	9	390.41917	9	554.46083	9	718.50250
20	65.61667	70	229.65833	120	393.70000	170	557.74167	220	721.78333
1	68.89750	1	232.93917	1	396.98083	1	561.02250	1	725.06417
2	72.17833	2	236.22000	2	400.26167	2	564.30333	2	728.34500
3	75.45917	3	239.50083	3	403.54250	3	567.58417	3	731.62583
4	78.74000	4	242.78167	4	406.82333	4	570.86500	4	734.90667
5	82.02083	5	246.06250	5	410.10417	5	574.14583	5	738.18750
6	85.30167	6	249.34333	6	413.38500	6	577.42667	6	741.46833
7	88.58250	7	252.62417	7	416.66583	7	580.70750	7	744.74917
8	91.86333	8	255.90500	8	419.94667	8	583.98833	8	748.03000
9	95.14417	9	259.18583	9	423.22750	9	587.26917	9	751.31083
30	98.42500	80	262.46667	130	426.50833	180	590.55000	230	754.59167
1	101.70583	1	265.74750	1	429.78917	1	593.83083	1	757.87250
2	104.98667	2	269.02833	2	433.07000	2	597.11167	2	761.15333
3	108.26750	3	272.30917	3	436.35083	3	600.39250	3	764.43417
4	111.54833	4	275.59000	4	439.63167	4	603.67333	4	767.71500
5	114.82917	5	278.87083	5	442.91250	5	606.95417	5	770.99583
6	118.11000	6	282.15167	6	446.19333	6	610.23500	6	774.27667
7	121.39083	7	285.43250	7	449.47417	7	613.51583	7	777.55750
8	124.67167	8	288.71333	8	452.75500	8	616.79667	8	780.83833
9	127.95250	9	291.99417	9	456.03583	9	620.07750	9	784.11917
40	131.23333	90	295.27500	140	459.31667	190	623.35833	240	787.40000
1	134.51417	1	298.55583	1	462.59750	1	626.63917	1	790.68083
2	137.79500	2	301.83667	2	465.87833	2	629.92000	2	793.96167
3	141.07583	3	305.11750	3	469.15917	3	633.20083	3	797.24250
4	144.35667	4	308.39833	4	472.44000	4	636.48167	4	800.52333
5	147.63750	5	311.67917	5	475.72083	5	639.76250	5	803.80417
6	150.91833	6	314.96000	6	479.00167	6	643.04333	6	807.08500
7	154.19917	7	318.24083	7	482.28250	7	646.32417	7	810.36583
8	157.48000	8	321.52167	8	485.56333	8	649.60500	8	813.64667
9	160.76083	9	324.80250	9	488.84417	9	652.88583	9	816.92750

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

Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.
250	820.20833	300	984.25000	350	1,148.29167	400	1,312.33333	450	1,476.37500
1	823.48917	1	987.53083	1	1,151.57250	1	1,315.61417	1	1,479.65583
2	826.77000	2	990.81167	2	1,154.85333	2	1,318.89500	2	1,482.93667
3	830.05083	3	994.09250	3	1,158.13417	3	1,322.17583	3	1,486.21750
4	833.33167	4	997.37333	4	1,161.41500	4	1,325.45667	4	1,489.49833
5	836.61250	5	1,000.65417	5	1,164.69583	5	1,328.73750	5	1,492.77917
6	839.89333	6	1,003.93500	6	1,167.97667	6	1,332.01833	6	1,496.06000
7	843.17417	7	1,007.21583	7	1,171.25750	7	1,335.29917	7	1,499.34083
8	846.45500	8	1,010.49667	8	1,174.53833	8	1,338.58000	8	1,502.62167
9	849.73583	9	1,013.77750	9	1,177.81917	9	1,341.86083	9	1,505.90250
260	853.01667	310	1,017.05833	360	1,181.10000	410	1,345.14167	460	1,509.18333
1	856.29750	1	1,020.33917	1	1,184.38083	1	1,348.42250	1	1,512.46417
2	859.57833	2	1,023.62000	2	1,187.66167	2	1,351.70333	2	1,515.74500
3	862.85917	3	1,026.90083	3	1,190.94250	3	1,354.98417	3	1,519.02583
4	866.14000	4	1,030.18167	4	1,194.22333	4	1,358.26500	4	1,522.30667
5	869.42083	5	1,033.46250	5	1,197.50417	5	1,361.54583	5	1,525.58750
6	872.70167	6	1,036.74333	6	1,200.78500	6	1,364.82667	6	1,528.86833
7	875.98250	7	1,040.02417	7	1,204.06583	7	1,368.10750	7	1,532.14917
8	879.26333	8	1,043.30500	8	1,207.34667	8	1,371.38833	8	1,535.43000
9	882.54417	9	1,046.58583	9	1,210.62750	9	1,374.66917	9	1,538.71083
270	885.82500	320	1,049.86667	370	1,213.90833	420	1,377.95000	470	1,541.99167
1	889.10583	1	1,053.14750	1	1,217.18917	1	1,381.23083	1	1,545.27250
2	892.38667	2	1,056.42833	2	1,220.47000	2	1,384.51167	2	1,548.55333
3	895.66750	3	1,059.70917	3	1,223.75083	3	1,387.79250	3	1,551.83417
4	898.94833	4	1,062.99000	4	1,227.03167	4	1,391.07333	4	1,555.11500
5	902.22917	5	1,066.27083	5	1,230.31250	5	1,394.35417	5	1,558.39583
6	905.51000	6	1,069.55167	6	1,233.59333	6	1,397.63500	6	1,561.67667
7	908.79083	7	1,072.83250	7	1,236.87417	7	1,400.91583	7	1,564.95750
8	912.07167	8	1,076.11333	8	1,240.15500	8	1,404.19667	8	1,568.23833
9	915.35250	9	1,079.39417	9	1,243.43583	9	1,407.47750	9	1,571.51917
280	918.63333	330	1,082.67500	380	1,246.71667	430	1,410.75833	480	1,574.80000
1	921.91417	1	1,085.95583	1	1,249.99750	1	1,414.03917	1	1,578.08083
2	925.19500	2	1,089.23667	2	1,253.27833	2	1,417.32000	2	1,581.36167
3	928.47583	3	1,092.51750	3	1,256.55917	3	1,420.60083	3	1,584.64250
4	931.75667	4	1,095.79833	4	1,259.84000	4	1,423.88167	4	1,587.92333
5	935.03750	5	1,099.07917	5	1,263.12083	5	1,427.16250	5	1,591.20417
6	938.31833	6	1,102.36000	6	1,266.40167	6	1,430.44333	6	1,594.48500
7	941.59917	7	1,105.64083	7	1,269.68250	7	1,433.72417	7	1,597.76583
8	944.88000	8	1,108.92167	8	1,272.96333	8	1,437.00500	8	1,601.04667
9	948.16083	9	1,112.20250	9	1,276.24417	9	1,440.28583	9	1,604.32750
290	951.44167	340	1,115.48333	390	1,279.52500	440	1,443.56667	490	1,607.60833
1	954.72250	1	1,118.76417	1	1,282.80583	1	1,446.84750	1	1,610.88917
2	958.00333	2	1,122.04500	2	1,286.08667	2	1,450.12833	2	1,614.17000
3	961.28417	3	1,125.32583	3	1,289.36750	3	1,453.40917	3	1,617.45083
4	964.56500	4	1,128.60667	4	1,292.64833	4	1,456.69000	4	1,620.73167
5	967.84583	5	1,131.88750	5	1,295.92917	5	1,459.97083	5	1,624.01250
6	971.12667	6	1,135.16833	6	1,299.21000	6	1,463.25167	6	1,627.29333
7	974.40750	7	1,138.44917	7	1,302.49083	7	1,466.53250	7	1,630.57417
8	977.68833	8	1,141.73000	8	1,305.77167	8	1,469.81333	8	1,633.85500
9	980.96917	9	1,145.01083	9	1,309.05250	9	1,473.09417	9	1,637.13583

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

Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.
500	1,640.41667	550	1,804.45833	600	1,968.50000	650	2,132.54167	700	2,296.58333
1	1,643.69750	1	1,807.73917	1	1,971.78083	1	2,135.82250	1	2,299.86417
2	1,646.97833	2	1,811.02000	2	1,975.06167	2	2,139.10333	2	2,303.14500
3	1,650.25917	3	1,814.30083	3	1,978.34250	3	2,142.38417	3	2,306.42583
4	1,653.54000	4	1,817.58167	4	1,981.62333	4	2,145.66500	4	2,309.70667
5	1,656.82083	5	1,820.86250	5	1,984.90417	5	2,148.94583	5	2,312.98750
6	1,660.10167	6	1,824.14333	6	1,988.18500	6	2,152.22667	6	2,316.26833
7	1,663.38250	7	1,827.42417	7	1,991.46583	7	2,155.50750	7	2,319.54917
8	1,666.66333	8	1,830.70500	8	1,994.74667	8	2,158.78833	8	2,322.83000
9	1,669.94417	9	1,833.98583	9	1,998.02750	9	2,162.06917	9	2,326.11083
510	1,673.22500	560	1,837.26667	610	2,001.30833	660	2,165.35000	710	2,329.39167
1	1,676.50583	1	1,840.54750	1	2,004.58917	1	2,168.03083	1	2,332.67250
2	1,679.78667	2	1,843.82833	2	2,007.87000	2	2,171.91167	2	2,335.95333
3	1,683.06750	3	1,847.10917	3	2,011.15083	3	2,175.19250	3	2,339.23417
4	1,686.34833	4	1,850.39000	4	2,014.43167	4	2,178.47333	4	2,342.51500
5	1,689.62917	5	1,853.67083	5	2,017.71250	5	2,181.75417	5	2,345.79583
6	1,692.91000	6	1,856.95167	6	2,020.99333	6	2,185.03500	6	2,349.07667
7	1,696.19083	7	1,860.23250	7	2,024.27417	7	2,188.31583	7	2,352.35750
8	1,699.47167	8	1,863.51333	8	2,027.55500	8	2,191.59667	8	2,355.63833
9	1,702.75250	9	1,866.79417	9	2,030.83583	9	2,194.87750	9	2,358.91917
520	1,706.03333	570	1,870.07500	620	2,034.11667	670	2,198.15833	720	2,362.20000
1	1,709.31417	1	1,873.35583	1	2,037.39750	1	2,201.43917	1	2,365.48083
2	1,712.59500	2	1,876.63667	2	2,040.67833	2	2,204.72000	2	2,368.76167
3	1,715.87583	3	1,879.91750	3	2,043.95917	3	2,208.00083	3	2,372.04250
4	1,719.15667	4	1,883.19833	4	2,047.24000	4	2,211.28167	4	2,375.32333
5	1,722.43750	5	1,886.47917	5	2,050.52083	5	2,214.56250	5	2,378.60417
6	1,725.71833	6	1,889.76000	6	2,053.80167	6	2,217.84333	6	2,381.88500
7	1,728.99917	7	1,893.04083	7	2,057.08250	7	2,221.12417	7	2,385.16583
8	1,732.28000	8	1,896.32167	8	2,060.36333	8	2,224.40500	8	2,388.44667
9	1,735.56083	9	1,899.60250	9	2,063.64417	9	2,227.68583	9	2,391.72750
530	1,738.84167	580	1,902.88333	630	2,066.92500	680	2,230.96667	730	2,395.00833
1	1,742.12250	1	1,906.16417	1	2,070.20583	1	2,234.24750	1	2,398.28917
2	1,745.40333	2	1,909.44500	3	2,073.48667	2	2,237.52833	2	2,401.57000
3	1,748.68417	3	1,912.72583	3	2,076.76750	3	2,240.80917	3	2,404.85083
4	1,751.96500	4	1,916.00667	4	2,080.04833	4	2,244.09000	4	2,408.13167
5	1,755.24583	5	1,919.28750	5	2,083.32917	5	2,247.37083	5	2,411.41250
6	1,758.52667	6	1,922.50833	6	2,086.61000	6	2,250.65167	6	2,414.69333
7	1,761.80750	7	1,925.84917	7	2,089.89083	7	2,253.93250	7	2,417.97417
8	1,765.08833	8	1,929.13000	8	2,093.17167	8	2,257.21333	8	2,421.25500
9	1,768.36917	9	1,932.41083	9	2,096.45250	9	2,260.49417	9	2,424.53583
540	1,771.65000	590	1,935.69167	640	2,099.73333	690	2,263.77500	740	2,427.81667
1	1,774.93083	1	1,938.97250	1	2,103.01417	1	2,267.05583	1	2,431.09750
2	1,778.21167	2	1,942.25333	2	2,106.29500	2	2,270.33667	2	2,434.37833
3	1,781.49250	3	1,945.53417	3	2,109.57583	3	2,273.61750	3	2,437.65917
4	1,784.77333	4	1,948.81500	4	2,112.85667	4	2,276.89833	4	2,440.94000
5	1,788.05417	5	1,952.09583	5	2,116.13750	5	2,280.17917	5	2,444.22083
6	1,791.33500	6	1,955.37667	6	2,119.41833	6	2,283.46000	6	2,447.50167
7	1,794.61583	7	1,958.65750	7	2,122.69917	7	2,286.74083	7	2,450.78250
8	1,797.89667	8	1,961.93833	8	2,125.98000	8	2,290.02167	8	2,454.06333
9	1,801.17750	9	1,965.21917	9	2,129.26083	9	2,293.30250	9	2,457.34417

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

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

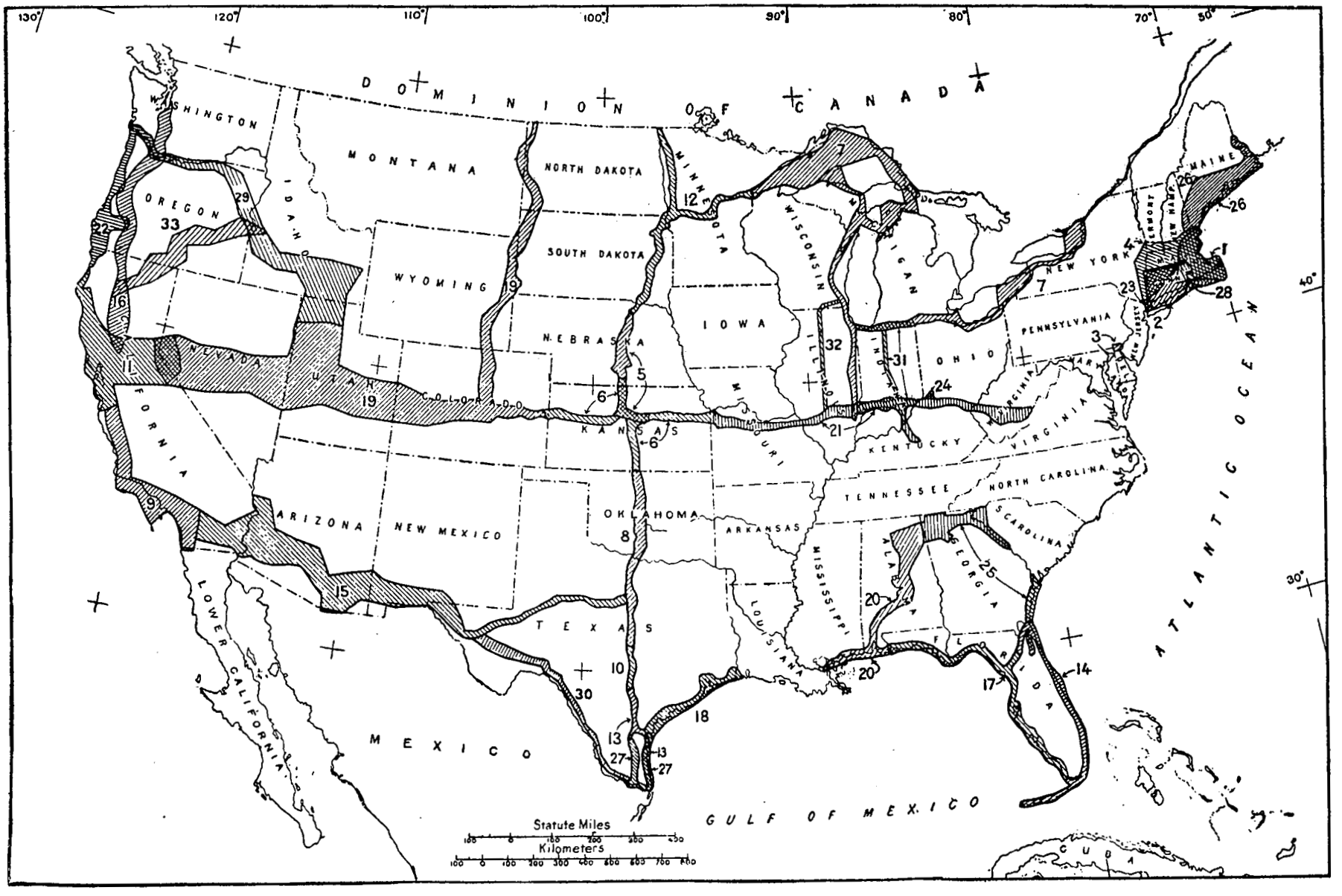

FIG. 1. INDEX MAP SHOWING AREAS IN THE UNITED STATES COVERED BY PUBLISHED TRIANGULATION AND TRAVERSE WHICH HAVE BEEN RIGIDLY COMPUTED ON THE NORTH AMERICAN DATUM.

1. Appendix 8, Report for 1885 (superseded by Special Publication No. 76).
2. Appendix 8, Report for 1888.
3. Appendix 8, Report for 1893.
4. Appendix 10, Report for 1894 (superseded by Special Publication No. 76).
5. Appendix 6, Report for 1901.
6. Special Publication No. 70.
7. Appendix EEE, Annual Report of the Chief of Engineers, 1902.
8. Appendix 4, Report for 1903 (superseded by S. P. No. 88).
9. Appendix 9, Report for 1904.
10. Appendix 5, Report for 1905 (superseded by S. P. No. 88).
11. Appendix 5, Report for 1910.
12. Appendix 4, Report for 1911.
13. Appendix 5, Report for 1911 (superseded by S. P. No. 88).
14. Appendix 6, Report for 1911.
15. Special Publication No. 11.
16. Special Publication No. 13.
17. Special Publication No. 16.
18. Special Publication No. 17.
19. Special Publication No. 19.
20. Special Publication No. 24.
21. Special Publication No. 30.
22. Special Publication No. 31.
23. Report on the triangulation of Greater New York.
24. Report on a plan of sewerage for the city of Cincinnati.
25. Special Publication No. 43.
26. Special Publication No. 46.
27. Special Publication No. 54.
28. Special Publication No. 62.
29. Special Publication No. 74.
30. Special Publication No. 78.
31. Special Publication No. 79.
32. Special Publication No. 86.
33. Special Publication No. 84.

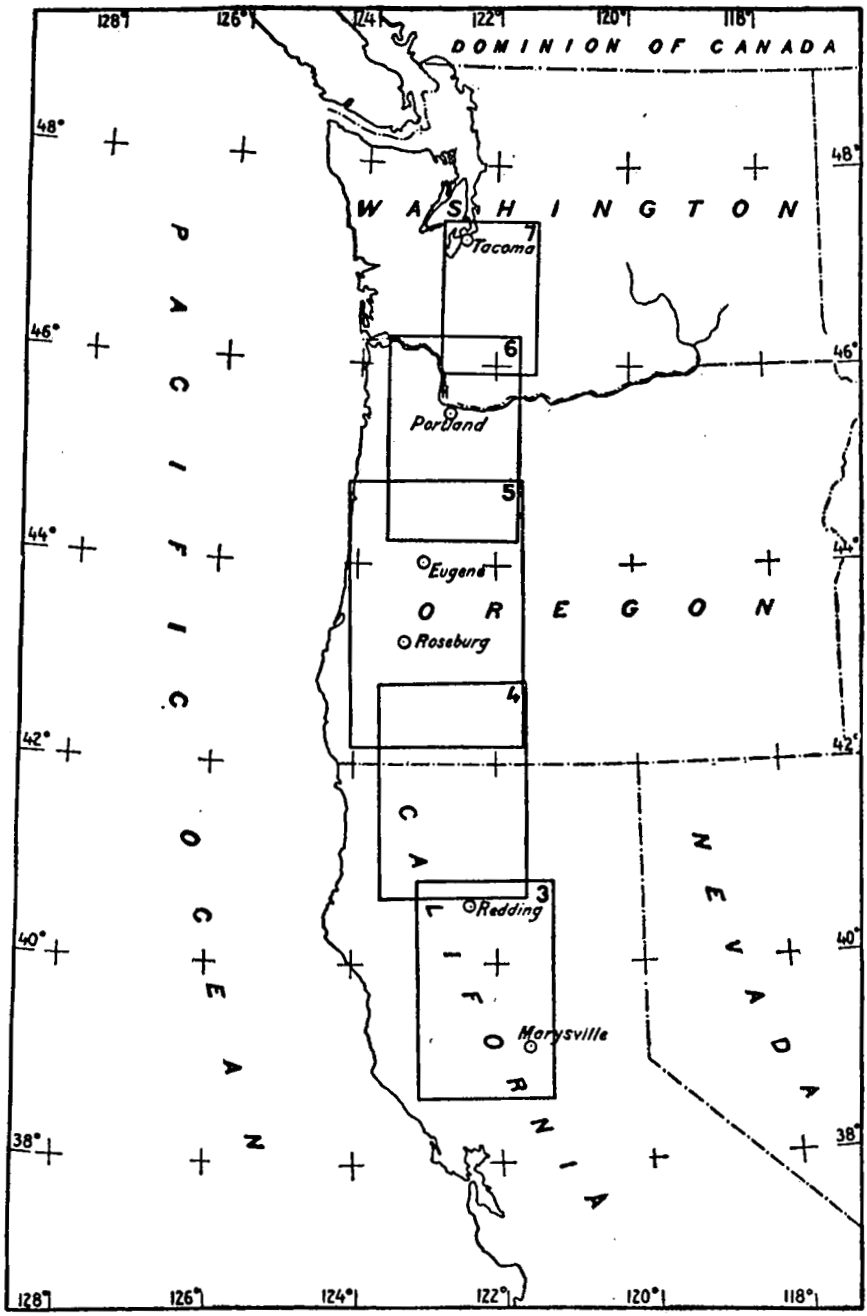

Fig. 2.—INDEX MAP OF THE CALIFORNIA-WASHINGTON ARC.

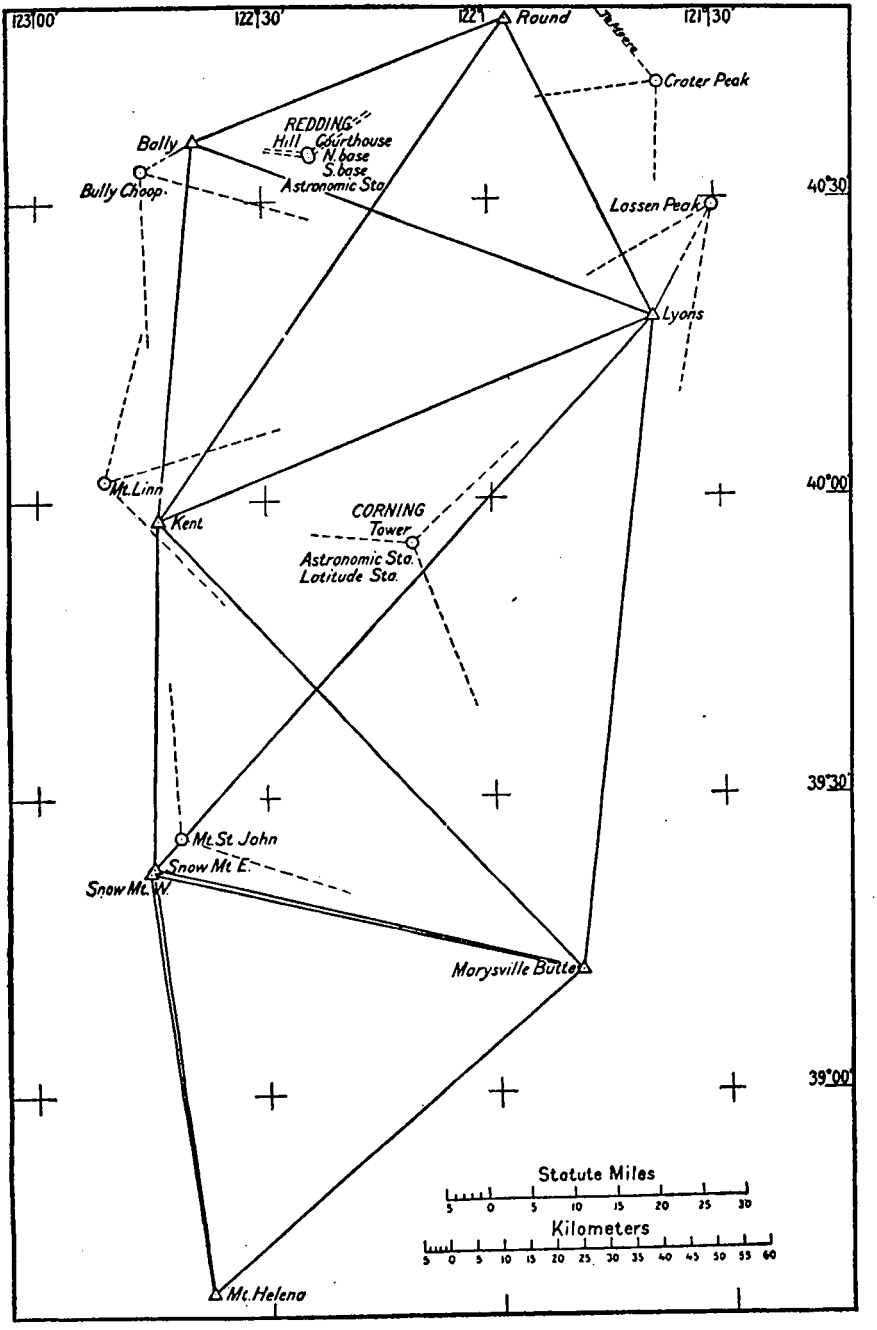

Fig. 3.—TRIANGULATION, THIRTY-NINTH PARALLEL TO VICINITY OF REDDING, CALIF.

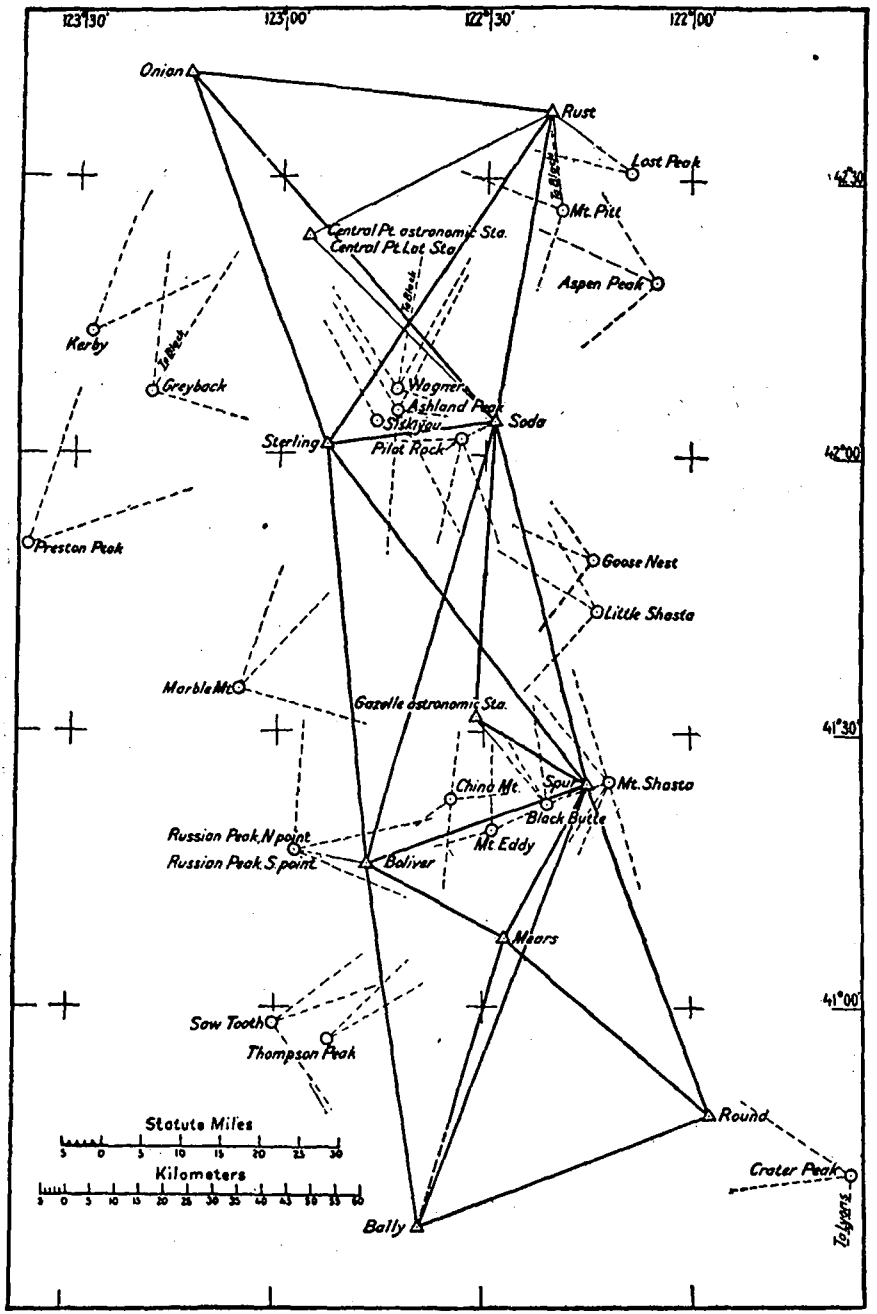

Fig. 4.—TRIANGULATION, VICINITY OF REDDING, CALIF., TO SOUTHERN OREGON,

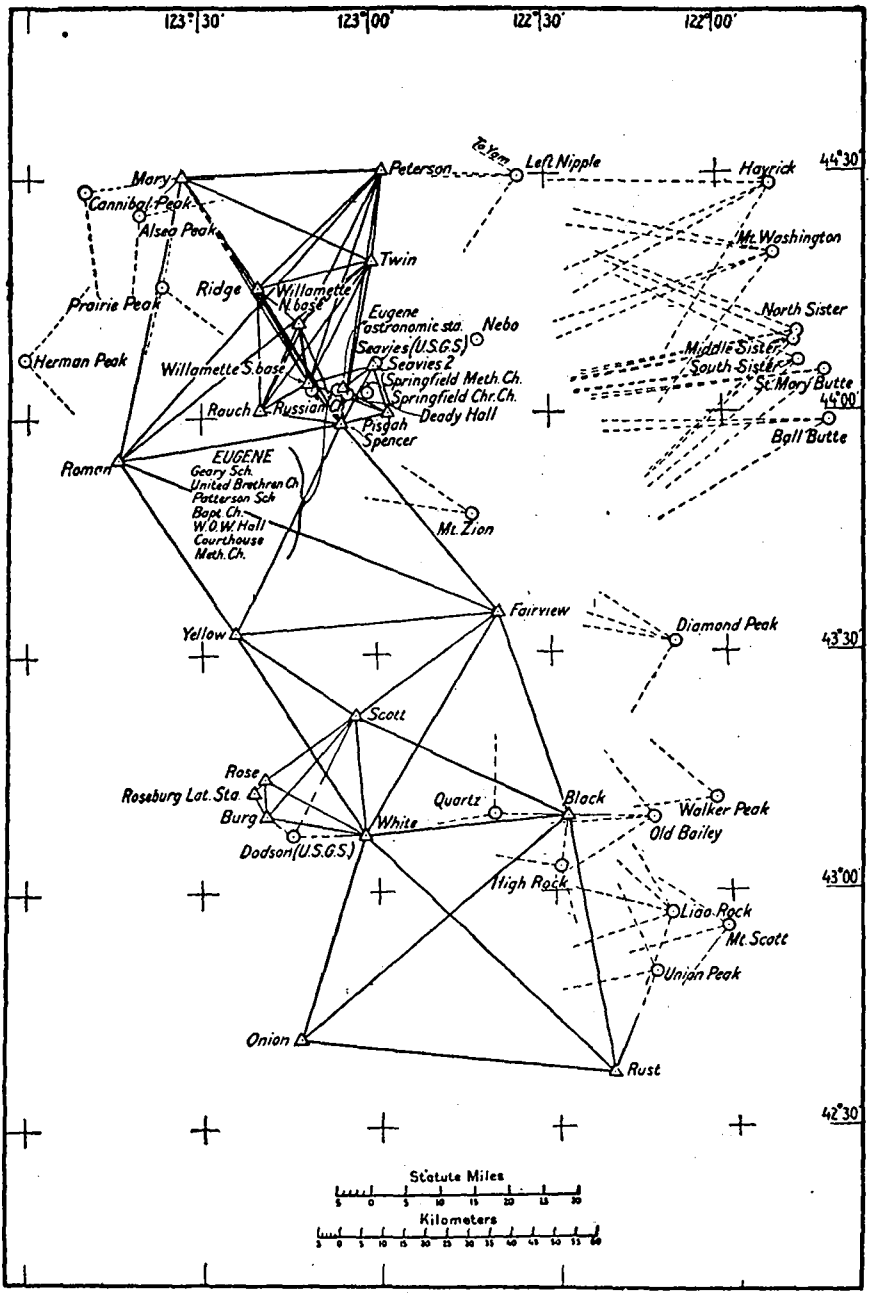

Fig. 5.—TRIANGULATION, SOUTHERN OREGON TO VICINITY OF EUGENE, OREG.

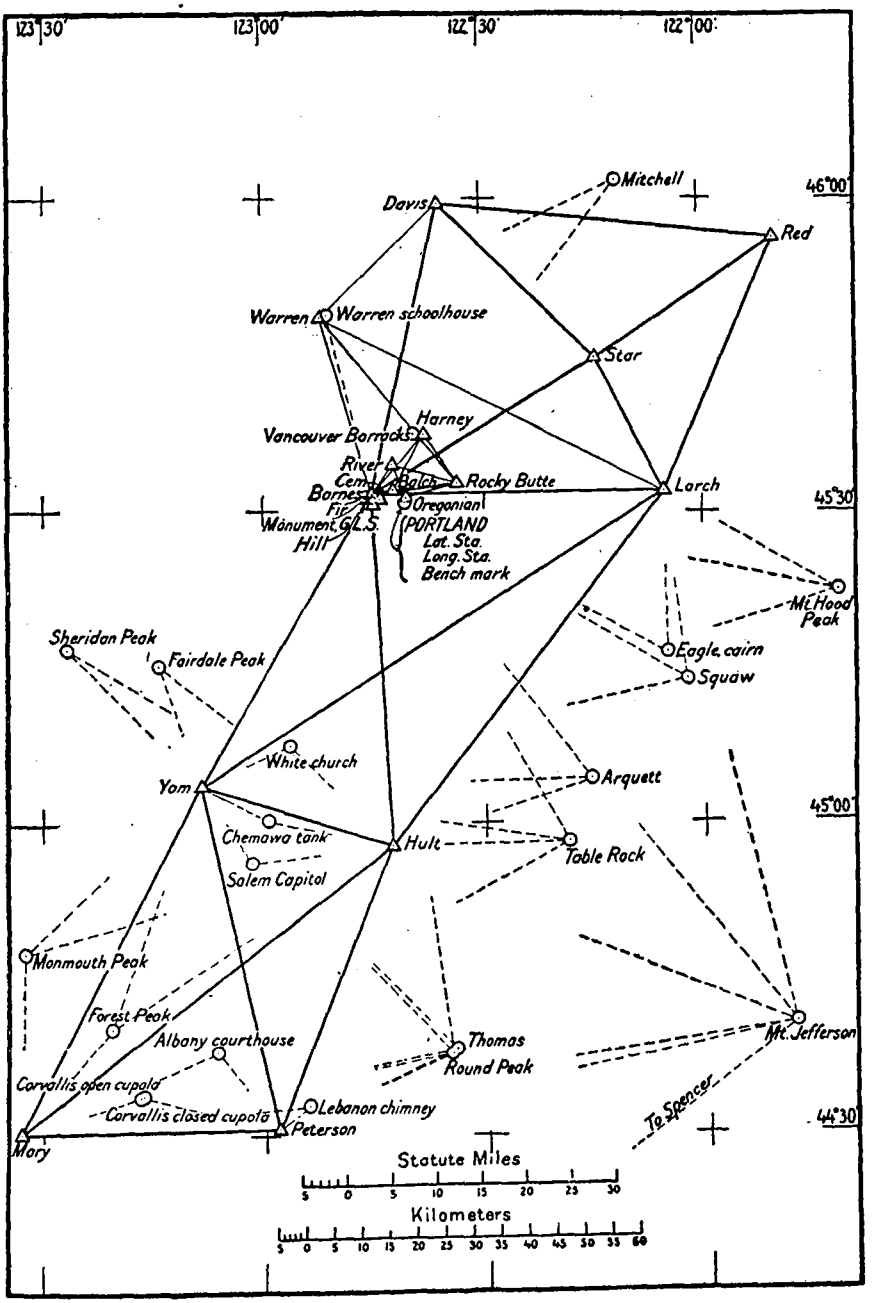

Fig. 6.—TRIANGULATION, VICINITY OF EUGENE, OREG., TO VICINITY OF PORTLAND, OREG.

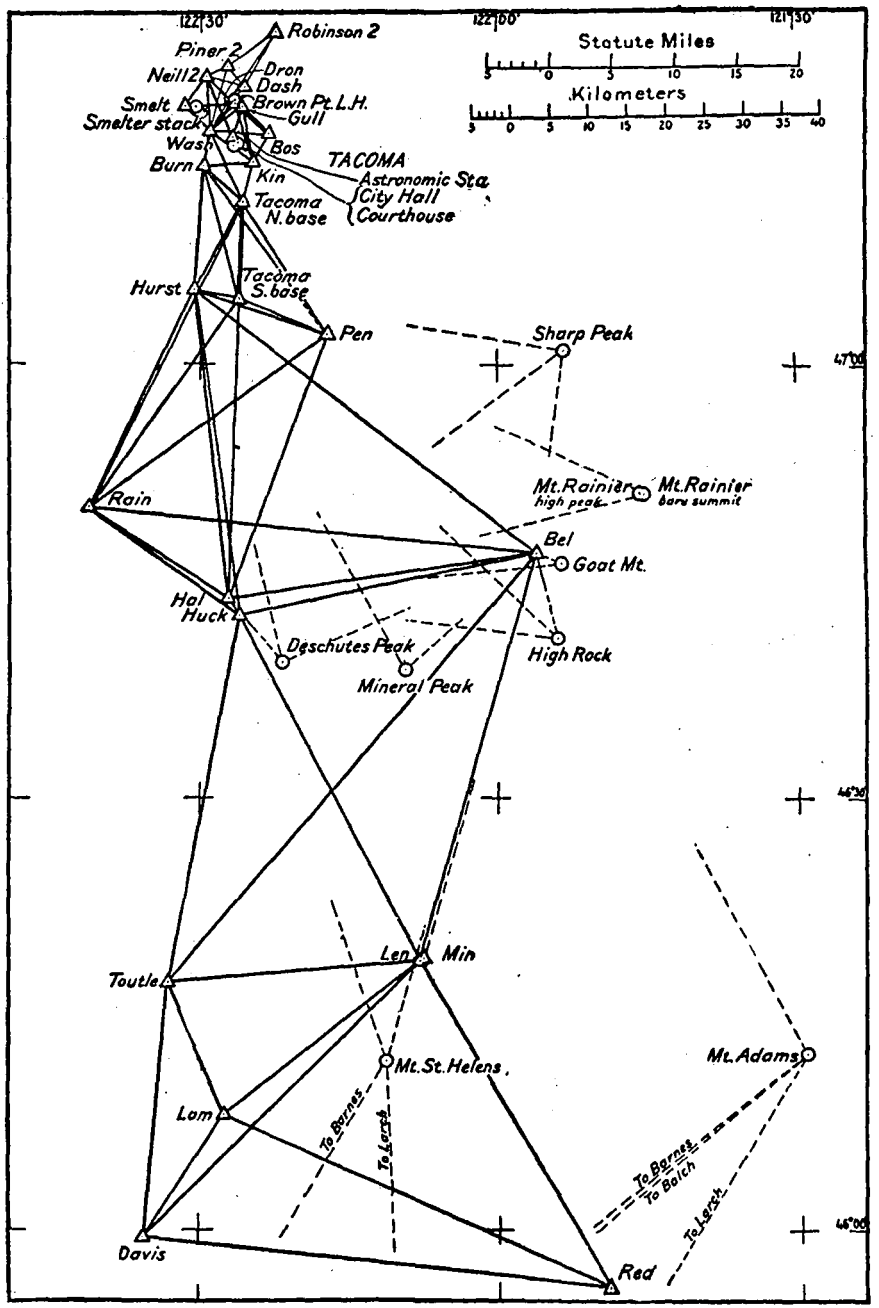

Fig. 7.—TR ANGULATION, VICINITY OF PORTLAND, OREG., TO TACOMA, WASH.

INDEX TO POSITIONS, DESCRIPTIONS, SKETCHES, AND ELEVATIONS.

Station.	Position.	Description.	Sketch.	Elevation.
	Page.	*Page.*	*Number.*	*Page.*
Albany courthouse cupola	18	.....	6	22
Alsea Peak, partly cleared, wooded summit	18	.....	5	22
Arquett cairn	18	.....	6	22
Ashland Peak, cairn	15	.....	4	21
Aspen Peak	15	.....	4	22
Astronomic station:				
Central Point	15	34	4	21
Corning	13	34		.....
Eugene	11	29	5	.....
Gazelle	10	25	4	21
Redding	13	34	3	21
Tacoma	13	33	7	22
Balch	19	36	6	.....
Ball Butte	17	.....	5	22
Bally	10	24	3, 4	21
Baptist Church spire, Eugene	17	35	5	.....
Barnes	12	20	6	22
Bel	12	31	7	22
Bench mark, Portland	19	.....	6	.....
Black	10	26	5	21
Black Butte, cairn	14	.....	4	21
Boliver (Calif.)	10	25	4	21
Bos	13	33	7	22
Brown Point Lighthouse	20	.....	7	22
Bully Choop	13	.....	3	21
Burg	16	35	5	21
Burn	13	32	7	22
Cannibal Peak, highest wooded summit	18	.....	5	22
Cem	19	.....	6	22
Central Point astronomic station	15	34	4	21
Central Point latitude station	15	34	4	.....
Chemawa tank	18	.....	6	22
China Mountain (not the cairn)	14	.....	4	21
Christian Church spire, Springfield	16	35	5	.....
City Hall, Tacoma	20	.....	7	22
Corning astronomic station	13	34	3	.....
Corning tower	13	33	3	.....
Corvallis, closed cupola	18	.....	6	22
Corvallis, open cupola	18	.....	6	22
Courthouse:				
Eugene, flagpole	17	35	5	.....
Redding	13	34	3	21
Tacoma, cupola	20	.....	7	22
Crater Peak	14	.....	3, 4	21
Dash	20	36	7	22
Davis	12	30	6, 7	22
Deady Hall, west tower, Eugene	16	35	5	.....
Deschutes Peak	20	.....	7	22
Diamond Peak	16	.....	5	22
Dodson (U. S. G. S.)	16	.....	5	22
Dron	13	33	7	22
Eagle, cairn	19	.....	6	22
Eugene:				
Astronomic station	11	29	5	.....
Baptist Church spire	17	35	5	.....
Courthouse flagpole	17	35	5	.....
Deady Hall, west tower	16	35	5	.....
Geary School spire	16	35	5	.....
Methodist Church	17	35	5	.....
Patterson School spire	17	35	5	.....
United Brethren Church spire	16	35	5	.....
W. O. W. Hall spire	17	35	5	.....
Fairdale Peak	19	.....	6	22
Fairview	11	26	5	21
Fir	19	.....	6	22
Forest Peak, tallest trees	18	.....	6	22
Gazelle astronomic station	10	25	4	21
Geary School spire, Eugene	16	35	5	.....
Goat Mountain	20	.....	7	22
Goose Nest, tall tree	15	.....	4	21
Greyback	15	.....	4	21
Gull	13	33	7	22

Index to positions, descriptions, sketches, and elevations.—Continued

Station.	Position.	Description.	Sketch.	Elevation.
	Page.	*Page.*	*Number.*	*Page.*
Hal	12	31	7	22
Harney	19	36	6	22
Hayrick	18	.....	5	22
Herman Peak, wooded summit	17	.....	5	22
High Rock (Oreg.)	15	.....	5	22
High Rock (Wash.)	20	.....	7	22
Hill (Calif.)	14	34	3	.....
Hill (Oreg.)	19	.....	6	22
Huck	12	31	7	22
Hult	12	29	6	22
Hurst	12	31	7	22
Kent	10	24	3	21
Kerby	15	.....	4	21
Kin	13	32	7	22
Lam	12	30	7	22
Larch	12	29	6	22
Lassen Peak	13	.....	3	21
Latitude station:				
Central Point	15	34	4	.....
Portland	19	36	6	.....
Roseburg	16	35	5	21
Lebanon, tall brick chimney	18	.....	6	22
Left Nipple	18	.....	5	22
Len	12	30	7	22
Liao Rock	15	.....	5	22
Little Shasta	14	.....	4	21
Longitude station, Portland	19	36	6	.....
Lost Peak	15	.....	4	21
Lyons	10	24	3	21
Marble Mountain	14	.....	4	21
Mary	11	27	5, 6	21
Marysville Butte	10	24	3	21
Mears	10	25	4	21
Methodist Church:				
Eugene	17	35	5	.....
Springfield, spire	16	35	5	.....
Middle Sister	17	.....	5	22
Min	20	.....	7	.....
Mineral Peak	20	.....	7	22
Mitchell	19	.....	6	22
Monmouth Peak	18	.....	6	22
Monument, General Land Survey	19	35	6	22
Mount Adams	19	.....	7	22
Mount Eddy, cairn	14	.....	4	21
Mount Helena	10	23	3	21
Mount Hood, peak	19	.....	6	22
Mount Jefferson	18	.....	6	22
Mount Linn	13	.....	3	21
Mount Pitt	15	.....	4	21
Mount Rainier bare summit	20	.....	7	22
Mount Rainier, high peak	20	.....	7	22
Mount St. Helens	20	.....	7	22
Mount St. John	13	.....	3	21
Mount Scott	15	.....	5	22
Mount Shasta, top	14	.....	4	21
Mount Washington	18	.....	5	22
Mount Zion	16	.....	5	22
Nebo	17	.....	5	22
Neill 2	13	33	7	22
North base:				
Redding	14	34	3	.....
Tacoma	12	32	7	22
Willamette	11	28	5	21
North Sister	17	.....	5	22
Old Bailey	16	.....	5	22
Onion	10	26	4, 5	21
Oregonian	19	36	6	22
Patterson School spire, Eugene	17	35	5	.....
Pen	12	32	7	22
Peterson	11	27	5, 6	21
Pilot Rock	15	.....	4	21
Piner 2	20	36	7	22
Pisgah	11	28	5	.....
Portland:				
Bench mark	19	.....	6	.....
Latitude station	19	36	6	.....
Longitude station	19	36	6	.....

Index to positions, descriptions, sketches, and elevations.—Continued

Station.	Position.	Description.	Sketch.	Elevation.
	Page.	*Page.*	*Number.*	*Page.*
Prairie Peak, west tree	17		5	22
Preston Peak	15		4	21
Quartz	16		5	22
Rain	12	31	7	22
Rauch	11	27	5	21
Red	12	30	6,7	22
Redding:				
Astronomic station	13	34	3	21
Courthouse	13	34	3	21
North base	14	34	3	
South base	14	34	3	
Ridge	11	27	5	21
River	19	35	6	22
Robinson 2	20	36	7	
Rocky Butte	19	36	6	22
Roman	11	26	5	21
Rose	16	34	5	21
Roseburg latitude station	16	35	5	21
Round	10	25	3,4	21
Round Peak	18		6	22
Russian Church, cross	16		5	
Russian Peak, north point	14		4	21
Russian Peak, south point	14		4	
Rust	10	26	4,5	21
St. Mary Butte	17		5	22
Salem Capitol, dome	18		6	22
Saw Tooth	14		4	21
Scott	11	26	5	21
Seavies (U. S. G. S.)	17	35	5	22
Seavies 2	11	28	5	
Sharp Peak	20		7	22
Sheridan Park, highest green tree	19		6	22
Siskiyou	15		4	21
Smelt	13	33	7	22
Smelter stack, 300 feet high	20		7	22
Snow Mountain east	10	24	3	21
Snow Mountain west	10	24	3	21
Soda	10	25	4	21
South base:				
Redding	14	34	3	
Tacoma	12	32	7	22
Willamette	11	27	5	21
South Sister	17		5	22
Spencer	11	26	5	21
Springfield:				
Christian Church spire	16	35	5	
Methodist Church spire	16	35	5	
Spur	10	25	4	21
Squaw, cairn	19		6	22
Star	12	30	6	22
Sterling	10	25	4	21
Table Rock, cairn	18		6	22
Tacoma:				
Astronomic station	13	33	7	22
City Hall cupola	20		7	22
Courthouse cupola	20		7	22
North base	12	32	7	22
South base	12	32	7	22
Thomas, cairn	18		6	22
Thompson Peak	14		4	21
Toutle	12	30	7	22
Twin	11	27	5	21
Union Peak	15		5	22
United Brethren Church spire, Eugene	16	35	5	
Vancouver Barracks flagstaff, west	19		6	
Wagner	15		4	21
Walker Peak	16		5	
Warren	12	30	6	22
Warren Schoolhouse cupola	19		6	
Wash	13	33	7	22
White	11	26	5	21
White Church spire, west of Brooks	19		6	22
Willamette north base	11	28	5	21
Willamette south base	11	27	5	21
W. O. W. Hall spire, Eugene	17	35	5	
Yam	11	29	6	22
Yellow	11	26	5	21