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PRECISE TRIANGULATION IN TEXAS, RIO GRANDE ARC

By

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Hydrographic and Geodetic Engineer

Special Publication No. 78

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PRECISE TRIANGULATION IN TEXAS, RIO GRANDE ARC.

By CLEM L. GARNER, *Hydrographic and Geodetic Engineer, U. S. Coast and Geodetic Survey.*

PART I.

INTRODUCTION.

The triangulation covered by this publication extends along the north and east side of the Rio Grande from a connection with the precise triangulation along the ninety-eighth meridian, in the vicinity of Harlingen, Tex., to a connection with the Texas-California arc of precise triangulation near Alpine, Tex. The strip of territory covered by this control lies adjacent to the Rio Grande as far west as Marathon. Starting with a width of about 5 miles at the eastern end it gradually widens until the width at the western end is about 30 miles.

The field work was done by various chiefs of party as follows: J. S. Bilby, signalman, did the reconnaissance and signal building on the eastern end of the arc from Harlingen to Dryden; E. H. Pagenhart, hydrographic and geodetic engineer, did the reconnaissance west of Dryden, made the observations at 32 stations west of Del Rio, and measured the 5 bases along the arc; C. V. Hodgson, hydrographic and geodetic engineer, made the observations at 19 stations on the eastern end of the arc; the writer made the observations at 79 stations between Riogrande and Del Rio.

All of the office computations, including the least-squares adjustments, were made by members of the division of geodesy. The main adjustment was made by Charles A. Mourhess and Oscar S. Adams, mathematicians, and the former had charge of the remainder of the computations. W. D. Sutcliffe, mathematician, assisted in the adjustment and computations. Miss Sarah Beall, mathematician, made the astronomic computations and prepared the text for the astronomic data.

The tabular arrangement of data in this publication follows the general plan adopted by the U. S. Coast and Geodetic Survey some years ago. No attempt has been made to secure originality in language in the explanation of the tables. On the contrary, in some paragraphs the language is identical with that found in previous publications of this Bureau, and it was not considered necessary to indicate such paragraphs as quotations.

CLASSES OF TRIANGULATION.

Triangulation is divided into different classes according to accuracy. The terms applied to these classes have recently been changed by agreement of representatives of the various Federal map-making

bureaus. Four classes of triangulation are now prescribed and defined—viz, precise, primary, secondary, and tertiary. The first three of these are, respectively, equal in accuracy to the classes primary, secondary, and tertiary as previously defined by the U. S. Coast and Geodetic Survey.

The ultimate criterion applied in classifying the different grades of triangulation is the actual error in the length of any line. This is indicated by the discrepancy between the measured length of a base line and its length as computed through the triangulation from the last preceding base. In precise triangulation such discrepancies must not exceed one part in 25 000, in primary triangulation one part in 10 000, and in secondary triangulation one part in 5000. Before making the comparison between the computed and measured lengths the adjustment of the triangulation should be carried to the point where the side and angle equations have been satisfied. It is also necessary to take into consideration the maximum actual error in the measurement of the base.

To secure the accuracy indicated above, certain standards are adopted for the field work, the most important one of which relates to the closing error of the triangles or the discrepancy between the sum of the measured angles in a triangle and 180° plus the spherical excess of the triangle. In precise triangulation the average closing error of the triangles must not be greatly in excess of 1″, in primary not more than 3″, and in secondary about 5″. The shape of the figures in the triangulation scheme, the frequency of bases, the size of the instrument, and the number and kind of observations are all selected with due regard to the accuracy desired.

Under certain conditions the proportionate error in the length of a line as specified above may be found to be exceeded in any class of triangulation. Where two points are comparatively close together as compared with the size of the triangulation scheme the distance between those points may be in error in excess of that indicated by the class of triangulation of the scheme. The accuracy of the computed length of any line can be estimated by computing the ΣR_1 in accordance with the formula for the strength of figures as given in U. S. Coast and Geodetic Survey Special Publication No. 26. In any class of triangulation the subsidiary stations will be located with a less degree of accuracy than the main scheme stations.

ARRANGEMENT OF SUBJECT MATTER.

In Part I are given such data for the Rio Grande arc of precise triangulation as will ordinarily be needed for control purposes.

The final results of a system of triangulation take the form of geographic positions, which give the latitude and longitude of each point of the triangulation, the azimuths of each line, and the logarithm of the length in meters of each line, together with its length in meters and feet.

Geographic positions, with descriptions and elevations of the stations, are arranged in tabulated form in Part I of this publication. Here the engineer and surveyor will find the data which will give him control points for his local surveys. On page 9 under the heading "How to find the data desired," is a description of the use of the tables. The tabulation of the various kinds of

data given in Part I is arranged in the following order: (1) The geographic positions of the triangulation points are found in the tables on pages 11 to 30. Points of precise accuracy are found in a separate table from those of lower grades. (2) Following the geographic positions is a table, pages 31 and 32, giving the trigonometric elevations of all points, referred to mean sea level. A note on page 32 indicates the degree of accuracy to be expected in the three different classes of elevations. Such elevations, intended primarily to furnish the approximate elevations of the stations in order that the sea-level lengths of the lines may be computed, may be used for some topographic purposes but not as elevations from which to start spirit leveling. (3) The descriptions of all marked points, with the character of the marks, are given on pages 32 to 50. (4) The lengths of the lines are given in this publication in both meters and feet, but for the convenience of those who may wish to convert other quantities from one system to the other, conversion tables are given on pages 51 to 58.

Part II of this publication is devoted to a brief description of the methods employed in making the observations and to a discussion of the errors and methods of adjustment. Tabulations of different factors in the results are given, as well as the condition equations used in making the adjustments.

An analysis of the costs of the different operations in both field and office is given for the information of the public, for whose benefit the work was done.

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

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

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

An examination of the station errors of the astronomic 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 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 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 the modern "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.

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 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. 3); 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 51–58. 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 explained in the discussion of the adjustments (see p. 80), depend upon the adjusted lengths of the line Rio-Donna of the ninety-eighth meridian triangulation and of the sides of the triangle Chispa-Krouse-Newman of the Texas-California triangulation, and upon the measured lengths of the following five bases: Samfordyce, Zapata, Carrizo, Paloma, and Dryden. 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 $\frac{1}{3000}$ 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 —, the azimuth from Mission to Hickley is 334° 54′ 37″.79, while the back azimuth, or the azimuth from Hickley to Mission, is 154° 56′ 39″.69.

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

ACCURACY OF DATA INDICATED IN TABLES.

The rule followed in recent publications of this office has been to give latitudes and longitudes to thousandths of seconds for all points, the positions of which are fixed by fully adjusted triangulation. Points, the position 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.

In the selection of stations upon which to base new triangulation or extensive surveys of any kind only the principal points, that is, the main scheme points, should be used. No-check points, or unoccupied ones determined from only two stations, should always be used with caution and never as the base for further triangulation.

HOW TO FIND THE DATA DESIRED.

Following the index at the back of this publication are eight sketches. 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 the area covered by each of figures 5–10, which are detailed maps showing the scheme of triangulation plotted by latitudes and longitudes on a polyconic projection. From these sketches may be obtained the names of all stations in any portion of the area covered.

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

Special Publication No. 5 is entitled "Tables for a Polyconic Projection of Maps, Based on Clarke's Reference Spheroid of 1866." These tables give the necessary explanation of the method employed in the construction of a polyconic projection, as well as furnishing 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." The object of this publication is to coordinate surveys which have been reduced to spherical coordinates with connecting surveys which have been computed with reference to plane coordinates and to place the whole on either system as may be desired.

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.
Special Publication No. 31, positions and descriptions in Oregon, Washington, and California.
Special Publication No. 43, positions in Georgia.
Special Publication No. 45, descriptions in Georgia.
Special Publication No. 46, positions and descriptions in Maine.
Special Publication No. 54, positions and descriptions in Texas.
Special Publication No. 62, positions and descriptions in Rhode Island.
Special Publication No. 70, positions and descriptions in Kansas.
Special Publication No. 74, positions and descriptions in Idaho, Oregon, and Washington.
Special Publication No. 76, positions and descriptions in Massachusetts.
Special Publication No. 78, positions and descriptions in Texas (Rio Grande arc).
Report on triangulation of Greater New York.
Report on a plan of sewerage for the city of Cincinnati.
Appendix EEE, pages 2905–3031, Annual Report of the Chief of Engineers, U. S. Army, 1902, positions of points on and near the Great Lakes.
Professional Paper No. 24, Corps of Engineers, U. S. Army, descriptions of points on and near the Great Lakes.
Publications of the Massachusetts Commission on Waterways and Public Lands.
Various bulletins of the United States Geological Survey.

GEOGRAPHIC POSITIONS.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
Principal points.	° ′ ″	° ′ ″	° ′ ″				
Donna, 1913	26 09 40.459						
	98 02 45.414						
Rio, 1913	26 04 24.807	134 07 54.34	314 05 15.57	Donna	4.1447561	13955.84	45786.8
	97 56 44.751						
Handy, 1917	26 05 36.803	215 16 06.13	35 17 30.19	Donna	3.9629258	9181.76	30123.8
	98 05 56.306	278 12 03.53	98 16 06.04	Rio	4.1899980	15488.10	50813.9
San Juan, 1917	26 11 18.323	295 07 34.00	115 09 15.94	Donna	3.8505850	7089.00	23257.8
	98 06 36.511	307 42 25.21	127 46 45.84	Rio	4.3178325	20788.95	68205.1
		353 55 49.43	173 56 07.15	Handy	4.0239218	10566.27	34666.5
McAllen, 1917	26 14 01.949	291 10 58.25	111 14 24.67	San Juan	4.1435539	13917.27	45660.2
	98 14 23.870	317 45 45.36	137 49 20.16	Handy	4.3218611	20982.69	68840.7
Hickley, 1917	26 08 48.054	197 43 13.18	17 44 02.27	McAllen	4.0060958	10141.35	33272.1
	98 16 15.081	253 54 30.42	73 58 45.57	San Juan	4.2232342	16719.92	54855.3
		288 51 09.98	108 55 42.40	Handy	4.2593509	18169.83	59612.2
Mission, 1917	26 17 39.985	301 58 03.58	122 00 54.89	McAllen	4.1026102	12665.15	41552.2
	98 20 50.978	334 54 37.79	154 56 39.69	Hickley	4.2570223	18072.67	59293.4
Mamie, 1917	26 13 02.931	190 39 05.54	19 39 54.09	Mission	3.9568326	9053.84	29704.1
	98 22 40.735	262 28 02.69	82 31 42.26	McAllen	4.1433538	13910.85	45639.2
		306 11 48.95	126 14 39.11	Hickley	4.1230035	13274.05	43549.9
Palo, 1917	26 19 38.951	287 31 39.45	107 34 44.40	Mission	4.0841906	12139.22	39826.8
	98 27 48.248	324 59 05.23	145 01 21.35	Mamie	4.1725213	14877.20	48809.6
Pedro, 1917	26 14 36.740	192 01 53.35	12 02 25.00	Palo	3.9781520	9509.38	31198.7
	98 28 59.722	247 23 27.31	67 27 03.62	Mission	4.1669364	14687.11	48186.0
		285 19 22.89	105 22 10.40	Mamie	4.0377574	10908.31	35788.3
Eltoro, 1917	26 21 51.958	291 37 04.85	111 39 49.97	Palo	4.0452888	11099.13	36414.4
	98 34 00.306	328 04 40.94	148 06 54.14	Pedro	4.1980194	15776.82	51761.1
Fordyce, 1917	26 17 47.435	189 23 58.94	9 24 18.87	Eltoro	3.8823865	7627.575	25024.80
	98 34 45.238	253 26 52.03	73 29 56.87	Palo	4.0815095	12064.51	39581.6
		301 27 01.97	121 29 34.90	Pedro	4.0507888	11240.58	36878.5
Pancho, 1917	26 26 36.793	305 52 10.56	125 55 24.88	Eltoro	4.1746513	14950.35	49049.6
	98 41 17.284	320 15 56.62	146 18 50.75	Fordyce	4.2918953	19583.73	64251.0
Garcia, 1917	26 20 41.271	190 19 55.06	10 20 27.07	Pancho	4.0461673	11121.60	36488.1
	98 42 29.279	261 12 20.34	81 16 06.29	Eltoro	4.1546963	14278.93	46846.9
		292 32 33.27	112 35 59.02	Fordyce	4.1441932	13937.77	45727.5
Monument, 1917	26 21 16.683	218 46 22.94	38 48 29.96	Pancho	4.1017111	12638.95	41466.3
	98 46 02.964	280 24 31.64	100 26 06.48	Garcia	3.7799200	6024.49	19765.3
Corpus, 1917	26 26 28.447	268 05 04.47	88 07 09.02	Pancho	3.8895189	7753.84	25439.1
	98 45 56.992	331 40 07.16	151 41 39.49	Garcia	4.0841028	12136.76	39818.7
		0 59 19.63	180 59 16.97	Monument	3.9820860	9595.91	31482.6
Grande, 1917	26 23 30.226	227 15 43.74	47 17 19.08	Corpus	3.9076210	8083.90	26521.9
	98 49 31.288	305 25 23.70	125 26 56.24	Monument	3.8505412	7088.29	23255.5
Hebron, 1917	26 27 00.538	274 44 51.74	94 48 01.83	Corpus	4.0743215	11866.47	38931.9
	98 53 03.818	312 11 21.21	132 14 28.35	Monument	4.1972557	15749.10	51670.2
		317 41 11.78	137 42 46.35	Grande	3.9420482	8750.81	28709.9
Ringgold, 1917	26 22 30.756	185 03 41.33	5 03 53.14	Hebron	3.9209086	8335.06	27345.9
	98 53 30.361	254 32 48.72	74 34 34.96	Grande	3.8372848	6875.19	22556.4
		280 23 09.36	100 26 28.04	Monument	4.1007696	12611.58	41376.5
Garcena, 1917	26 26 56.347	268 19 27.67	88 20 38.98	Hebron	3.6471051	4437.16	14557.6
	98 55 43.912	335 37 47.79	155 38 47.20	Ringgold	3.9529121	8972.47	29437.2
Gorgora, 1917	26 25 23.581	250 31 22.70	70 33 32.53	Garcena	3.9329710	8569.81	28116.1
	99 00 35.540	256 33 46.41	76 37 07.52	Hebron	4.1094707	12866.80	42213.8
		294 15 53.65	114 19 02.69	Ringgold	4.1115667	12929.05	42418.5
Roma, 1917	26 28 12.690	283 19 03.81	103 21 43.17	Garcena	4.0078722	10182.92	33408.5
	99 01 41.583	340 37 32.22	160 38 01.63	Gorgora	3.7416730	5516.62	18099.1

GEOGRAPHIC POSITIONS—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
Principal points—Continued.	° ′ ″	° ′ ″	° ′ ″				
Chinges, 1917	26 31 27.361	349 16 32.09	169 16 57.52	Garcena	3.9288405	8488.69	27850.0
	98 56 40.929	30 08 51.52	210 07 06.94	Gorgora	4.1120929	12944.73	42469.5
		54 16 52.83	234 14 38.70	Roma	4.0110380	10257.42	33652.9
Banchez, 1917	26 32 16.348	348 56 43.33	168 56 48.08	Chinges	3.1864202	1536.10	5039.7
	98 56 51.567	46 58 51.36	226 56 41.94	Roma	4.0408988	10987.50	36048.2
Margo, 1917	26 33 23.394	285 17 48.05	105 19 49.72	Banchez	3.8928056	7812.78	25632.4
	99 01 23.791	294 29 51.00	114 31 57.39	Chinges	3.9348091	8606.15	28235.3
		2 57 01.81	182 56 53.87	Roma	3.9811252	9574.70	31413.0
Labra, 1917	26 34 41.947	282 59 58.15	103 02 47.06	Margo	4.0305205	10728.19	35197.4
	99 07 41.456	320 13 36.57	140 16 17.28	Roma	4.1926078	15581.45	51120.1
Burros, 1917	26 37 43.420	341 20 15.58	161 20 59.29	Margo	3.9266659	8446.29	27710.9
	99 03 01.438	352 49 20.63	172 49 56.32	Roma	4.2480477	17703.03	58080.7
		54 13 48.23	234 11 42.83	Labra	3.9800294	9550.57	31333.8
Flores, 1917	26 38 24.747	315 07 34.27	135 07 54.79	Burros	3.2539816	1794.66	5888.0
	99 03 47.214	43 23 54.44	223 22 09.52	Labra	3.9747283	9434.70	30953.7
Presa, 1917	26 42 31.454	19 21 24.40	199 20 33.87	Burros	3.9729080	9395.24	30824.2
	99 01 08.860	29 58 51.39	209 57 40.30	Flores	3.9427373	8764.70	28755.5
Roleta, 1917	26 45 41.929	288 31 45.52	108 36 29.50	Presa	4.2650236	18408.72	60395.9
	99 11 40.307	315 43 16.47	135 47 09.57	Burros	4.3129813	20558.02	67447.4
		315 47 01.09	135 50 34.27	Flores	4.2733136	18763.49	61559.9
		341 58 21.47	162 00 08.68	Labra	4.3295693	21358.43	70073.4
Ale, 1917	26 46 31.681	295 55 09.70	115 50 17.04	Presa	4.2277173	16893.41	55424.5
	99 10 18.535	55 52 36.26	235 51 59.43	Roleta	3.4360292	2729.16	8953.9
Evanito, 1917	26 49 58.213	318 27 27.86	138 30 46.30	Presa	4.2639344	18302.61	60044.7
	99 08 29.406	25 22 33.51	205 21 44.31	Ale	3.8472475	7034.73	23079.8
		33 46 28.29	213 45 02.23	Roleta	3.9771588	9487.65	31127.4
Rafael, 1917	26 50 35.629	276 25 25.98	96 28 12.61	Evanito	4.0109597	10255.57	33640.8
	99 14 38.492	331 25 21.53	151 26 41.88	Roleta	4.0124985	10291.97	33766.2
Humaran, 1917	26 53 33.495	341 57 29.07	161 58 04.39	Evanito	3.8431182	6903.16	22861.4
	99 09 47.565	12 06 49.83	192 05 58.96	Roleta	4.1715834	14843.40	48698.7
		55 44 14.22	235 42 02.75	Rafael	3.9876164	9718.88	31886.0
Zapata, 1917	26 52 49.422	264 08 55.54	84 12 33.55	Humaran	4.1262843	13374.71	43880.2
	99 17 49.676	307 57 00.25	127 58 26.63	Rafael	3.8256823	6693.95	21961.7
Moleno, 1917	26 57 02.270	300 06 26.53	120 09 28.19	Humaran	4.1071992	12799.68	41993.6
	99 16 28.792	345 38 40.76	165 39 30.66	Rafael	4.0892974	12282.80	40297.8
		16 00 25.73	195 59 49.12	Zapata	3.9082510	8095.64	26560.4
Urebeno, 1917	26 57 05.069	270 45 47.70	90 47 31.97	Moleno	3.8025474	6346.69	20822.4
	99 20 18.863	332 22 24.43	152 23 31.96	Zapata	3.9484039	8879.81	29133.2
Feora, 1917	26 58 31.387	288 17 48.85	108 20 05.06	Moleno	3.9409093	8727.89	28634.8
	99 21 29.214	323 51 10.42	143 51 42.32	Urebeno	3.5171616	3289.74	10793.1
		330 03 59.42	150 05 38.84	Zapata	4.0843292	12143.09	39839.5
Loma, 1917	26 59 52.391	346 55 38.07	166 55 58.06	Moleno	3.7303890	5375.13	17634.9
	99 17 12.869	44 53 51.07	224 52 26.71	Urebeno	3.8614362	7268.36	23846.3
		70 35 17.94	250 33 21.62	Feora	3.8747929	7495.367	24591.05
Ygnacio, 1917	27 03 28.757	304 45 06.12	124 47 44.23	Loma	4.0672921	11675.95	38306.8
	99 23 00.808	344 34 14.73	164 34 56.34	Feora	3.9774602	9494.24	31149.0
Union, 1917	27 08 30.576	356 11 53.08	176 12 10.57	Loma	4.2036778	15983.72	52439.9
	99 17 51.308	18 02 58.55	198 01 19.43	Feora	4.2876827	19394.68	63630.7
		42 33 54.74	222 31 33.75	Ygnacio	4.1006725	12608.76	41367.2
Dan, 1917	27 10 59.888	337 57 31.64	157 58 02.48	Union	3.6952867	4957.77	16265.6
	99 18 58.873	25 39 05.19	205 37 14.90	Ygnacio	4.1875494	15401.02	50528.2
Dolores, 1917	27 10 46.829	312 31 24.07	132 34 37.53	Dan	4.1984037	15790.79	51807.0
	99 26 01.660	318 30 30.46	138 34 14.68	Union	4.3092274	20381.09	66867.0
		348 31 48.44	168 33 11.02	Ygnacio	4.3990290	25062.76	82226.7

GEOGRAPHIC POSITIONS—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
Principal points—Continued.	° ′ ″	° ′ ″	° ′ ″				
George, 1917	27 21 00.641	2 09 06.82	182 08 55.25	Dan	4.2672515	18503.40	60706.6
	99 18 33.633	57 38 45.48	237 35 19.89	Dolores	4.1639492	14586.44	47855.7
Fort, 1917	27 20 45.284	314 07 36.19	134 10 39.20	George	4.1826653	15228.79	49963.1
	99 25 11.344	340 35 14.42	160 38 05.33	Dan	4.4892226	30847.69	101206.1
		4 17 47.21	184 17 24.08	Dolores	4.2665082	18471.76	60602.8
Casbeer, 1917	27 30 21.762	353 34 49.99	173 35 22.55	George	4.2400439	17379.76	57020.1
	99 19 44.331	53 20 22.04	233 23 51.16	Fort	4.0484542	11180.32	36680.8
Taylor, 1917	27 30 49.944	288 18 38.88	108 19 22.98	Casbeer	3.4409363	2760.17	9055.7
	99 21 19.803	345 51 57.74	165 53 14.29	George	4.2719288	18703.75	61363.9
		40 10 57.70	220 09 10.86	Fort	3.9936426	9854.68	32331.6
Laredo, 1917	27 30 37.041	268 14 03.24	88 17 43.00	Taylor	4.1178015	13116.00	43031.4
	99 29 17.480	316 32 05.64	136 33 59.22	Fort	3.9923699	9825.85	32237.0
Orvil, 1917	27 38 12.176	320 10 33.96	140 13 45.34	Taylor	4.2483810	17716.62	58125.3
	99 28 13.223	346 42 26.83	166 43 50.93	Fort	4.3369285	21723.44	71271.0
		7 10 30.80	187 10 01.05	Laredo	4.1498196	14119.51	46323.8
Knob, 1917	27 36 00.758	237 19 20.95	57 21 07.63	Orvil	3.8747791	7495.13	24590.3
	99 32 03.351	298 24 38.34	118 29 36.07	Taylor	4.3027769	20080.01	65881.1
		326 29 48.31	146 32 58.71	Fort	4.3117068	20497.78	67249.8
		335 26 34.32	155 27 51.05	Laredo	4.0395714	10953.97	35938.1
Fieldings, 1917	27 40 30.921	295 12 55.85	115 15 29.28	Orvil	4.0007150	10016.48	32862.4
	99 33 43.781	341 40 29.07	161 41 15.66	Knob	3.9424849	8759.61	28738.8
Davis, 1917	27 46 06.218	349 42 41.04	169 43 25.95	Orvil	4.1711253	14829.46	48653.0
	99 29 49.838	11 06 55.46	191 05 53.43	Knob	4.2785727	18992.00	62309.9
		31 51 09.18	211 49 20.35	Fieldings	4.0845196	12148.41	39856.9
Tordillo, 1917	27 43 26.859	253 25 46.06	73 30 26.99	Davis	4.2365096	17238.90	56558.0
	99 39 53.274	298 07 11.77	118 10 03.52	Fieldings	4.0599319	11481.06	37667.4
Coleman, 1917	27 45 20.493	200 13 23.85	86 18 42.70	Davis	4.2737762	18783.48	61625.5
	99 41 14.342	306 21 53.12	126 25 22.07	Fieldings	4.1856434	15333.57	50306.9
		328 54 26.42	148 55 04.16	Tordillo	3.6334712	4300.03	14107.7
Tajone, 1917	27 49 18.511	3 05 14.34	183 05 08.90	Davis	3.7728781	5927.59	19447.4
	99 29 38.179	69 30 09.04	249 24 44.47	Coleman	4.3086163	20352.43	66772.9
Thomas, 1917	27 53 24.241	287 17 56.85	107 24 50.15	Tajone	4.4040668	25355.19	83186.2
	99 44 22.723	299 23 06.37	119 20 53.86	Davis	4.4382251	27420.96	89993.1
		340 40 04.78	160 41 32.70	Coleman	4.1926557	15583.17	51125.8
Willie, 1917	27 56 02.506	290 39 58.30	110 47 00.59	Tajone	4.4418310	27658.65	90743.4
	99 44 41.304	354 02 52.47	174 03 01.17	Thomas	3.6002684	4900.82	16078.8
Brewster, 1917	28 01 05.273	330 43 22.58	150 46 51.19	Tajone	4.3967926	24934.03	81804.4
	99 37 03.718	40 14 46.34	220 11 20.55	Thomas	4.2691598	18584.88	60973.9
		53 20 33.31	233 16 58.65	Willie	4.1929755	15594.65	51163.4
Cup, 1917	28 03 34.938	286 44 43.63	106 49 06.54	Browster	4.2029257	15956.00	52349.2
	99 46 23.021	348 42 17.93	168 43 05.67	Willie	4.1522472	14198.65	46583.4
Galvan, 1917	28 05 59.642	356 51 51.94	176 52 00.49	Brewster	3.9578415	9074.89	29773.2
	99 37 21.887	33 10 49.99	213 07 23.58	Willie	4.3414032	21951.45	72019.0
		73 15 29.41	253 11 14.70	Cup	4.1884073	15431.47	50628.1
Twin, 1917	28 05 35.399	267 47 53.19	87 53 35.42	Galvan	4.2977900	19851.35	65129.0
	99 49 28.559	306 11 25.88	126 12 53.20	Cup	3.7978219	6278.01	20597.1
Cat, 1917	28 17 31.302	318 58 17.86	139 03 38.31	Galvan	4.4503152	28204.29	92533.6
	99 48 40.112	351 43 34.66	171 44 39.39	Cup	4.4152308	26015.78	85353.4
		3 26 04.32	183 25 41.43	Twin	4.3439422	22077.11	72431.3
Big, 1917	28 11 48.605	226 49 07.47	46 52 22.79	Cat	4.1881891	15423.72	50602.7
	99 55 32.852	310 06 28.32	130 09 20.15	Twin	4.1816086	15191.78	49841.7
Tom, 1918	28 12 56.666	232 13 51.42	52 17 01.08	Cat	4.1402360	13811.35	45312.7
	99 55 20.771	324 41 55.04	144 44 41.22	Twin	4.2211276	16639.02	54589.9
		8 56 13.71	188 56 08.00	Big	3.3265094	2120.85	6958.2

GEOGRAPHIC POSITIONS—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
Principal points—Continued.	° ′ ″	° ′ ″	° ′ ″				
Dentonio, 1918.....	28 18 32.500	278 39 30.13	98 43 04.64	Cat.....	4.0959137	12471.36	40916.5
	99 56 12.573	352 13 09.78	172 13 34.31	Tom.....	4.0184514	10434.01	34232.2
Carlow, 1918.....	28 22 46.859	306 50 47.90	126 54 33.53	Cat.....	4.2091618	16186.83	53106.3
	99 56 35.479	353 36 07.56	173 36 42.98	Tom.....	4.2020183	18281.77	59979.4
		355 26 34.77	175 26 45.05	Dentonio.....	3.8951386	7854.86	25770.5
Barr, 1918.....	28 18 12.512	229 56 31.20	49 59 26.41	Carlow.....	4.1182461	13129.44	43075.5
	100 02 44.569	308 45 40.10	128 49 10.22	Tom.....	4.1908866	15519.82	50917.9
English, 1918.....	28 23 25.269	279 41 26.70	99 43 27.45	Carlow.....	3.8458597	7012.29	23006.2
	100 00 49.354	335 09 00.82	155 11 36.62	Tom.....	4.3288111	21321.17	69951.2
		18 03 34.74	198 02 40.04	Barr.....	4.0054471	10120.214	33222.42
Indio, 1918.....	28 21 23.797	259 29 28.56	79 35 22.07	English.....	4.3138154	20597.54	67577.1
	100 13 13.254	288 56 02.13	109 01 00.47	Barr.....	4.2578089	18109.18	59413.2
Glass, 1918.....	28 28 12.571	301 03 50.52	121 08 12.99	English.....	4.2335475	17121.72	56173.5
	100 09 48.068	328 00 02.19	148 03 23.53	Barr.....	4.3379589	21775.04	71440.3
		23 56 45.43	203 55 07.80	Indio.....	4.1388477	13767.27	45168.1
Farland, 1918.....	28 25 23.772	240 27 50.09	60 30 31.39	Glass.....	4.0231737	10548.09	34606.5
	100 15 25.423	278 38 22.57	98 45 10.34	English.....	4.3824494	24124.01	79146.9
		302 35 58.92	122 42 00.38	Barr.....	4.3910030	24607.21	80732.3
		334 01 17.20	154 02 20.11	Indio.....	3.9147149	8217.03	26958.7
Mack, 1918.....	28 26 24.884	251 33 41.21	71 36 35.58	Glass.....	4.0209502	10494.37	34430.3
	100 15 54.033	337 30 56.65	157 31 10.27	Farland.....	3.3087821	2036.02	6679.8
Kennedy, 1918.....	28 33 02.043	325 23 18.68	145 25 06.57	Glass.....	4.0344456	10825.44	35516.5
	100 13 34.100	12 07 15.81	192 06 22.71	Farland.....	4.1592209	14428.78	47338.4
		17 17 58.48	197 16 51.72	Mack.....	4.1073748	12804.86	42010.6
Silo, 1918.....	28 33 15.477	271 41 48.61	91 45 40.33	Kennedy.....	4.1366166	13690.72	44936.7
	100 21 57.748	321 55 44.93	141 58 38.46	Mack.....	4.2054845	16050.35	52658.5
Davidson, 1918.....	28 38 11.212	330 34 04.82	150 35 39.35	Kennedy.....	4.0384863	10926.63	35848.5
	100 16 51.621	355 52 40.14	175 53 07.65	Mack.....	4.3384601	21800.18	71522.8
		42 26 12.16	222 23 45.64	Silo.....	4.0010202	12331.79	40458.5
Eagle, 1918.....	28 43 37.481	300 56 03.58	121 00 59.38	Davidson.....	4.2903864	19515.80	64028.1
	100 27 07.937	336 13 51.97	156 16 20.65	Silo.....	4.3205557	20919.71	68634.1
Pass, 1918.....	28 42 50.859	198 42 04.86	18 42 13.40	Eagle.....	3.1804923	1515.28	4971.4
	100 27 25.840	296 31 13.08	116 36 17.41	Davidson.....	4.2844722	19251.84	63162.1
		333 16 15.15	153 18 52.38	Silo.....	4.2972890	19828.46	65053.9
Laplace, 1918.....	28 42 46.420	248 19 27.55	68 20 37.60	Eagle.....	3.6201248	4257.21	13967.2
	100 29 33.719	267 44 23.02	87 45 24.45	Pass.....	3.5407618	3473.40	11395.8
		324 47 59.62	144 51 38.12	Silo.....	4.3324734	21501.73	70543.6
Lone, 1918.....	28 45 59.375	324 21 28.11	144 24 30.79	Davidson.....	4.2486858	17729.07	58166.1
	100 26 11.985	49 54 05.82	229 52 03.77	Pass.....	3.9545861	9007.12	29550.9
		55 42 31.91	235 40 38.44	Eagle.....	3.8803198	7750.32	25427.5
Nine, 1918.....	28 49 22.326	295 38 09.00	115 41 59.90	Lone.....	4.1590949	14424.31	47323.8
	100 31 11.365	328 06 10.71	148 08 07.89	Eagle.....	4.0969863	12502.20	41017.6
		347 43 54.32	167 44 41.32	Laplace.....	4.0959532	12472.49	40920.2
Paloma, 1918.....	28 53 28.803	354 48 02.57	174 48 24.95	Lone.....	4.1427980	13893.06	45580.8
	100 23 58.395	15 46 44.32	195 45 12.99	Eagle.....	4.2768270	18915.90	62059.9
		57 08 32.40	237 05 03.44	Nine.....	4.1453447	13974.77	45848.9
Burr, 1918.....	28 52 35.352	259 39 42.50	79 42 23.66	Paloma.....	3.9632745	9189.13	30148.0
	100 29 32.032	24 22 54.81	204 22 06.88	Nine.....	3.8145153	6524.02	21404.2
Pen, 1918.....	28 56 27.828	303 31 00.87	123 33 29.30	Paloma.....	3.9989503	9975.86	32729.1
	100 29 05.354	5 46 05.11	185 45 52.22	Burr.....	3.8560357	7193.42	23600.4
Wiffp, 1918.....	28 56 48.315	274 28 37.26	94 31 00.57	Pen.....	3.9054875	8044.280	26301.96
	100 34 01.479	316 50 10.38	136 52 20.65	Burr.....	4.0283165	10673.74	35018.8
		341 25 49.90	161 27 12.08	Nine.....	4.1606086	14483.34	47517.4
White, 1918.....	29 00 03.625	334 30 37.39	154 31 34.03	Pen.....	3.8068508	7359.54	24145.4
	100 31 02.300	38 54 27.78	218 53 00.96	Wiffp.....	3.8879426	7725.78	25347.0

GEOGRAPHIC POSITIONS—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
Principal points—Continued.	° ′ ″	° ′ ″	° ′ ″				
Lake, 1918	29 00 00.131	263 43 02.41	83 43 19.93	White	2.0027519	983.45	3226.5
	100 31 38.416	327 36 48.58	147 38 02.72	Pen	3.8886803	7739.08	25390.6
		34 16 13.00	213 15 03.70	Wiffp	3.8489419	7062.23	23170.0
Jamerson, 1918	29 06 31.510	340 44 07.21	160 45 22.09	White	4.1020658	12649.28	41500.2
	100 33 36.490	2 09 30.75	182 09 18.02	Wiffp	4.2544846	17967.37	58947.9
Towne, 1918	29 02 50.791	217 00 01.56	37 01 33.02	Jamerson	3.9299328	8510.06	27920.1
	100 36 45.906	298 56 27.86	118 59 14.57	White	4.0284287	10627.44	34866.9
		338 14 44.06	158 16 03.77	Wiffp	4.0796937	12014.17	39410.5
Dixie, 1918	29 08 48.316	287 45 13.12	107 49 09.52	Jamerson	4.1305045	13788.10	45236.5
	100 41 42.148	323 56 00.09	143 58 24.15	Towne	4.1339730	13613.60	44664.0
Peters, 1918	29 10 32.904	331 55 21.14	151 56 32.54	Jamerson	3.9254339	8422.36	27632.4
	100 36 03.100	4 39 13.47	184 38 52.04	Towne	4.1545486	14274.10	46830.9
		70 39 37.24	250 36 52.03	Dixie	3.9873094	9712.02	31863.5
Ross, 1918	29 17 43.989	330 24 35.57	150 26 51.77	Peters	4.1835487	15259.80	50064.9
	100 40 41.963	5 37 59.64	185 37 30.26	Dixie	4.2193747	16571.09	54369.9
Brackett, 1918	29 21 23.298	45 56 36.79	225 50 22.73	Peters	4.4589340	28769.61	94388.3
	100 23 17.939	52 08 03.98	231 59 04.41	Dixie	4.5775487	37804.96	124031.8
		70 35 30.41	256 26 59.07	Ross	4.4619080	28967.30	95036.9
Dobkins, 1918	29 20 59.278	268 51 12.59	89 03 29.08	Brackett	4.6083527	40583.80	133148.7
	100 48 22.220	295 48 09.38	115 51 54.78	Ross	4.1398083	13797.78	45268.2
		313 58 16.60	134 04 17.90	Peters	4.4432723	27750.60	91045.1
Hamilton, 1918	29 33 07.531	306 56 35.25	127 05 20.00	Brackett	4.5504824	36014.92	118158.9
	100 41 05.069	358 44 36.91	178 44 48.27	Ross	4.4539497	28441.32	93311.2
		27 44 51.19	207 41 16.20	Dobkins	4.4036067	25328.34	83098.1
Johnstone, 1918	29 22 38.529	49 03 55.92	229 02 51.89	Dobkins	3.6686709	4663.06	15298.7
	100 46 11.628	203 04 43.27	23 07 14.06	Hamilton	4.3233387	21054.20	69075.8
Moore, 1918	29 29 19.539	240 33 29.03	60 37 17.46	Hamilton	4.1551811	14294.00	46899.2
	100 48 47.474	357 28 02.80	177 28 15.20	Dobkins	4.1880093	15417.33	50581.7
Kelly, 1918	29 27 13.571	243 23 50.70	63 30 29.52	Hamilton	4.3871020	24383.87	79999.4
	100 54 34.912	247 28 17.61	67 31 08.55	Moore	4.0057258	10132.71	33243.7
		318 53 15.03	138 56 18.00	Dobkins	4.1843944	15289.54	50162.4
Mark, 1918	29 43 26.810	326 51 52.67	146 55 41.21	Hamilton	4.3572093	22761.04	74678.1
	100 48 47.225	0 00 53.01	180 00 52.89	Moore	4.4164233	26086.95	85586.9
		17 21 55.17	197 19 03.49	Kelly	4.4068226	31392.26	102902.8
Feely, 1918	29 32 37.945	237 26 09.50	57 35 46.29	Mark	4.5705307	37198.95	122043.6
	101 08 13.723	294 18 21.16	114 25 04.35	Kelly	4.3840170	24211.24	79433.0
McNutt, 1918	29 45 45.150	276 59 20.95	97 09 54.39	Mark	4.5387266	34572.17	113425.5
	101 10 04.022	323 47 23.74	143 55 02.78	Kelly	4.6271908	42382.91	139051.3
		358 00 52.58	178 01 47.15	Feely	4.3877206	24418.59	80113.3
Harrison, 1918	29 59 32.352	352 40 29.61	172 41 40.41	Mark	4.4767381	29973.54	98338.2
	100 51 09.418	50 09 54.24	230 00 29.04	McNutt	4.5087448	39095.83	130235.4
Jim, 1918	29 46 14.525	230 13 01.08	50 22 10.31	Harrison	4.5849223	38452.30	126155.6
	101 09 31.833	278 41 31.41	98 51 48.96	Mark	4.5294151	33838.81	111019.5
		43 43 00.69	223 42 44.71	McNutt	3.0973685	1251.32	4105.4
Blue, 1918	30 03 20.872	278 27 00.60	98 41 32.35	Harrison	4.6740512	47211.87	154894.3
	101 20 11.653	331 26 55.14	151 32 14.21	Jim	4.5558460	35962.18	117985.9
		333 19 33.49	153 24 36.47	McNutt	4.5006793	36304.64	119106.3
Tippetts, 1918	29 51 15.072	214 57 21.45	35 02 12.81	Blue	4.4358575	27280.82	89503.8
	101 29 55.155	287 32 12.70	107 42 04.82	McNutt	4.5258293	33560.57	110106.6
Babb, 1918	30 01 32.036	262 19 58.01	82 27 47.20	Blue	4.4036692	25331.98	83110.0
	101 35 48.871	305 00 55.03	125 13 44.99	McNutt	4.7048040	50676.20	166260.2
		333 26 24.74	153 29 21.28	Tippetts	4.3270251	21233.67	69664.1
Proctor, 1918	29 53 04.392	217 01 57.75	37 05 37.59	Babb	4.2919960	19588.27	64265.8
	101 43 09.149	278 55 17.98	99 01 53.41	Tippetts	4.3339084	21572.90	70777.1

GEOGRAPHIC POSITIONS—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
Principal points—Continued.	° ′ ″	° ′ ″	° ′ ″				
Ike, 1918	30 02 04.315	287 11 53.84	107 12 53.79	Babb	3.5203268	3359.90	11023.3
	101 37 48.655	327 32 37.87	147 36 34.23	Tippetts	4.3744317	23682.73	77699.1
		27 21 24.92	207 18 44.87	Proctor	4.2721772	18714.46	61399.0
Bassett, 1918	30 04 49.169	296 41 34.64	116 45 20.03	Babb	4.1302693	13498.00	44284.7
	101 43 18.928	299 49 22.01	119 52 07.43	Ike	4.0085908	10199.78	33463.8
		359 18 25.96	179 18 30.85	Proctor	4.3365091	21702.46	71202.2
Hoddy, 1918	30 05 54.871	282 50 32.67	102 53 18.50	Bassett	3.9583683	9085.91	29809.4
	101 48 49.712	338 55 49.17	158 58 39.40	Proctor	4.4051696	25419.65	83397.6
Peggy, 1918	29 56 16.469	229 29 02.31	49 35 32.13	Hoddy	4.4384513	27444.25	90040.0
	102 01 48.916	241 58 00.84	62 07 21.98	Bassett	4.5273315	33676.85	110488.1
		281 03 38.28	101 12 56.66	Proctor	4.4859435	30615.65	100444.8
Hen, 1918	30 07 06.358	274 13 47.92	94 22 55.67	Hoddy	4.4071135	29316.59	96182.8
	102 07 01.624	337 15 30.13	157 18 06.62	Peggy	4.3363467	21694.35	71175.5
Eldridge, 1918	30 00 27.814	201 08 44.90	21 10 13.73	Hen	4.1192181	13158.85	43172.0
	102 09 58.945	253 24 46.52	73 35 22.16	Hoddy	4.5497417	35460.24	116339.1
		300 28 04.61	120 32 09.42	Peggy	4.1832005	15247.56	50024.7
Dryden, east base, 1918.	30 02 39.865	58 05 36.39	238 03 34.51	Eldridge	3.8858909	7689.37	25227.5
	102 05 55.380	167 48 19.16	347 47 45.96	Hen	3.9240379	8395.33	27543.7
Dryden, west base, 1918.	30 03 11.371	213 42 04.59	33 43 34.97	Hen	3.9394482	8698.58	28538.6
	102 10 01.917	278 20 20.21	98 22 23.66	Dryden, east base.	3.8244765	6675.388	21900.84
		359 05 38.07	179 05 39.56	Eldridge	3.7021517	5036.77	16524.8
Road, 1918	29 59 38.828	232 05 08.15	52 10 39.50	Hen	4.3511906	22448.67	73650.3
	102 18 03.191	263 20 14.84	83 24 16.97	Eldridge	4.1161469	13066.13	42867.8
Sanderson (U. S. G. S.), 1918.	30 12 21.331	293 14 54.43	113 21 57.14	Hen	4.3893883	24512.54	80421.6
	102 21 02.932	320 58 32.83	141 04 05.89	Eldridge	4.4512005	28261.84	92722.4
		348 24 12.65	168 25 42.79	Road	4.3796127	23966.94	78631.5
New, 1918	30 03 58.491	231 55 48.97	52 02 00.46	Sanderson (U. S. G. S.).	4.4003477	25138.98	82476.8
	102 33 22.870	287 54 44.22	108 02 24.48	Road	4.4134115	25906.66	84995.4
Dry, 1918	30 09 44.113	263 03 46.76	83 16 26.20	Sanderson (U. S. G. S.).	4.6095729	40697.98	133523.3
	102 46 13.400	292 15 39.82	112 29 46.93	Road	4.6897762	48952.65	160605.5
		297 14 09.28	117 20 35.88	New	4.3057077	23211.74	76153.9
Pyle, 1918	30 21 49.417	299 20 14.73	119 30 00.09	Sanderson (U. S. G. S.).	4.5516103	35613.14	116840.8
	102 40 23.661	22 41 19.55	202 41 23.29	Dry	4.3840251	24211.69	79434.5
Brown, 1918	30 09 16.766	229 09 59.90	49 18 26.69	Pyle	4.5501602	35495.16	116453.7
	102 57 09.357	264 14 55.17	84 33 04.30	Sanderson (U. S. G. S.).	4.7652047	58237.76	191068.4
		267 12 27.69	87 17 57.24	Dry	4.2448541	17573.33	57655.2
		284 17 34.32	104 29 29.96	New	4.5958056	39428.08	129357.0
		285 38 56.91	105 58 32.65	Road	4.8149590	65306.89	214261.0
Nation, 1918	30 24 03.421	278 19 29.89	98 28 19.34	Pyle	4.4510478	28251.91	92689.8
	102 57 50.479	357 41 30.79	177 41 51.52	Brown	4.4365518	27324.47	89647.0
Madera, 1917	30 35 33.588	317 42 33.50	137 49 51.56	Pyle	4.5349776	34275.01	112450.6
	102 54 47.326	12 57 20.79	192 55 47.84	Nation	4.3385909	21806.75	71544.3
Chancellor, 1917	30 41 25.463	303 09 27.52	123 14 44.44	Madera	4.2964052	19788.15	64921.6
	103 05 09.138	339 56 54.99	160 00 37.93	Nation	4.5334195	34152.27	112047.9
Ord (U. S. G. S.), 1917.	30 14 25.542	219 27 56.62	39 41 00.25	Chancellor	4.8110102	64715.78	212321.7
	103 30 54.670	251 18 17.17	71 34 58.88	Nation	4.7475357	55915.95	183450.9
		279 48 45.48	100 05 44.19	Brown	4.7403874	55003.13	180456.1
Beard, 1917	30 49 40.428	110 06 39.87	289 49 32.18	Newman	4.7521334	56511.05	185403.3
	103 31 12.212	290 01 28.59	110 14 48.00	Chancellor	4.6461849	44277.68	145267.7
		359 35 14.51	179 35 23.42	Ord (U. S. G. S.).	4.8137612	65127.02	213670.9

GEOGRAPHIC POSITIONS—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
Principal points—Continued.	° ′ ″	° ′ ″	° ′ ″				
Star, 1917	30 46 38.779	132 50 29.43	312 41 49.26	Newman	4.5641694	36658.05	120269.0
	103 47 39.306	277 54 47.71	98 16 31.00	Chancellor	4.8358451	68524.38	224817.1
		335 42 07.80	155 50 37.83	Ord (U. S. G. S.).	4.8147855	65280.81	214175.5
Baldy, 1917	30 38 07.858	109 59 14.43	289 42 48.43	Chispa	4.7371950	54600.30	179134.5
	104 10 24.600	158 53 30.68	338 45 40.32	Krouse	4.8279775	67294.18	220781.0
		192 56 51.05	12 59 51.44	Newman	4.6200345	41690.25	136778.8
		246 29 15.82	66 40 53.00	Star	4.5976039	39591.68	129893.7
		251 00 52.10	71 20 54.23	Beard	4.8203071	66110.08	216915.8
		304 32 18.58	124 52 19.22	Ord (U. S. G. S.).	4.8860644	76924.45	252376.3
Newman, 1909	31 00 07.100						
	104 04 32.501						
Krouse, 1909	31 12 05.529	303 16 49.53	123 27 44.28	Newman	4.6044711	40222.69	131963.9
	104 25 40.020						
Chispa, 1909	30 48 09.928	211 15 55.19	31 24 37.87	Krouse	4.7140112	51762.02	169822.6
	104 42 34.783	249 48 57.49	70 08 29.02	Newman	4.8096126	64507.87	211639.6
Supplementary points.							
San Juan, standpipe, 1917.	26 11 03.209	69 25 33.3	249 22 37.6	Hickley	4.072098	11822.2	38787
	98 09 36.607	124 30 47.2	304 34 40.4	McAllen	3.986228	9687.9	31784
		204 40 30.0	84 41 49.4	San Juan	3.700903	5022.3	16477
		328 37 42.4	148 39 19.5	Handy	4.070395	11759.7	38582
Pharr, standpipe, finial, 1917.	26 11 33.273	59 22 38.3	239 20 22.0	Hickley	3.998958	9976.0	32730
	98 11 06.013	129 48 22.9	309 46 55.5	McAllen	3.854223	7148.6	23453
		273 30 06.6	93 32 05.5	San Juan	3.874894	7497.1	24597
		321 52 12.1	141 54 28.5	Handy	4.144222	13938.7	45731
Pharr, elevator, east of railroad station, flagpole, 1917.	26 11 41.452	275 41 46.5	95 43 39.6	San Juan	3.854396	7151.5	23463
	98 10 52.797	323 42 00.1	143 44 10.7	Handy	4.143551	13917.2	45660
		59 12 56.6	239 10 34.4	Hickley	4.017870	10420.1	34187
Pharr, post office, pagoda, cupola, 1917.	26 11 37.201	128 28 26.5	308 26 57.4	McAllen	3.855013	7161.6	23496
	98 11 01.805	274 29 32.0	94 31 29.1	San Juan	3.868083	7390.7	24248
		322 32 54.4	142 35 09.1	Handy	4.144998	13963.6	45812
Tall stack south of station McAllen, 1917.	26 10 08.501	60 46 27.4	240 45 17.2	Hickley	3.704915	5068.9	16630
	98 13 35.821	169 29 01.4	349 28 40.2	McAllen	3.863737	7307.0	23973
		303 11 15.1	123 14 37.5	Handy	4.183506	15258.3	50060
McAllen School, temporary scaffold, 1917.	26 12 07.000	166 21 44.9	346 21 31.3	McAllen	3.561117	3640.1	11943
	98 13 52.949	277 01 13.1	97 04 25.7	San Juan	4.086710	12209.8	40058
		312 10 18.7	132 13 48.8	Handy	4.252167	17871.7	58634
		32 49 05.2	212 48 02.5	Hickley	3.862391	7284.4	23899
Donna sugar mill, taller of two stacks, 1917.[1]	26 08 17.11	39 22 06	219 21 02	Handy	3.804605	6376.8	20921
	98 03 30.75	137 14 20	317 12 58	San Juan	3.880642	7597.0	24924
McAllen, Methodist Church, steeple, 1917.[1]	26 11 54.47	169 41 08	349 40 57	McAllen	3.600711	3987.6	13083
	98 13 58.15	310 56 02	130 59 34	Handy	4.248560	17723.9	58149
Edinburg courthouse, cupola, 1917.[2]	26 18 03.60	337 16 43	157 18 06	San Juan	4.130985	13520.3	44358
	98 09 44.59	46 11 50	226 09 47	McAllen	4.031023	10740.5	35238
Pump station, tall metal stack, 1917.[1]	26 06 16.75	140 04 32	320 01 46	Mamie	4.212312	16304.7	53493
	98 16 23.79	182 58 21	2 58 25	Hickley	3.668810	4602.4	15297
McAllen, standpipe, 1917.	26 12 17.838	311 58 26.3	132 02 03.7	Handy	4.265719	18438.2	60493
	98 14 09.593	28 22 00.6	208 21 05.3	Hickley	3.865479	7336.3	24069
		172 56 57.3	352 56 51.0	McAllen	3.508980	3228.3	10592
Mission, standpipe, 1917.	26 12 46.829	255 03 33.8	75 05 51.9	McAllen	3.953178	8978.0	29455
	98 19 36.400	322 43 27.1	142 44 55.9	Hickley	3.965335	9232.8	30291
		95 32 33.2	275 31 11.7	Mamie	3.711057	5141.1	16867

[1] No check on this position.

[2] 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.	° ′ ″	° ′ ″	° ′ ″				
Banco, 1917.....	26 11 01.793	122 40 41.5	302 37 57.3	Pedro.....	4.088457	12259.1	40220
	98 22 47.925	183 03 52.5	3 03 55.7	Mamie.....	3.572086	3733.2	12248
		290 38 39.7	110 41 32.9	Hickley.....	4.066719	11600.5	38056
Capatosa ranch, southwest windmill, 1917.	26 16 36.601	321 36 25.0	141 37 48.0	Mamie.....	3.923072	8388.3	27521
	98 25 48.401	55 13 15.8	235 11 51.2	Pedro.....	3.810545	6464.6	21209
		149 21 51.1	329 20 58.0	Palo.....	3.814417	6522.5	21399
Maximo Diaz ranch, windmill, 1917.[1]	26 18 33.18	21 04 14	201 04 05	Fordyce.....	3.178588	1508.7	4950
	98 34 25.69	186 33 43	6 33 54	Eltoro.....	3.789416	6157.7	20202
Windmill near trees, 1917.[1]	26 20 34.13	37 58 21	217 57 17	Fordyce.....	3.813306	6500.8	21348
	98 32 20.92	131 00 08	310 59 24	Eltoro.....	3.562425	3651.1	11979
Flores ranch, windmill, 1917.[1]	26 18 02.50	72 36 25	252 36 02	Fordyce.....	3.190047	1551.1	5089
	98 33 51.88	178 06 19	358 06 15	Eltoro.....	3.849125	7065.2	23180
Windmill near white house, 1917.[1]	26 18 14.22	66 48 24	246 47 53	Fordyce.....	3.320063	2092.5	6865
	98 33 35.90	174 14 06	354 13 55	Eltoro.....	3.828334	6734.9	22090
Eltoro ranch, windmill, 1917.[1]	26 21 50.23	13 11 30	193 11 02	Fordyce.....	3.885031	7674.2	25178
	98 33 42.11	96 02 00	276 01 52	Eltoro.....	2.705333	507.4	1665
Monument R. P. 4 (International Boundary Survey), 1917.[2]	26 21 16.08	262 57 06	82 57 08	Monument....	2.177767	150.58	494.0
	98 46 08.35						
Mission, first lift pump, stack, 1917.[2]	26 09 55.05	143 01 49	323 00 40	Mamie.....	3.859595	7237.6	23745
	98 20 03.94	287 57 27	107 59 08	Hickley.....	3.824020	6682.3	21924
Edinburg, second lift pump, stack, 1917.[1]	26 12 24.78	221 20 41	41 21 23	McAllen.....	3.600255	3983.4	13069
	98 15 58.68	3 54 31	183 54 24	Hickley.....	3.826100	6685.1	21933
Mission, third lift pump, stack, 1917.[2]	26 14 55.43	280 02 47	100 05 15	McAllen.....	3.973874	9416.2	30893
	98 19 57.92	331 17 49	151 19 28	Hickley.....	4.110183	12887.9	42283
Metal stack southeast of station Mamie, 1917.[1]	26 10 05.34	170 21 00	350 20 46	Mamie.....	3.743804	5543.8	18188
	98 22 07.26	283 38 40	103 41 16	Hickley.....	4.002870	10000.3	33026
Derrick, 1917[1].....	26 09 54.93	143 22 30	323 21 21	Mamie.....	3.857913	7209.6	23654
	98 20 05.79	287 47 33	107 49 15	Hickley.....	3.828032	6730.3	22081
Monastery, north end, east cupola, 1917.[2]	26 09 15.26	143 14 14	323 12 51	Mamie.....	3.941853	8746.9	28697
	98 19 32.15	278 41 07	98 42 34	Hickley.....	3.743302	5537.4	18167
Edinburg Pump Co., taller of two stacks, 1917.[1]	26 09 44.91	143 23 05	323 21 53	Mamie.....	3.880411	7593.0	24911
	98 19 57.59	285 47 42	105 49 20	Hickley.....	3.807747	6423.1	21073
Hidalgo, church steeple near river, 1917.	26 05 57.458	171 09 59.6	351 09 46.7	Hickley.....	3.725333	5312.9	17431
	98 15 45.708	188 39 44.1	8 40 20.2	McAllen.....	4.178456	15081.9	49481
		272 10 36.3	92 14 55.6	Hundy.....	4.214596	16390.6	53775
Mission, second lift pump, stack, 1917.	26 12 42.886	255 00 34.8	75 02 59.7	McAllen.....	3.974007	9419.0	30902
	98 19 51.677	320 13 01.8	140 14 37.4	Hickley.....	3.973227	9402.1	30847
		97 29 54.4	277 28 39.7	Mamie.....	3.676178	4733.5	15530
Capatosa ranch, northeast windmill, 1917.	26 16 36.641	321 40 12.5	141 41 35.3	Mamie.....	3.923375	8382.5	27502
	98 25 48.013	55 15 59.3	235 14 34.5	Pedro.....	3.811187	6474.2	21241
		140 16 37.7	329 15 44.4	Palo.....	3.814711	6527.0	21414
Church steeple (Mexico), 1917.	26 18 55.647	124 25 23.7	304 20 44.2	Gorgora.....	4.325101	21139.8	69356
	98 50 06.253	147 41 55.7	327 39 25.8	Garcena.....	4.243183	17505.8	57434
		161 45 21.8	341 44 02.9	Hebron.....	4.196265	15718.2	51552

[1] No check on this position.

[2] 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.	° ′ ″	° ′ ″	° ′ ″				
Riogrande Pump Co., stack, 1918.	26 05 47.185	139 06 50.2	319 03 45.7	Mamie	4.249053	10744.1	35250
	98 15 42.338	170 43 11.8	350 42 57.4	Hickley	3.751266	5639.8	18503
		188 08 25.4	8 09 00.0	McAllen	4.186983	15380.9	50462
		271 04 42.1	91 08 59.9	Handy	4.211869	16288.0	53438
Riogrande, Catholic Church, steeple, 1917.	26 22 50.018	298 37 15.7	118 38 40.0	Monument	3.777726	5994.1	19666
	98 49 12.732	85 16 16.0	265 14 21.6	Ringgold	3.855301	7166.4	23512
		157 25 45.6	337 25 37.4	Grande	3.127122	1340.1	4397
Riogrande, Starr County Courthouse, dome, 1917.	26 22 52.921	218 56 56.1	38 58 22.1	Corpus	3.930954	8530.1	27986
	98 49 10.531	299 39 07.1	119 40 30.4	Monument	3.777017	5984.4	19634
		84 36 22.4	264 34 26.9	Ringgold	3.859442	7235.1	23737
		153 22 57.9	333 22 48.7	Grande	3.108628	1284.2	4213
Riogrande, Methodist Church, steeple, 1917.	26 22 46.871	86 12 17.4	266 10 18.2	Ringgold	3.872703	7460.4	24476
	98 49 01.837	148 32 25.7	328 32 12.6	Grande	3.194288	1564.2	5132
		216 54 14.9	36 55 37.2	Corpus	3.930889	8528.8	27982
Riogrande, standpipe, 1917.	26 22 28.660	90 20 07.9	270 27 01.2	Ringgold	3.897500	7897.7	25911
	98 48 45.483	146 10 30.0	326 10 09.6	Grande	3.358086	2280.8	7483
		212 18 53.3	32 20 08.2	Corpus	3.941152	8732.8	28651
		296 10 08.3	116 11 20.5	Monument	3.700774	5020.8	16472
Roma, Catholic Church, spire, 1917.	26 24 21.458	171 19 32.0	351 19 14.4	Roma	3.857246	7198.6	23617
	99 01 02.387	201 15 44.5	21 15 56.3	Gorgora	3.312070	2051.5	6731
		241 36 17.2	61 38 38.9	Garcena	4.001297	10029.9	32906
Roma, Church of the Covenant, cupola, 1917.	26 24 23.034	171 23 43.0	351 23 25.8	Roma	3.854196	7148.2	23452
	99 01 02.973	202 11 35.3	22 11 47.5	Gorgora	3.303722	2012.4	6602
		241 53 33.7	61 55 55.8	Garcena	4.000921	10021.2	32878
Oil derrick No. 1, 1917.[1]	26 36 08.65	321 01 30	141 03 03	Banchez	3.903528	9194.5	30166
	99 00 20.47	324 55 16	144 56 54	Chinges	4.024345	10576.0	34700
Oil derrick No. 2, 1917.[1]	26 35 10.85	330 04 26	150 05 17	Banchez	3.806795	6409.1	21027
	98 58 47.07	333 41 13	153 42 09	Chinges	3.896437	7878.4	25848
Windmill A, 1917[1].	26 37 17.41	100 22 06	19 22 18	Flores	3.341773	2190.7	7207
	99 04 13.55	248 07 51	68 08 23	Burros	3.332335	2149.5	7052
San Ygnacio, white church spire, 1917.[1]	27 02 38.26	254 45 14	74 46 48	Ygnacio	3.771957	5915.0	19406
	99 26 27.90	312 40 47	132 43 03	Feoro	4.049388	11204.4	36760
Zapata, post office flagpole, 1917.	26 52 31.069	163 17 22.7	343 16 41.1	Urebeno	3.944730	8805.0	28888
	99 18 47.077	250 22 28.3	70 22 54.3	Zapata	3.225830	1682.0	5518
		297 21 23.6	117 23 15.9	Rafael	3.888041	7727.5	25353
Zapata, church steeple, 1917.	26 52 15.557	104 04 03.6	344 03 21.8	Urebeno	3.906918	9266.5	30402
	99 18 46.644	236 27 30.2	56 27 56.0	Zapata	3.275050	1886.4	6189
		294 09 41.6	114 11 33.7	Rafael	3.875593	7509.2	24636
Urebeno, green roof, north gable, 1917.	26 55 40.454	160 09 58.6	340 09 27.4	Feoro	3.747626	5592.8	18349
	99 20 20.404	180 56 06.8	00 56 07.5	Urebeno	3.415737	2604.6	8545
		321 40 34.0	141 41 42.1	Zapata	3.826044	6708.8	22010
Windmill west of station George, 1917.	27 20 17.906	174 33 11.0	354 32 52.0	Fort	4.078259	11974.5	39286
	99 24 29.953	202 20 39.0	82 23 22.7	George	3.994830	9881.7	32420
		332 02 51.9	152 05 23.5	Dan	4.288755	19442.6	63788
		21 12 36.6	201 11 54.5	Dolores	3.843325	6971.5	22872
Windmill northwest of station Dolores, 1917.	27 20 27.697	176 31 13.5	356 30 54.3	Laredo	4.273925	18789.9	61647
	99 28 35.928	205 47 51.4	25 49 25.5	Fort	4.110918	12909.8	42355
		328 01 42.4	148 02 53.2	Dolores	3.903786	8012.8	26289
Windmill south of station Fort, 1917.	27 25 54.445	175 01 28.5	355 01 26.2	Fort	3.196111	1570.8	5154
	99 25 06.383	214 21 20.1	34 23 04.6	Taylor	4.042151	11019.2	36152
		227 02 26.0	47 04 54.5	Casbeer	4.082004	12078.2	39627
Mountain peak No. 1 (Mexico), 1917.	26 03 52.040	222 47 46.5	43 07 00.9	Roleta	5.023411	105538.5	346254
	99 54 55.415	233 54 35.9	54 15 32.5	Labra	4.986907	97050.3	318406
		242 54 33.2	63 18 06.7	Roma	4.997251	99369.0	326013

[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.	° ′ ″	° ′ ″	° ′ ″				
Mountain peak No. 2 (Mexico), 1917.	26 13 56.384 100 00 09.210	233 45 58.3 246 05 09.2 254 37 25.3	54 07 36.1 66 28 29.1 75 03 22.3	Roleta..... Labra..... Roma.....	4.998436 4.979043 5.003309	99640.5 95289.0 100764.8	326904 312627 330593
Mountain peak No. 3 (Mexico), 1917.	26 07 08.624 100 33 22.409	242 02 10.1 250 02 27.9 255 21 39.9	62 38 32.9 70 40 29.7 76 02 16.9	Roleta..... Labra..... Roma.....	5.185671 5.180003 5.197222	153345.5 151357.2 157478.8	503101 496578 516662
Mountain peak No. 4 (Mexico), 1917.	26 18 22.326 100 27 58.248	248 00 25.3 256 58 22.8 262 27 52.8	68 34 30.5 77 34 07.8 83 06 13.8	Roleta..... Labra..... Roma.....	5.134849 5.136138 5.160278	136410.9 136816.4 144630.5	447541 448872 474528
Laredo, north wireless mast, 1917.	27 30 25.279 99 31 06.895	171 28 23.2 198 19 43.8 263 07 06.5 304 43 32.8	351 27 57.0 18 21 04.1 83 07 57.0 124 46 16.8	Knob..... Orvil..... Laredo..... Fort.....	4.018766 4.180130 3.480695 4.074818	10441.6 15140.1 3024.8 11880.0	34257 49672 9924 38976
Laredo, south wireless mast, 1917.	27 30 20.144 99 31 05.258	171 21 35.1 197 58 57.4 260 01 17.2 304 13 03.4	351 21 08.2 18 00 17.0 80 02 07.0 124 15 46.7	Knob..... Orvil..... Laredo..... Fort.....	4.025492 4.184019 3.477026 4.070169	10604.5 15276.3 3003.5 11753.5	34792 50119 9854 38561
Laredo, electric light and power plant, standpipe, 1917.	27 30 03.821 99 29 04.637	155 57 38.9 160 58 48.9 185 21 24.7	335 56 16.2 340 58 43.0 5 21 48.5	Knob..... Laredo..... Orvil.....	4.080301 3.034047 4.178908	12031.0 1081.6 15097.6	39472 3549 49533
Laredo, electric light and power plant, brick stack, 1917.	27 30 03.687 99 29 05.839	156 06 44.2 162 42 51.8 185 28 47.4 203 37 06.8	336 05 22.1 342 42 46.5 5 29 11.8 83 40 42.2	Knob..... Laredo..... Orvil..... Taylor.....	4.079952 3.031495 4.179116 4.109581	12021.3 1075.2 15104.8 12870.1	39440 3528 49556 42225
Nuevo Laredo, Presbyterian Church (Mexico), 1917.	27 30 30.009 99 30 09.783	162 59 25.8 192 39 34.4 261 25 18.0 310 09 08.7	342 58 33.3 12 40 28.4 81 25 42.2 130 11 26.4	Knob..... Orvil..... Laredo..... Fort.....	4.027210 4.163770 3.161887 4.030302	10646.6 14580.4 1451.7 10722.6	34930 47836 4763 35179
Laredo, Catholic Church, steeple, 1917.	27 30 07.089 99 30 19.167	165 16 13.8 193 02 07.9 241 54 42.0 264 56 40.2	345 15 25.5 13 03 06.2 61 55 10.4 85 00 49.3	Knob..... Orvil..... Laredo..... Taylor.....	4.050053 4.184904 3.083092 4.172036	11237.1 15307.5 1210.9 14860.6	36867 50221 3973 48755
Nuevo Laredo, standpipe (Mexico), 1917.	27 29 12.998 99 31 03.530	172 33 11.3 195 42 42.9 228 22 02.2 295 09 33.9	352 32 43.6 15 44 01.7 48 22 51.2 115 12 16.4	Knob..... Orvil..... Laredo..... Fort.....	4.102353 4.236562 3.590424 4.028790	12057.6 17241.0 3894.3 10685.4	41527 56565 12777 35057
Nuevo Laredo, church (Mexico), 1917.	27 29 34.095 99 30 30.021	167 56 21.1 193 17 22.4 226 00 47.4 300 38 10.0	347 55 38.2 13 18 26.0 46 01 21.2 120 40 37.3	Knob..... Orvil..... Laredo..... Fort.....	4.085304 4.214471 3.445606 4.008185	12170.4 16385.9 2790.0 10190.3	39929 53759 9154 33433
Central Laredo waterworks, standpipe, 1917.	27 30 04.794 99 30 29.912	166 50 13.7 194 01 27.9 243 27 49.5 264 42 21.1	346 49 30.4 14 02 31.2 63 28 22.9 84 46 35.2	Knob..... Orvil..... Laredo..... Taylor.....	4.051248 4.189297 3.346755 4.180766	11252.5 15463.1 2222.1 15162.3	36918 50732 7290 49745
Central Laredo waterworks, brick stack, 1917.	27 30 03.335 99 30 29.728	166 51 50.5 193 57 58.0 242 22 38.8 264 32 06.7	346 51 07.0 13 59 01.1 62 23 12.0 84 36 20.6	Knob..... Orvil..... Laredo..... Taylor.....	4.052976 4.190485 3.349858 4.180743	11297.3 15505.5 2238.0 15161.5	37065 50871 7343 49742
Pumping station, southernmost of two stacks, 1917.[1]	27 34 52.87 99 31 46.43	167 28 36 223 36 27	347 28 29 43 38 06	Knob..... Orvil.....	3.330523 3.928102	2140.5 8474.3	7023 27803
House north of station Taylor, south gable, 1917.[1]	27 34 00.59 99 21 31.17	336 28 20 350 57 25	156 29 09 176 57 30	Casbeer..... Taylor.....	3.866036 3.769100	7345.7 5876.2	24100 19279
Windmill east of station Knob, 1917.[1]	27 36 49.76 99 28 29.92	75 33 45 190 13 48	255 32 06 10 13 55	Knob..... Orvil.....	3.781311 3.411245	6043.8 2577.8	19829 8457
White house (Mexico), 1917.[1]	27 34 40.32 99 31 50.81	172 05 32 222 26 42	352 05 26 42 28 22	Knob..... Orvil.....	3.397801 3.946387	2499.5 8838.7	8200 28998

[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.	° ′ ″	° ′ ″	° ′ ″				
Windmill east of north of station Fieldings, 1917.[1]	27 43 22.68 99 34 49.76	341 07 12 90 54 19	161 07 42 270 51 57	Fieldings..... Tordillo.....	3.747211 3.919872	5587.4 8315.2	18331 27281
Isabel, 1917.....	27 39 52.600 99 38 46.163	164 25 28.9 201 52 46.2 302 50 40.2	344 24 57.7 81 55 06.6 122 53 47.0	Tordillo..... Fieldings..... Knob.....	3.835475 3.922759 4.118870	6846.6 8370.7 13148.3	22463 27463 43137
Smallhouse, mine, 1917.	27 41 36.274 99 33 15.427	238 24 42.0 277 16 50.8 299 13 49.2	58 26 16.1 97 21 16.4 119 19 01.1	Tordillo..... Fieldings..... Knob.....	3.812958 4.198469 4.324094	6500.7 15793.2 21120.0	21328 51815 69291
Matthews's ranch, windmill, 1917.	27 41 28.497 99 35 22.603	116 10 56.7 127 16 09.3 303 11 45.2	296 08 50.9 307 13 25.7 123 12 31.1	Tordillo..... Coleman..... Fieldings.....	3.917091 4.082917 3.510060	8262.1 12103.7 3236.4	27107 39710 10618
Arsia ranch, windmill, 1917.	27 44 39.697 99 30 59.527	81 18 56.0 94 55 46.3 215 37 11.3	261 14 47.6 274 50 59.9 35 37 43.7	Tordillo..... Coleman..... Davis.....	4.169976 4.227854 3.515388	14790.3 16898.7 3276.3	48525 55442 10749
Windmillnear Maverick, 1917.	27 37 42.714 99 30 24.807	40 44 07.9 133 31 22.4 183 32 07.2	220 43 22.2 313 29 50.1 3 32 23.5	Knob..... Fieldings..... Davis.....	3.617129 3.876225 4.191108	4141.2 7520.1 15527.7	13587 24672 50944
White windmill southwest of station Orvil, 1917.	27 36 49.757 99 28 29.923	75 33 47.3 128 22 21.7 190 13 48.7	255 32 08.3 308 19 56.1 10 13 56.5	Knob..... Fieldings..... Orvil.....	3.781308 4.040248 3.411259	6043.8 10971.1 2577.9	19829 35994 8458
Windmill east of station Orvil, 1917.	27 38 49.290 99 27 28.781	46 50 39.9 106 57 08.5 163 58 38.4	226 50 19.3 286 54 14.4 343 57 32.8	Orvil..... Fieldings..... Davis.....	3.222746 4.031150 4.145915	1670.1 10743.6 13993.1	5479 35248 45909
Windmill northeast of station Orvil, 1917.	27 41 45.263 99 27 19.384	12 40 56.4 77 46 05.7 152 50 58.8	192 40 31.4 257 43 07.1 332 49 48.7	Orvil..... Fieldings..... Davis.....	3.827552 4.032578 3.955584	6722.8 10779.0 9027.8	22056 35364 29619
Windmill northeast of station Knob, 1917.	27 40 01.702 99 31 37.098	301 05 17.3 5 32 41.1 104 31 52.2	121 06 51.9 185 32 28.9 284 30 53.5	Orvil..... Knob..... Fieldings.....	3.814679 3.872225 3.554603	6526.5 7451.2 3586.4	21412 24446 11766
Windmill northeast of station Fieldings 1917.[1]	27 41 39.40 99 33 41.72	1 32 00 108 01 31	181 31 59 287 58 38	Fieldings..... Tordillo.....	3.323982 4.029508	2108.5 10703.1	6918 35115
Windmill northeast of Margarita ranch, 1917.[1]	27 47 54.90 99 31 08.45	327 14 28 60 10 27	147 15 05 240 06 23	Davis..... Tordillo.....	3.599042 4.219359	3977.8 16571.4	13050 54368
Windmill south of station Tajone, 1917.[1]	27 48 59.27 99 29 02.17	13 46 05 121 00 40	193 45 43 301 00 23	Davis..... Tajone.....	3.739110 3.060025	5484.2 1149.8	17993 3772
Windmill, no wheel, 1917.[1]	27 47 52.08 99 28 17.15	37 54 58 140 11 20	217 54 15 320 10 51	Davis..... Tajone.....	3.615944 3.539540	4129.9 3463.7	13550 11364
Tordillo, white house, west gable, 1917.[1]	27 43 51.36 99 36 59.85	80 59 19 112 48 17	260 57 59 292 46 19	Tordillo..... Coleman.....	3.682130 3.878518	4809.8 7559.9	15780 24803
Windmill northeast of station Cup, 1917.	28 04 33.203 99 44 07.003	04 12 00.0 102 18 50.4 162 44 37.0	244 10 56.0 282 16 19.0 342 42 28.0	Cup..... Twin..... Cat.....	3.615300 3.953442 4.399354	4123.8 8983.4 25081.5	13530 29473 82288
House northwest of station Twin, south gable, 1917.	28 09 20.861 99 52 15.870	326 38 45.5 130 15 28.6 142 48 26.3	146 40 04.4 310 13 55.6 322 46 59.0	Twin..... Big..... Tom.....	3.919487 3.847547 3.921195	8307.8 7039.6 8340.6	27257 23090 27364
Windmillnear station Big, 1917.	28 11 55.065 99 54 40.002	323 57 20.3 82 08 55.0 149 37 05.9 223 26 37.7	143 59 53.2 262 08 30.0 329 36 46.0 43 29 28.0	Twin..... Big..... Tom..... Cat.....	4.159873 2.162878 3.342060 4.154161	14450.2 1455.0 2198.2 14201.4	47409 4774 7212 46789
Espey's ranch, windmill, 1917.[1]	28 08 38.08 99 49 34.30	358 24 12 130 07 43	178 24 15 310 04 59	Twin..... Tom.....	3.750159 4.091896	5625.5 12356.5	18456 40540

[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.	° ′ ″	° ′ ″	° ′ ″				
Red, 1918.....	28 20 28.468	139 30 49.0	319 27 15.6	Glass.....	4.273996	18793.0	61657
	100 02 19.541	204 16 47.9	24 17 30.7	English.....	3.776047	5971.0	19590
		245 31 35.0	65 34 18.4	Carlow.....	4.012520	10292.5	33768
		320 36 02.5	140 39 20.9	Tom.....	4.255055	17991.0	59025
		9 15 17.1	189 15 05.2	Barr.....	3.627400	4240.3	13912
Dentonio hotel, south gable, 1918.	28 19 18.027	190 21 40.7	10 22 01.1	Carlow.....	3.815260	6535.2	21441
	99 57 18.649	307 53 51.6	127 54 22.9	Dentonio.....	3.358194	2281.4	7485
		344 41 12.3	164 42 08.0	Tom.....	4.085333	12171.2	39932
Dentonio windmill, 1918.	28 19 31.832	190 18 04.5	10 18 23.6	Carlow.....	3.785473	6102.0	20020
	99 57 15.556	284 45 56.7	104 50 01.2	Cat.....	4.102121	14525.2	47655
		316 47 02.3	136 47 32.3	Dentonio.....	3.398081	2506.0	8222
		345 34 11.2	165 35 05.6	Tom.....	4.099000	12560.3	41208
Windmill near station Red (no wheel), 1918.	28 20 03.775	286 32 56.8	106 35 41.2	Dentonio.....	3.993490	9851.2	32320
	100 01 59.174	320 25 21.6	140 28 30.3	Tom.....	4.231766	17051.0	55943
		19 51 20.7	199 50 59.1	Barr.....	3.561277	3641.5	11947
		139 43 27.3	319 39 44.2	Glass.....	4.296157	19776.8	64884
Windmill near clump of trees, 1918.	28 19 55.641	197 27 21.0	17 27 49.9	Carlow.....	3.742353	5525.3	18128
	99 57 36.353	286 52 51.8	106 57 06.0	Cat.....	4.183845	15270.2	50099
		318 16 09.1	138 16 48.8	Dentonio.....	3.535194	3429.2	11251
Windmill near station Barr, 1918.	28 18 05.407	225 44 25.8	45 47 00.9	Carlow.....	4.094091	12419.1	40745
	100 02 02.156	310 57 12.7	131 00 22.7	Tom.....	4.161139	14492.4	47547
		100 43 16.3	280 42 56.1	Barr.....	3.070456	1176.1	3859
Windmill near station Red, 1918.	28 19 42.260	283 39 49.4	103 42 22.9	Dentonio.....	3.957934	9076.8	29779
	100 01 36.301	320 37 57.1	140 40 54.9	Tom.....	4.208019	16144.3	52967
		33 57 00.1	213 56 36.7	Barr.....	3.522498	3330.4	10926
Windmill, 1918....	28 21 28.22	237 22 11	57 23 17	Carlow.....	3.652299	4490.5	14733
	99 58 54.38	320 49 00	140 50 17	Dentonio.....	3.843098	6977.5	22892
		46 09 36	226 07 47	Barr.....	3.939296	8695.5	28528
Windmill, 1918....	28 23 26.676	61 43 02.2	241 40 59.6	Indio.....	3.901941	7978.9	26177
	100 08 55.243	108 46 23.1	288 43 17.5	Farland.....	4.049827	11215.7	36797
		170 43 36.1	350 43 10.9	Glass.....	3.950248	8917.6	29257
Silo, single gray, 1918.[1]	28 31 58.06	212 51 44	32 53 55	Davidson.....	4.136042	13078.6	44877
	100 21 24.89	261 13 10	81 16 55	Kennedy.....	4.112247	12949.3	42484
Tallest of three stacks, mine (Mexico), 1918.	28 38 12.003	233 32 51.1	53 36 13.4	Laplace.....	4.153148	14228.1	46680
	100 36 35.378	236 55 19.8	56 59 52.2	Eagle.....	4.264285	18377.4	60293
		240 02 57.1	60 07 20.8	Pass.....	4.285878	17218.8	56476
Stack, mine (Mexico), 1918.	28 34 39.295	230 16 44.9	50 22 03.9	Laplace.....	4.370853	23488.4	77062
	100 40 39.363	233 00 28.1	53 06 57.2	Eagle.....	4.440429	27569.5	90451
		234 52 16.9	54 58 37.3	Pass.....	4.420506	26333.3	86395
Stack, mine (Mexico), 1918.	28 36 48.754	231 37 55.8	51 42 01.8	Laplace.....	4.249263	17752.6	58244
	100 38 06.546	234 49 30.7	54 54 46.8	Eagle.....	4.339767	21865.9	71738
		237 18 29.1	57 23 36.5	Pass.....	4.315186	20662.6	67791
Spire, mine (Mexico), 1918.	28 37 24.031	232 07 30.5	52 11 16.1	Laplace.....	4.208907	16177.3	53075
	100 37 24.205	235 27 58.7	55 32 54.5	Eagle.....	4.307524	20301.3	66605
		238 11 29.6	58 16 10.7	Pass.....	4.281268	19110.3	62698
Flat-roof building, chimney (Mexico), 1918.	28 37 26.971	232 35 26.5	52 39 13.9	Laplace.....	4.209512	16199.9	53149
	100 37 27.823	235 49 58.5	55 54 56.0	Eagle.....	4.308168	20331.4	66704
		238 34 34.4	58 39 23.2	Pass.....	4.282091	19146.6	62817
Tank near station Laplace, 1918.	28 42 43.891	239 36 18.3	59 39 20.2	Lone.....	4.075669	11903.3	39053
	100 29 30.469	246 53 33.7	66 54 42.2	Eagle.....	3.623804	4205.4	13797
		266 21 47.2	86 22 47.1	Pass.....	3.530119	3389.4	11120
		324 52 22.4	144 55 59.4	Silo.....	4.330153	21387.2	70168
Eagle Pass water and power plant, tall stack, 1918.	28 42 39.095	242 15 49.2	62 19 17.2	Lone.....	4.122570	13260.8	43506
	100 30 24.649	251 22 47.0	71 24 21.5	Eagle.....	3.750754	5633.2	18482
		265 43 13.3	85 44 39.2	Pass.....	3.687228	4866.6	15967
		321 31 58.8	141 36 01.7	Silo.....	4.345375	22150.1	72671

[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.	° ′ ″	° ′ ″	° ′ ″				
Lone tree, 1918.....	28 45 56.599	248 59 42.2	68 59 46.2	Lone.....	2.377444	238.5	782
	100 23 20.190	49 23 29.7	229 21 81.6	Pass.....	3.943600	8782.1	28813
		55 17 24.3	235 15 34.8	Eagle.....	3.876128	7518.4	24667
Eagle Pass Catholic Church, cross, 1918.	28 42 37.328	250 45 33.3	70 47 07.3	Eagle.....	3.749976	5623.1	18448
	100 30 23.569	258 18 05.3	78 18 29.2	Laplace.....	3.140419	1381.7	4533
		265 03 09.8	85 04 35.2	Pass.....	3.685006	4841.8	15885
Eagle Pass convent, cupola, 1918.	28 42 57.214	255 20 27.7	75 21 51.7	Eagle.....	3.690392	4902.2	16083
	100 30 02.099	272 37 15.0	92 38 30.4	Pass.....	3.629590	4261.8	13982
		292 53 24.0	112 53 37.9	Laplace.....	2.931358	853.8	2801
North Eagle Pass, prominent building, latticework on roof, 1918.	28 43 11.292	260 14 21.0	80 15 44.1	Eagle.....	3.677704	4761.1	15620
	100 30 00.838	278 29 39.2	98 30 53.7	Pass.....	3.628743	4253.5	13955
		316 07 21.6	136 07 34.6	Laplace.....	3.026108	1062.0	3484
International Coal Mine, tank, 1918.	28 45 27.570	297 06 41.6	117 08 38.8	Eagle.....	3.871143	7432.6	24385
	100 31 11.729	308 11 23.8	128 13 12.4	Pass.....	3.892117	7800.4	25592
		331 47 50.2	151 48 37.3	Laplace.....	3.750415	5628.8	18467
House 12 miles northwest of Eagle Pass, cupola, 1918.[1]	28 51 55.47	312 39 44	132 44 39	Eagle.....	4.354213	22605.4	74165
	100 37 20.49	316 04 21	136 09 07	Pass.....	4.366683	23263.9	76325
Lamar mine, tank, 1918.[1]	28 48 02.79	349 42 19	169 42 50	Pass.....	3.989451	9760.0	32021
	100 28 30.10	119 15 26	299 14 08	Nine.....	3.699970	5011.5	16442
Windmill south of station N f n e, 1918.[1]	28 48 12.87	185 02 50	5 02 53	Nine.....	3.331770	2146.7	7043
	100 31 18.33	199 37 08	19 38 00	Burr.....	3.933450	8579.3	28147
Windmill northeast of station Nine, 1918.[1]	28 50 46.80	212 52 04	32 52 43	Burr.....	3.599768	3978.9	13054
	100 30 51.72	11 34 36	191 34 26	Nine.....	3.424008	2654.7	8710
House 3 miles northwest of Paloma, north gable, 1918.[1]	28 54 26.58	138 23 53	318 22 54	Pen.....	3.698313	4992.4	16379
	100 27 02.96	289 34 09	109 35 38	Paloma ..	3.724877	5307.3	17412
Paloma ranch, windmill, 1918.[1]	28 52 46.33	87 36 49	267 34 26	Burr.....	3.905704	8048.3	26405
	100 24 35.31	133 00 17	312 58 07	Pen.....	4.000052	10001.2	32812
Tank near red-roofed building, 1918.	28 59 39.213	355 43 19.7	175 43 34.9	Paloma.....	4.058251	11435.4	37513
	100 24 29.877	51 42 39.8	231 40 26.4	Pen.....	3.977059	9505.2	31185
		94 04 25.3	274 01 15.0	White.....	4.027288	10648.5	34936
Windmill near station Lake, 1918.	28 59 53.534	326 53 25.3	146 54 39.1	Pen.....	3.878505	7559.7	24802
	100 31 37.831	34 18 18.4	214 17 08.8	Wiffp.....	3.838989	6902.2	22645
		175 32 45.0	355 32 44.6	Lake.....	2.309020	203.7	668
Windmill near station White, 1918.	29 00 10.011	335 04 49.0	155 05 45.8	Pen.....	3.877483	7541.9	24744
	100 31 02.692	37 50 56.1	217 55 29.5	Wiffp.....	3.896151	7873.2	25831
		72 32 23.5	252 32 06.2	Lake.....	3.005882	1013.6	3325
Windmill, 1918.....	29 06 51.120	116 23 13.2	296 21 02.1	Dixie.....	3.909755	8123.7	26653
	100 37 12.902	195 26 28.9	15 27 02.9	Peters.....	3.850276	7084.0	23241
		275 52 34.5	95 54 19.8	Jamerson.....	3.769552	5882.4	19299
		354 21 45.5	174 21 58.6	Towne.....	3.871277	7434.9	24393
Neely's ranch, windmill, 1918.	29 07 21.573	13 59 59.6	193 59 52.6	Jamerson.....	3.200977	1588.5	5212
	100 33 22.278	33 27 44.3	213 26 05.3	Towne.....	3.999621	9991.3	32780
		101 12 49.1	281 08 45.7	Dixie.....	4.139051	13773.7	45189
		143 35 13.1	323 33 54.8	Peters.....	3.804551	7320.7	24018
Jamerson ranch, windmill, 1918.	29 06 36.653	25 00 17.2	205 00 15.9	Jamerson.....	2.242252	174.7	573
	100 33 33.759	36 47 10.4	216 45 37.0	Towne.....	3.938569	8681.0	28481
		107 06 02.4	287 02 04.7	Dixie.....	4.140220	13811.0	45312
		150 58 51.6	330 57 38.9	Peters.....	3.920048	8318.6	27292
Anacucho Mountains, highest peak, 1918.[1]	29 11 03.90	18 35 40	198 32 24	Paloma.....	4.534870	34206.5	112423
	100 17 15.13	35 30 37	215 24 52	Pen.....	4.520015	33114.3	108642

[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.	° ′ ″	° ′ ″	° ′ ″				
Spofford, church steeple, 1918.[1]	29 10 18.35 100 24 32.12	91 25 18 185 34 56	271 19 41 5 35 33	Peters..... Brackett.....	4.271300 4.313235	18076.7 20570.0	61275 67487
Brackettville, church, 1918.[1]	29 18 22.37 100 25 18.34	87 20 54 210 14 30	267 13 22 30 15 29	Ross..... Brackett.....	4.397154 3.809448	24954.8 6448.3	81873 21156
Brackettville, Army post flagpole, 1918.[1]	29 18 19.53 100 25 16.42	87 33 17 209 27 27	267 25 44 29 28 25	Ross..... Brackett.....	4.397989 3.812810	25002.8 6498.5	82030 21320
Brackettville, house, cupola, 1918.[1]	29 18 10.17 100 25 21.24	88 12 16 209 13 06	268 04 46 29 14 07	Ross..... Brackett.....	4.395537 3.833362	24862.1 6813.4	81508 22354
Brackettville, standpipe, 1918.	29 18 20.870 100 25 23.124	50 13 33.9 87 26 26.7 211 00 42.7	230 08 21.3 267 18 57.0 31 01 43.9	Peters..... Ross..... Brackett.....	4.352179 4.394868 3.816501	22499.8 24823.8 6553.9	73818 81443 21502
Windmill near station Moore, 1918.	29 29 10.254 100 48 28.003	70 03 03.0 118 39 53.3 238 29 17.3	250 00 02.5 298 39 43.7 58 32 55.5	Kelly..... Moore..... Hamilton.....	4.021885 2.775215 4.145792	10516.8 596.0 13989.2	34504 1955 45896
Windmill north of station Moore, 1918.	29 31 11.371 100 48 41.555	253 44 42.7 2 39 05.7 52 27 31.4	73 48 27.8 182 39 02.8 232 24 37.5	Hamilton..... Moore..... Kelly.....	4.107248 3.537424 4.079511	12801.1 3446.9 12009.1	41998 11309 39400
Word, 1918.....	30 02 54.954 101 01 28.141	22 52 34.2 23 36 56.5 91 35 49.2	202 48 33.0 203 32 39.3 271 26 26.6	Jim..... McNutt..... Blue.....	4.524077 4.539041 4.478075	33425.4 34597.2 30107.5	109663 113508 98778
Santa Rosa Mountain (Mexico), 1918.	29 05 28.104 102 37 14.600	197 07 53.3 203 19 21.9 211 14 13.3	17 17 21.8 23 32 48.6 31 31 40.5	Road..... Eldridge..... Poggy.....	5.020265 5.044251 5.041138	104776.8 110726.3 109935.5	343755 363275 360680
Precise level B. M., E 31, 1918.[1]	29 22 41.19 100 46 04.04	68 08 09	248 08 06	Johnstone.....	2.343113	220.35	722.9
Del Rio standpipe, finial, 1918.[1]	29 22 06.54 100 54 12.10	176 16 45 282 21 10	356 16 34 102 24 01	Kelly..... Dobkins.....	3.976489 3.985057	9473.0 9661.8	31079 31699
Windmill northeast of station Johnstone, 1918.[1]	29 23 01.46 100 45 54.39	33 21 52 46 40 32	213 21 43 226 39 19	Johnstone..... Dobkins.....	2.927077 3.738916	845.4 5481.7	2774 17985
Windmill south of station Johnstone, 1918.[1]	29 22 19.93 100 46 05.92	55 58 23 164 57 16	235 57 16 344 57 13	Dobkins..... Johnstone.....	3.647025 2.773052	4436.3 593.0	14555 1946
Jim, cairn, 1918[1]...	29 46 14.37 101 09 31.87	43 50 22 191 23 15	223 50 06 11 23 15	McNutt..... Jim.....	3.095903 0.698395	1247.1 5.0	4092 16
Round Mountain (Mexico), 1918.	29 11 36.482 101 47 44.697	104 39 35.8 191 44 47.0 204 50 15.7	344 32 39.2 11 50 40.7 25 03 52.8	Peggy..... Babb..... Blue.....	4.932400 4.974146 5.022928	85586.0 94220.6 105421.2	280795 309122 345869
Dryden water tank, 1918.	30 02 47.730 102 00 54.184	48 58 55.7 178 34 02.1 278 44 08.1	228 57 23.3 358 33 58.4 98 44 37.6	Eldridge..... Hon..... Dryden east base.	3.817087 3.901244 3.202450	6562.8 7966.1 1593.9	21531 26135 5229
Sharp tip (Mexico), 1918.	29 21 28.074 102 36 38.344	183 48 52.1 202 57 19.1 210 43 28.8	3 50 29.0 23 06 31.3 30 56 41.0	New..... Road..... Eldridge.....	4.895989 4.884460 4.923755	78702.6 76640.8 83898.7	258210 251446 275258
White tip, 1918....	30 12 20.553 102 45 52.840	297 34 02.5 6 30 55.6 72 41 03.3	117 47 59.8 186 30 45.2 252 35 23.2	Road..... Dry..... Brown.....	4.703160 3.685598 4.277919	50484.7 4848.4 18963.5	165632 15907 62216
Black Mountain, 1918.	30 43 21.033 103 58 53.651	62 22 40.7 163 49 19.3 251 11 58.2 319 55 12.2	242 16 48.2 343 46 25.5 71 17 43.0 140 09 23.9	Baldy..... Newman..... Star..... Ord (U. S. G. S.).	4.317372 4.508712 4.277428 4.843381	20766.9 32263.5 18942.1 69723.8	68133 105851 62146 228752

[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.	° ′ ″	° ′ ″	° ′ ″				
Sawtooth, 1918.....	30 41 06.32	105 54 32	285 39 45	Chispa.....	4.680795	47950.7	157318
	104 13 40.12	161 35 39	341 29 29	Krouse.....	4.780754	60360.7	198033
		202 27 39	22 32 20	Newman.....	4.580074	38025.4	124755
Twin Buttes (U. S. G. S. signal), 1918.	29 57 27.32	134 00 08	313 58 50	Road.....	3.765064	5829.9	19127
	102 15 26.74	237 39 56	57 42 40	Eldridge.....	4.016912	10397.1	34111
Moffeta section house, south gable, 1918.[1]	30 03 16.02	311 52 34	131 54 22	Eldridge.....	3.889691	7757.0	25449
	102 13 34.46	47 08 05	229 05 50	Road.....	3.992444	9827.5	32242
Tres Hermanos, 1918.[1]	30 00 45.00	176 14 14	356 13 54	Brown.....	4.198447	15792.4	51812
	102 56 30.63	260 47 58	80 59 33	New.....	4.575820	37654.8	123539
Tres Hermanos (cairn), 1918.	30 00 45.626	224 52 15.3	44 57 24.7	Dry.....	4.369470	23413.7	76816
	102 56 30.721	249 14 37.1	69 32 24.5	Sanderson (U. S. G. S.).	4.784343	60861.5	199670
		260 49 45.9	81 01 20.6	New.....	4.575812	37654.1	123537
Ord (U. S. G. S. cairn), 1918.[1]	30 14 25.05	157 07 25	337 07 25	Ord (U. S. G. S.).	1.220760	16.6	54
	103 30 54.43	279 47 53	100 04 52	Brown.....	4.740317	54994.2	180427
Marathon, 1918[1]...	30 12 31.84	281 02 25	101 11 59	Brown.....	4.493395	31145.5	102183
	103 16 11.67	98 29 44	278 22 19	Ord (U. S. G. S.).	4.377871	23871.0	78317
Goat Mountain, northwest end, 1918.[1]	29 45 14.64	167 53 46	347 47 10	Baldy.....	4.999793	99952.4	327927
	103 57 17.61	218 05 31	38 18 43	Ord (U. S. G. S.).	4.836355	68604.9	225081
Tree (U. S. G. S. signal), 1918.[1]	30 46 38.46	117 13 18	297 13 18	Star.....	1.336460	21.7	71
	103 47 38.58						
Star (U. S. G. S.), 1918.[1]	30 46 38.38	115 45 06	295 45 06	Star.....	1.452093	28.32	92.9
	103 47 38.35						
Baldy (U.S.G.S.), 1918.[1]	30 38 07.86	87 44 16	267 44 16	Baldy.....	0.748188	5.60	18.4
	104 10 24.40						
Flat cone, 1918.....	30 56 29.53	172 54 07	352 52 58	Krouse.....	4.463125	29048.6	95304
	104 23 24.44	257 20 41	77 30 24	Newman.....	4.488221	30776.6	100973
		328 30 46	148 37 20	Baldy.....	4.599447	39760.1	130446
South Guard, 1918.	31 53 31.97	322 41 40	143 06 15	Newman.....	5.092554	123752.5	406011
	104 51 39.58	331 38 33	151 52 10	Krouse.....	4.939153	86926.7	285192
		334 38 59	155 00 23	Baldy.....	5.187372	153947.3	505075
San Juan reference mark, 1917.[1]	26 11 17.400	197 31 40	17 31 40	San Juan.....	1.47422	29.80	97.8
	98 06 36.834						
Handy reference mark, 1917.[1]	26 05 37.859	33 09 39	213 09 38	Handy.....	1.55035	35.51	116.5
	98 05 55.607						
McAllen reference mark, 1917.[1]	26 14 03.006	312 19 39	132 19 40	McAllen.....	1.68417	48.33	158.6
	98 14 25.157						
Hickley reference mark, 1917.[1]	26 08 48.105	272 53 54	92 53 54	Hickley.....	1.49457	31.23	102.5
	98 16 16.204						
Mamie reference mark, 1917.[1]	26 13 02.016	190 38 36	10 38 36	Mamie.....	1.45728	28.66	94.0
	98 22 40.926						
Palo reference mark, 1917.[1]	26 19 37.350	180 35 48	0 35 48	Palo.....	1.69249	49.26	161.6
	98 27 48.266						
Pedro reference mark, 1917.[1]	26 14 36.917	287 51 21	107 51 21	Pedro.....	1.24969	17.77	58.3
	98 28 59.113						
Fordyce reference mark, 1917.[1]	26 17 47.509	279 11 20	99 11 20	Fordyce.....	1.15137	14.17	46.5
	98 34 45.742						
Eltoro reference mark, 1917.[1]	26 21 50.454	188 29 29	8 29 29	Eltoro.....	1.67015	46.79	153.5
	98 34 00.555						

[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.	° ′ ″	° ′ ″	° ′ ″				
Chinges reference mark, 1917.[1]	26 31 27.785 98 56 40.245	55 25 51	235 25 51	Chinges	1.36154	22.99	75.4
Banchez reference mark, 1917.[1]	26 32 16.073 98 56 50.779	127 48 14	307 48 14	Banchez	1.13972	13.795	45.26
Margo reference mark, 1917.[1]	26 33 23.209 99 01 24.327	249 00 14	69 00 14	Margo	1.20140	15.90	52.2
Labra reference mark, 1917.[1]	26 34 42.268 99 07 41.388	10 47 51	190 47 51	Labra	1.00247	10.057	33.00
Burros reference mark, 1917.[1]	26 37 43.853 99 03 01.686	332 44 16	152 44 16	Burros	1.17580	14.990	49.18
Flores reference mark, 1917.[1]	26 38 25.027 99 03 46.697	58 58 40	238 58 40	Flores	1.22272	16.700	54.79
Presa reference mark, 1917.[1]	26 42 31.154 99 01 08.778	166 10 24	346 10 24	Presa	0.97864	9.52	31.23
Roleta reference mark, 1917.[1]	26 45 41.719 99 11 40.015	128 47 18	308 47 18	Roleta	1.01431	10.335	33.91
Ale reference mark, 1917.[1]	26 46 31.935 99 10 18.805	31o 21 26	136 21 26	Ale	1.03403	10.815	35.48
Evanito reference mark, 1917.[1]	26 49 58.486 99 08 29.520	339 26 09	159 26 09	Evanito	0.95279	8.970	29.43
Zapata reference mark, 1917.[1]	26 52 49.122 99 17 49.761	194 11	14 11	Zapata	0.97932	9.535	31.28
Rafael reference mark, 1917.[1]	26 50 35.869 99 14 38.183	49 07 42	229 07 42	Rafael	1.05308	11.300	37.07
Moleno reference mark, 1917.[1]	26 57 01.927 99 16 28.569	149 42	329 42	Moleno	1.08672	12.21	40.1
Humaran reference mark, 1917.[1]	26 53 33.025 99 09 47.535	176 41 09	356 41 09	Humaran	1.16077	14.480	47.51
Feora reference mark, 1917.[1]	26 58 31.009 99 21 29.056	159 26 22	339 26 22	Feora	1.09482	12.44	40.8
Loma reference mark, 1917.[1]	26 59 52.024 99 17 13.394	232	52	Loma	1.26387	18.36	60.2
Ygnacio reference mark, 1917.[1]	27 03 28.547 99 23 00.582	136 08 57	316 08 57	Ygnacio	0.95304	8.975	29.45
Union reference mark, 1917.[1]	27 08 30.473 99 17 51.398	218 00 48	38 00 48	Union	0.60423	4.02	13.2
Dan reference mark, 1917.[1]	27 10 59.549 99 18 58.854	177 08	357 08	Dan	1.01841	10.433	34.23
George reference mark, 1917.[1]	27 21 01.028 99 18 33.697	351 36 37	171 36 37	George	1.08027	12.030	39.47
Urebeno reference mark, 1917.[1]	26 57 04.824 99 20 19.216	232 16 51	52 16 51	Urebeno	1.09036	12.313	40.40
Fort reference mark, 1917.[1]	27 26 45.416 99 25 10.843	73 31 41	253 31 41	Fort	1.15661	14.342	47.05
Taylor reference mark, 1917.[1]	27 30 50.186 99 21 19.950	331 38	151 38	Taylor	0.92763	8.465	27.77
Casbeer reference mark, 1917.[1]	27 30 21.708 99 19 44.621	258 10	78 10	Casbeer	0.91062	8.14	26.7
Laredo reference mark, 1917.[1]	27 30 36.667 99 29 17.507	183 42	3 42	Laredo	1.06164	11.525	37.81

[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.	° ′ ″	° ′ ″	° ′ ″				
Knob reference mark, 1917.[1]	27 36 01.093 99 32 03.672	319 33	139 33	Knob	1.13226	13.56	44.5
Orvil reference mark, 1917.[1]	27 38 11.912 99 28 13.636	234 19	54 19	Orvil	1.14457	13.95	45.8
Garcia reference mark, 1917.[1]	26 20 41.887 98 42 29.169	9 07 52	189 07 52	Garcia	1.28308	19.19	63.0
Pancho reference mark, 1917.[1]	26 26 37.433 98 41 16.148	57 57 39	237 57 39	Pancho	1.56972	37.13	121.8
Monument reference mark, 1917.[1]	26 21 16.936 98 46 02.646	48 36 47	228 36 46	Monument	1.07041	11.76	38.6
Corpus reference mark, 1917.[1]	26 26 28.905 98 45 50.615	36 36 02	216 36 02	Corpus	1.24403	17.54	57.5
Hebron reference mark, 1917.[1]	26 27 00.739 98 53 03.403	61 43 33	241 43 33	Hebron	1.11544	13.045	42.80
Ringgold reference mark, 1917.[1]	26 22 30.859 98 53 31.464	275 56 22	95 56 22	Ringgold	1.48770	30.740	100.85
Garcena reference mark, 1917.[1]	26 26 56.532 98 55 43.375	69 06 17	249 06 17	Garcena	1.20235	15.935	52.28
Gorgora reference mark, 1917.[1]	26 25 23.990 99 00 35.573	355 53 40	175 53 40	Gorgora	1.10089	12.615	41.39
Roma reference mark, 1917.[1]	26 28 12.256 99 01 41.661	189 13 46	9 13 46	Roma	1.13098	13.52	44.4
Fieldings reference mark, 1917.[1]	27 40 30.292 99 33 43.566	163 06	343 06	Fieldings	1.30642	20.25	66.4
Davis reference mark, 1917.[1]	27 46 05.812 99 29 49.622	154 44	334 44	Davis	1.14092	13.833	45.38
Tordillo reference mark, 1917.[1]	27 43 26.490 99 39 52.925	139 57	319 57	Tordillo	1.17173	14.85	48.7
Coleman reference mark, 1917.[1]	27 45 26.181 99 41 14.023	137 42	317 42	Coleman	1.11311	13.005	42.67
Tajone reference mark, 1917.[1]	27 49 18.838 99 29 37.906	36 37	216 37	Tajone	1.09830	12.54	41.1
Thomas reference mark, 1917.[1]	27 53 23.795 99 44 22.530	159	339	Thomas	1.16761	14.71	48.3
Willie reference mark, 1917.[1]	27 56 02.855 99 44 41.440	335	155	Willie	0.94498	8.81	28.9
Brewster reference mark, 1917.[1]	28 01 04.934 99 37 04.182	230 35	50 35	Brewster	1.21543	16.422	53.88
Cup reference mark, 1917.[1]	28 03 35.183 99 46 22.586	57 34	237 34	Cup	1.14836	14.072	46.17
Galvan reference mark, 1917.[1]	28 05 59.210 99 37 21.835	173 52	353 52	Galvan	1.12620	13.372	43.87
Twin reference mark, 1917.[1]	28 05 35.026 99 49 28.133	134 35	314 35	Twin	1.21325	16.340	53.61
Cat reference mark, 1917.[1]	28 17 31.294 99 48 39.774	91 30	271 30	Cat	0.96398	9.204	30.20
Big reference mark, 1917.[1]	28 11 48.166 99 55 32.481	143 10	323 10	Big	1.22750	16.885	55.40

[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.	° ′ ″	° ′ ″	° ′ ″				
Tom reference mark, 1918.[1]	28 12 56.803 99 55 21.426	283 18	103 18	Tom	1.26385	18.359	60.23
Dentonio reference mark, 1918.[1]	28 18 32.860 99 56 12.633	351 40	171 40	Dentonio	1.04961	11.210	36.78
Carlow reference mark, 1918.[1]	28 22 46.605 99 56 35.100	127 07	307 07	Carlow	1.11240	12.954	42.50
Barr reference mark, 1918.[1]	28 18 12.716 100 02 44.183	59 06	239 06	Barr	1.08842	12.258	40.22
English reference mark, 1918.[1]	28 23 25.617 100 00 49.640	324 01 57	144 01 57	English	1.12179	13.237	43.43
Glass reference mark, 1918.[1]	28 28 12.993 100 09 47.736	34 49 27	214 49 27	Glass	1.10948	15.83	51.9
Indio reference mark, 1918.[1]	28 21 24.102 100 13 13.283	355 13	175 13	Indio	0.97359	9.410	30.87
Farland reference mark, 1918.[1]	28 25 23.793 100 15 25.916	272 46	92 46	Farland	1.12775	13.420	44.03
Mack reference mark, 1918.[1]	28 26 24.899 100 15 54.355	272 59	92 59	Mack	0.94374	8.785	28.82
Kennedy reference mark, 1918.[1]	28 23 02.455 100 13 34.162	352 26 49	172 26 49	Kennedy	1.10748	12.808	42.02
Silo reference mark, 1918.[1]	28 33 15.462 100 21 58.244	267 59	87 59	Silo	1.12985	13.485	44.24
Davidson reference mark, 1918.[1]	28 38 11.455 100 16 52.011	305 16 35	125 16 35	Davidson	1.11260	12.960	42.52
Pass reference mark, 1918.[1]	28 42 51.190 100 27 26.039	332 03	152 03	Pass	1.06206	11.552	37.90
Eagle reference mark, 1918.[1]	28 43 37.718 100 27 07.596	51 47	231 47	Eagle	1.07122	11.782	38.65
Laplace reference mark, 1918.[1]	28 42 47.725 100 29 33.689	1 10	181 10	Laplace	1.60195	39.990	131.20
Lone reference mark, 1918.[1]	28 45 59.465 100 23 11.400	80 03	260 03	Lone	1.20683	16.100	52.82
Nine reference mark, 1918.[1]	28 49 21.998 100 31 11.049	139 43	319 43	Nine	1.12228	13.252	43.48
Paloma reference mark, 1918.[1]	28 53 28.801 100 23 58.223	163 13	343 13	Paloma	1.20809	16.147	52.98
Burr reference mark, 1918.[1]	28 52 35.611 100 29 32.434	306 13	126 13	Burr	1.13008	13.492	44.27
Pen reference mark, 1918.[1]	28 56 28.267 100 29 05.257	10 59	190 59	Pen	1.13878	13.765	45.16
Wiffp reference mark, 1918.[1]	28 56 48.271 100 34 01.103	97 38	277 38	Wiffp	1.01199	10.280	33.73
Lake reference mark, 1918.[1]	29 00 00.083 100 31 37.997	97 23	277 23	Lake	1.05824	11.435	37.52
White reference mark, 1918.[1]	29 00 03.591 100 31 02.682	264 18	84 18	White	1.01708	10.401	34.12
Towne reference mark, 1918.[1]	29 02 50.558 100 36 46.267	233 43	53 43	Towne	1.08361	12.123	39.77
Jamerson reference mark, 1918.[1]	29 06 31.256 100 33 36.814	228 16	48 16	Jamerson	1.06948	11.735	38.50

[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.	° ′ ″	° ′ ″	° ′ ″				
Dixie reference mark, 1918.[1]	29 08 48.448 100 41 42.714	284 55	104 55	Dixie	1.19976	15.840	51.97
Peters reference mark, 1918.[1]	29 10 32.982 100 36 03.445	284 29	104 29	Peters	0.98318	9.620	31.56
Ross reference mark, 1918.[1]	29 17 44.346 100 40 41.622	39 56	219 56	Ross	1.15655	14.340	47.05
Brackett reference mark, 1918.[1]	29 21 23.160 100 23 17.384	105 49	285 49	Brackett	1.19220	15.567	51.07
Dobkins reference mark, 1918.[1]	29 20 59.732 100 48 22.001	22 53	202 53	Dobkins	1.18064	15.158	49.73
Johnstone reference mark, 1918.[1]	29 22 38.534 100 46 11.378	88 43	268 43	Johnstone	0.82879	6.742	22.12
Hamilton reference mark, 1918.[1]	29 33 08.056 100 41 04.744	28 23	208 23	Hamilton	1.26458	18.390	60.33
Moore reference mark, 1918.[1]	29 29 19.756 100 48 47.708	310 06	130 06	Moore	1.01578	10.37	34.0
Kelly reference mark, 1918.[1]	29 27 13.469 100 54 34.549	107 49	287 49	Kelly	1.01178	10.275	33.71
Mark reference mark, 1918.[1]	29 43 26.543 100 48 47.701	237 18	57 18	Mark	1.18109	15.205	49.89
Feely reference mark, 1918.[1]	29 32 38.020 101 08 14.081	283 27	103 27	Feely	0.99504	9.90	32.5
McNutt reference mark, 1918.[1]	29 45 44.873 101 10 03.658	131 04 00	311 04 00	McNutt	1.11294	12.97	42.6
Harrison reference mark, 1918.[1]	29 59 32.198 100 51 09.034	114 43 43	294 43 43	Harrison	1.05461	11.34	37.2
Jim reference mark, 1918.[1]	29 46 14.330 101 09 31.528	126 13	306 13	Jim	1.00647	10.15	33.3
Blue reference mark, 1918.[1]	30 03 21.073 101 20 12.150	294 54 08	114 54 08	Blue	1.16673	14.68	48.2
Tippetts reference mark, 1918.[1]	29 51 14.778 101 29 55.305	204 00 10	24 00 10	Tippetts	0.99607	9.91	32.5
Babb reference mark, 1918.[1]	30 01 31.730 101 35 48.709	155 17 16	335 17 16	Babb	1.01578	10.37	34.0
Ike reference mark, 1918.[1]	30 02 04.495 101 37 48.374	53 33	233 33	Ike	0.97081	9.35	30.7
Proctor reference mark, 1918.[1]	29 53 01.029 101 43 09.253	193 59 18	13 59 18	Proctor	1.06108	11.51	37.8
Bassett reference mark, 1918.[1]	30 04 49.198 101 43 18.406	86 20	266 20	Bassett	1.14075	14.02	46.0
Hoddy reference mark, 1918.[1]	30 05 54.718 101 48 40.943	232 42 09	52 42 09	Hoddy	0.89098	7.78	25.5
Peggy reference mark, 1918.[1]	29 56 16.512 102 01 49.290	277 32 45	97 32 45	Peggy	1.00475	10.11	33.2
Hon reference mark, 1918.[1]	30 07 06.502 102 07 01.353	58 30 44	238 39 44	Hon	0.92942	8.50	27.9
Eldridge reference mark, 1918.[1]	30 00 27.759 102 09 59.377	261 40 42	81 40 42	Eldridge	1.06819	11.70	38.4

[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.	° ′ ″	° ′ ″	° ′ ″				
Dryden east base reference mark, 1918.[1]	30 02 40.082 102 05 57.078	278 20 50	08 20 51	Dryden east base.	1.66248	45.97	150.8
Dryden west base reference mark, 1918.[1]	30 03 10.743 102 10 06.676	261 22 14	81 22 17	Dryden west base.	2.11039	128.94	423.0
Road reference mark, 1918.[1]	29 59 38.839 102 18 02.749	88 20 28	268 20 28	Road.....	1.07372	11.85	38.9
Sanderson (U. S. G. S.) reference mark No. 1, 1918.[1]	30 12 22.204 102 21 02.151	37 50 33	217 50 33	Sanderson (U. S. G. S.).	1.53212	34.05	111.7
Sanderson (U. S. G. S.) reference mark No. 2, 1918.[1]	30 12 20.699 102 21 02.141	132 35 18	312 35 18	Sanderson (U. S. G. S.).	1.45864	28.75	94.8
Sanderson (U. S. G. S.) reference mark No. 3, 1918.[1]	30 12 20.202 102 21 03.478	202 46 58	22 46 58	Sanderson (U. S. G. S.).	1.57634	37.70	123.7
New reference mark, 1918.[1]	30 03 58.769 102 33 23.189	315 00 34	135 00 34	New.....	1.08243	12.09	39.7
Dry reference mark, 1918.[1]	30 09 44.632 102 46 14.418	300 24	120 24	Dry.....	1.49955	31.59	103.6
Pyle reference mark, 1918.[1]	30 21 50.000 102 40 23.950	336 44 22	156 44 22	Pyle.....	1.29092	19.54	64.1
Brown reference mark, 1918.[1]	30 09 17.276 102 57 08.899	37 58 38	217 58 38	Brown.....	1.29951	19.93	65.4
Nation reference mark, 1918.[1]	30 24 03.301 102 57 50.063	108 19 30	288 19 30	Nation.....	1.06856	11.71	38.4
Madera reference mark, 1917.[1]	30 35 33.025 102 54 47.377	184 29	4 29	Madera.....	1.24005	17.38	57.0
Chancellor reference mark, 1917.[1]	30 41 25.314 103 05 09.232	208 32 56	28 32 56	Chancellor....	0.71933	5.24	17.2
Ord (U. S. G. S.) reference mark, 1917.[1]	30 14 25.160 103 30 54.493	158 03 32	338 03 32	Ord(U.S.G.S.)	1.10312	12.68	41.6
Beard reference mark, 1917.[1]	30 49 40.382 103 31 12.301	239 24	59 24	Beard.....	0.44091	2.76	9.1
Star reference mark, 1917.[1]	30 46 38.335 103 47 39.428	193 17 34	13 17 34	Star.....	1.14799	14.06	46.1
Baldy reference mark, 1917.[1]	30 38 07.779 104 10 24.424	116 37	296 37	Baldy.....	0.73480	5.43	17.8

[1] No check on this position.

TABLE OF ELEVATIONS.[1]

Station.	Point to which elevation refers.	Elevation.	
Class 1.		*Meters.*	*Feet.*
Rio	Station mark.	24.15	79.2
Donna	....do....	29.94	98.2
San Juan	....do....	31.38	103.0
Mamie	....do....	43.13	141.5
Pedro	....do....	52.30	171.6
Ringgold	....do....	53.93	176.9
Labra	....do....	121.30	398.0
Zapata	....do....	113.25	371.5
Urebeno	....do....	136.80	448.8
Feora	....do....	138.93	455.8
Loma	....do....	152.98	501.9
Laredo	....do....	151.80	498.0
Tajone	....do....	237.70	779.8
Laplace	....do....	256.84	842.7
Johnstone	....do....	320.91	1072.5
Dryden east base	....do....	645.56	2118.0
Dryden west base	....do....	675.81	2217.2
Newman	....do....	1947.82	6390.5
Krouse	....do....	1724.27	5057.0
Chispa	....do....	1585.00	5200.1
Class 2.			
Handy	....do....	26.80	87.9
McAllen	....do....	37.12	121.8
Hickley	....do....	32.09	105.3
Mission	....do....	53.71	176.2
Palo	....do....	72.46	237.7
Eltoro	....do....	94.67	310.6
Fordyce	....do....	71.78	235.5
Pancho	....do....	113.23	371.5
Garcia	....do....	72.65	238.4
Corpus	....do....	101.70	333.7
Monument	....do....	74.42	244.2
Grande	....do....	81.49	267.4
Hebron	....do....	116.92	383.6
Garcena	....do....	120.65	395.8
Gorgora	....do....	100.82	330.8
Chinges	....do....	143.82	471.8
Banchez	....do....	139.29	457.0
Roma	....do....	132.20	433.7
Margo	....do....	152.12	499.1
Burros	....do....	167.57	549.8
Flores	....do....	162.74	533.9
Presa	....do....	152.14	499.2
Alc	....do....	129.53	425.0
Roleta	....do....	123.84	406.3
Evanito	....do....	149.93	491.9
Rafael	....do....	122.27	401.2
Humaran	....do....	138.36	453.9
Moleno	....do....	156.19	512.4
Ygnacio	....do....	157.40	516.4
Union	....do....	161.75	530.7
Dan	....do....	172.49	565.9
Dolores	....do....	158.91	521.4
George	....do....	151.94	498.5
Fort	....do....	202.08	663.0
Casbeer	....do....	205.59	674.5
Taylor	....do....	203.62	668.0
Orvil	....do....	208.76	684.9
Knob	....do....	154.73	507.6
Fieldings	....do....	203.49	667.6
Davis	....do....	235.61	773.0
Tordillo	....do....	186.26	611.1
Coleman	....do....	203.01	666.0
Thomas	....do....	236.01	774.3
Willie	....do....	239.35	785.3
Brewster	....do....	242.73	796.4

Station.	Point to which elevation refers.	Elevation.	
Class 2—Cont.		*Meters.*	*Feet.*
Galvan	Station mark.	254.75	835.8
Cup	....do....	243.77	799.8
Twin	....do....	244.18	801.1
Big	....do....	261.63	858.4
Tom	....do....	262.14	860.0
Cat	....do....	220.39	723.0
Dentonio	....do....	250.69	822.5
Carlow	....do....	253.36	831.2
English	....do....	265.41	870.8
Barr	....do....	253.53	832.1
Indio	....do....	251.46	825.0
Glass	....do....	260.55	854.8
Farland	....do....	261.59	858.2
Mack	....do....	259.97	852.9
Kennedy	....do....	265.96	872.6
Silo	....do....	252.01	826.8
Davidson	....do....	262.01	859.6
Lone	....do....	279.16	915.9
Eagle	....do....	279.10	915.7
Pass	....do....	276.16	906.0
Mine	....do....	266.94	875.8
Paloma	....do....	276.95	908.6
Burr	....do....	272.23	893.1
Pen	....do....	273.93	898.7
Wiffp	....do....	279.18	915.9
Lake	....do....	277.62	910.8
White	....do....	279.64	917.4
Towne	....do....	280.88	919.9
Jamerson	....do....	291.47	956.3
Dixie	....do....	292.60	960.0
Peters	....do....	309.21	1014.5
Ross	....do....	335.00	1099.1
Brackett	....do....	510.54	1675.0
Dobkins	....do....	341.89	1121.7
Hamilton	....do....	449.29	1474.0
Moore	....do....	401.04	1315.8
Kelly	....do....	378.09	1240.4
Mark	....do....	576.36	1890.9
Feely	....do....	426.60	1399.6
McNutt	....do....	606.04	1990.4
Harrison	....do....	653.75	2144.8
Jim	....do....	605.38	1986.2
Blue	....do....	656.68	2154.5
Tippetts	....do....	551.26	1808.6
Babb	....do....	628.72	2062.7
Proctor	....do....	562.72	1846.2
Ike	....do....	630.77	2069.4
Bassett	....do....	643.13	2110.0
Hoddy	....do....	659.29	2163.0
Peggy	....do....	656.46	2153.7
Hen	....do....	711.75	2335.1
Eldridge	....do....	712.72	2338.3
Road	....do....	740.95	2430.9
Sanderson	....do....	1082.48	3551.4
New	....do....	921.84	3024.4
Dry	....do....	1368.14	4488.6
Brown	....do....	1064.11	5459.7
Pyle	....do....	1298.51	4260.2
Nation	....do....	1561.93	5124.4
Madera	....do....	1401.91	4599.4
Chancellor	....do....	1175.87	3857.8
Ord (U. S. G. S.)	....do....	2076.92	6814.0
Beard	....do....	1527.57	5011.7
Star	....do....	1933.80	6344.5
Baldy	....do....	2558.74	8378.4

[1] See note regarding accuracy at end of table.

TABLE OF ELEVATIONS—Continued.

Station.	Point to which elevation refers.	Elevation.		Station.	Point to which elevation refers.	Elevation.	
Class 3.		*Meters.*	*Feet.*	*Class 3*—Con.		*Meters.*	*Feet.*
Edinburg courthouse.	Top of cupola.	56.8	186	Laredo, north wireless mast.	Top.....	218.8	718
San Juan standpipe.	Base of finial.	58.7	193	Laredo, south wireless mast.	.....do.....	217.6	714
Pharr standpipe..	.....do.....	57.2	188	Laredo, electric light and power plant.	Top of brick stack.	170.7	560
Mission, first lift pump.	Top of stack..	66.3	218	Nuevo Laredo, standpipe.	Top.....	159.9	525
Mission, third lift pump.	Top of tall stack.	77.4	254	Central Laredo water works.	Top of brick stack.	148.4	487
Banco[1].....	Station mark.	37.1	122	Isabel.....	Station mark.	164.2	539
Monastery, north end.	East cupola..	58.8	193	Matthews ranch, white windmill.	Hub of wheel.	176.8	580
Hidalgo church steeple.	Base of finial.	53.2	175	Tordillo, white house.	West gable...	148.8	488
International Boundary Survey Monument R. P. 4.[1]	Mark.....	47.0	154	Red.....	Station mark.	261.5	858
				Dentonio Hotel..	South gable..	255.7	839
Riogrande Catholic Church.	Intersection of two slopes of steeple.	73.3	240	Brackettville standpipe.	Finial.....	382.2	1254
				Word.....	Station mark.	649.3	2130
Riogrande courthouse.	Base of finial, cupola.	84.0	276	Santa Rosa Mountain.	Highest point	2737.1	8980
Riogrande standpipe.	Base of finial.	91.0	299	Black Mountain..	.....do.....	2300.9	7549
				Sawtooth Mountain.	.....do.....	2337.3	7668
Roma Catholic Church.	.....do.....	86.5	284	Southeast Buracho, flat cone.	.....do.....	1723.3	5654
Roma, Church of the Covenant.	Base of cupola.	79.0	259	South Guard Mountain.	.....do.....	2697.6	8850
Zapata, post office	Roof.....	97.4	320	Goat Mountain...	.....do.....	1546.8	5075
Zapata, church steeple.	Base of finial.	97.6	320				

[1] No check on this elevation.

NOTE.—The datum for all the elevations is mean sea level. The stations are in three classes—first, those fixed by direct connection with sea level, the elevations of which are subject to a probable error of ±0.15 meter; second, the stations in the main scheme fixed by reciprocal measures of vertical angles and subject to probable errors varying from ±0.15 to ±0.9 meter; and, third, the intersection stations the elevations of which are fixed by measurement of vertical angles which are not reciprocal, the staions not being occupied, and subject to probable errors which may be as great as ±2 meters.

DESCRIPTION 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.

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

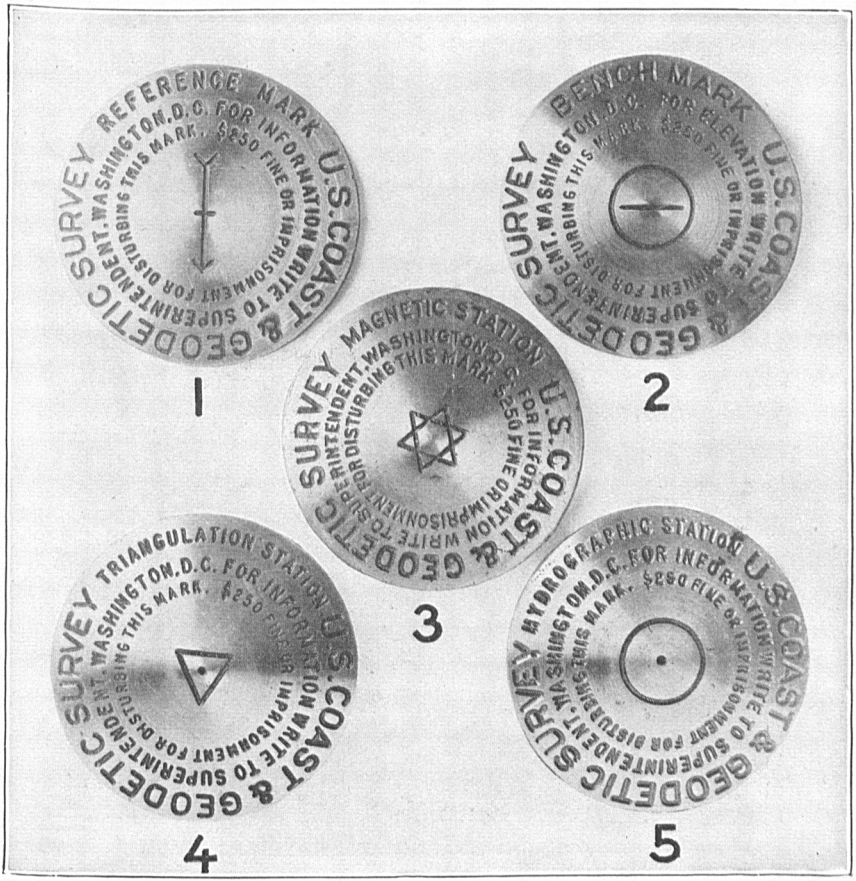

FIG. 1.—STANDARD MARKS OF THE U. S. COAST AND GEODETIC SURVEY.

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

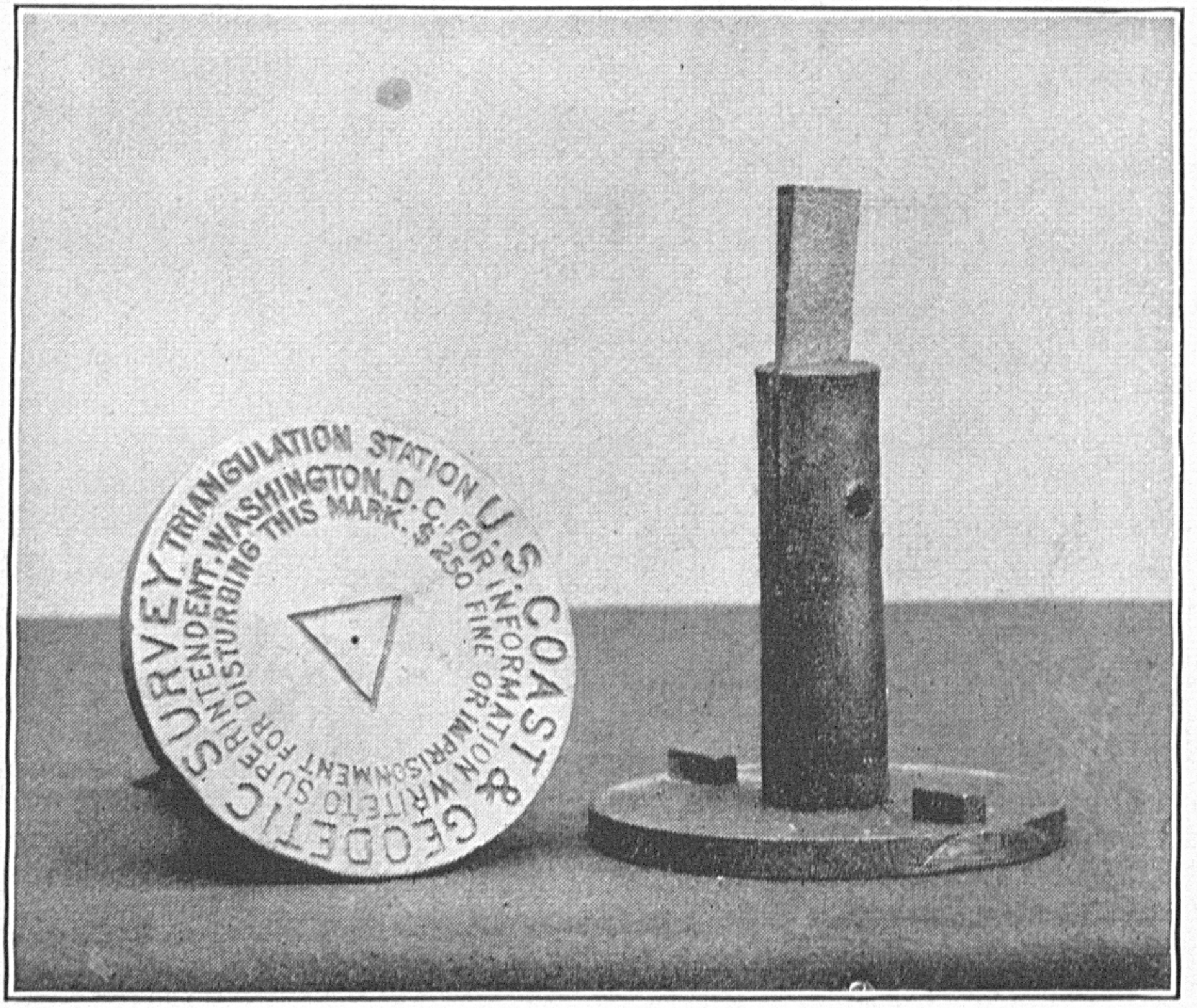

FIG. 2.—STANDARD TRIANGULATION STATION MARK.

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 standard bronze station and reference marks referred to in the following descriptions and notes consist of a disk and shank of bronze cast in one piece, as shown in figures 1 and 2. The disk of the station mark is 90 mm. in diameter, with a hole at the center surrounded by a 20-mm. equilateral triangle, and has the following inscribed legend: "U. S. Coast and Geodetic Survey Triangulation Station. For information write to the Superintendent, Washington, D. C. $250 fine or imprisonment for disturbing this mark." The shank is 25 mm. in diameter and 80 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 hold the mark firmly in place.

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

The following standard notes on the marking of stations are made as general as possible in order that it may not be necessary in the field to describe small and unimportant variations:

STANDARD NOTES DESCRIBING SURFACE AND SUBSURFACE STATION MARKS, REFERENCE, AND WITNESS MARKS.

Surface marks.

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

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

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

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

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

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

Underground marks.

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

Note 8.—In bedrock (*a*) a standard bronze tablet wedged in a drill hole, (*b*) a standard bronze tablet set in concrete in a depression, (*c*) a copper bolt set in cement

in a drill hole or depression, (*d*) an iron spike set point up in cement in a drill hole or depression.

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

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

Reference marks.

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

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

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

Witness marks.

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

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

PRINCIPAL POINTS.

Handy (Hidalgo County, C. V. Hodgson, 1917).—About 6 miles south and 3 miles west of Donna, 3 miles west of the point where the road running south from Donna along the east side of the Donna sugar mill joins the military road, and 1.8 miles west of the point where the Donna Canal crosses the military road. The station is about 40 meters south of the military road and 3 telephone poles east of the point where the military road changes direction from west to southwest. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] distant 35.51 meters (116.5 feet) in azimuth 213° 09′ 38″.

San Juan (Hidalgo County, C. V. Hodgson, 1917).—About 3.6 miles west and 0.6 mile north of Donna, on the west side of a newly opened road which leaves the Donna-Mission road 3.6 miles west of Donna, and 0.6 mile north of the St. Louis, Brownsville & Mexico Railway, on a small sand ridge. A canal is projected to run just north of the station along the foot of the tower. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] set in the fence line along the road on the side nearest the station, distant 28.80 meters (94.5 feet) from the station in azimuth 17° 31′ 40″.

Donna (Hidalgo County, C. V. Hodgson, 1913; 1917).—About one-half mile southeast of Donna, on the west side of a large irrigation canal, on land owned by Dr. Roberts, of Donna. A Mexican jacal is 25 meters (82.02 feet) east of north from the station. The center of the transit on the longitude pier was 31.607 meters (103.70 feet) from the station in azimuth 90° 18′ 33″. In 1916 this pier, which was of concrete, had been broken off even with the surface of the ground, but the base was still in place. The station is marked by a bronze tablet in concrete, as described in notes 1b and 7a,[1] with a reference mark, a bronze tablet in concrete, as described in note 11b,[1] set at the same elevation as the station, distant 31.58 meters (103.6 feet) in azimuth 8° 07′ 08″. "Donna 1913" was stenciled on the metal station and reference marks.

Rio (Hidalgo County, C. V. Hodgson, 1913; 1917).—About 40 meters south of the old military road in an open space directly in front of Progresso village. The church at Progresso is about 400 meters distant, in azimuth 358° 24′ 52″. The station

[1] See p. 33.

is marked by a bronze tablet in concrete, as described in notes 1b and 7a,[1] with a reference mark, a bronze tablet in concrete, as described in note 11b,[1] set at the same elevation as the station, in a fence line 1 meter east of the gate on the road leading from the main road to Progresso post office and church, 42.61 meters (139.8 feet) from the station, in azimuth 354° 05′ 56″. In 1917 "Rio 1913" was stenciled on the metal station and reference marks.

McAllen (Hidalgo County, C. V. Hodgson, 1917).—Two miles north of McAllen, on the east side of the main wagon road, in a small field owned by T. H. Cromwell, 1343 D Street, Lincoln, Nebr., and rented by P. R. Rice. The station is 48 meters (157 feet) southwest of the southwest corner of Mr. Rice's residence. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] set at the southwest corner of the house, 48.325 meters (158.5 feet) from the station in azimuth 132° 19′ 40″.

Hickley (Hidalgo County, C. V. Hodgson, 1917).—About 4 miles south and 2 miles west of McAllen, on the farm of J. J. Hackney, about 60 or 70 meters (200 or 225 feet) northwest of his house, 30 meters (100 feet) northwest of a concrete water tank, 38 meters (125 feet) east of the east fence line along the lane leading south to Mr. Hackney's house, and 25 meters (80 feet) north of his feed-lot fence. It is best found by going south from the old railroad depot at McAllen for 4 miles, west 1 mile, and then south one-half mile to Mr. Hackney's house. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 31.23 meters (102.5 feet) from the station in azimuth 92° 53′ 54″.

Mission (Hidalgo County, C. V. Hodgson, 1917).—About 5½ miles northwest by west from the town of Mission, on a ranch owned by Alfredo Flores, about 0.3 mile east by south from the ranch house and the same distance southeast by east from the windmill and tank at the ranch and about 10 meters south of the wagon trail leading eastward from the ranch. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 30.13 meters (98.8 feet) from the station in azimuth 191° 21′ 31″.

Mamie (Hidalgo County, C. V. Hodgson, 1917).—About 4 miles west of Mission, 1 mile west of the Mamie railroad siding, and 0.4 mile south of the railroad. A wagon road, which crosses the railroad 1 mile west of Mamie, runs south and then southwest 0.8 mile to a point where it intersects with a north and south road, which is cleared through the brush, but which is ungraded and untraveled. The station is 12 meters (40 feet) east of this intersection. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 28.66 meters (94.0 feet) from the station in azimuth 10° 29′ 36″.

Palo (Hidalgo County, C. V. Hodgson, 1917).—About 6½ miles north of the St. Louis, Brownsville & Mexico Railway, 7 miles north by west from Penitas, and 2½ miles northwest from Palo Blanco ranch, near a new frame house and windmill on a goat ranch. It is best found by going three-fourths mile northwest from the Palo Blanco ranch, then 2 miles north and one-half mile west to the station. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] set at the northwest corner of the new frame house mentioned above, 49.26 meters (161.7 feet) from the station in azimuth 0° 35′ 50″.

Pedro (Hidalgo County, C. V. Hodgson, 1917).—About 3 miles east of Samfordyce, 1 mile north of the Mission-Riogrande wagon road, on the hill at the north edge of the Mexican village of Tabasco, and at the north end of a small unfenced cemetery, 21 meters (69 feet) east of the center of the main wagon road running north from the village, 14 meters (46 feet) north and 2 meters (7 feet) east of the monument marking the grave of Ignacio Trevino. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 17.77 meters (58.3 feet) from the station in azimuth 107° 51′ 21″.

Eltoro (Starr County, C. V. Hodgson, 1917).—About 8½ miles northwest of Samfordyce, 7 miles north of the military wagon road, 4.65 miles north of Fordyce, and 0.3 mile west of the Eltoro ranch, on the east side of the main wagon road running north past the Eltoro ranch. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 46.79 meters (153.5 feet) from the station in azimuth 8° 29′ 30″.

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[1] See p. 33.

Fordyce (Starr County, C. V. Hodgson, 1917).—About 3½ miles west and 3 miles north of Samfordyce, 2 miles north of the military wagon road, 1 mile north of the point where the road from Samfordyce to Eltoro ranch changes from a northwest to a north course, and 5 meters (16 feet) east of the middle of the present track, and 4.8 miles south of the Eltoro ranch. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 14.71 meters (48.3 feet) from the station in azimuth 287° 48′ 48″.

Pancho (Starr County, C. V. Hodgson, 1917).—About 7 miles direct and 9 miles by road north-northeast of Garcia post office, just east of the ranch house on the northeast ranch of Pancho Lopez. There is a windmill 106 meters (348 feet) from the station in azimuth 126° 44′ 24″. The line from the station to the windmill passes midway between two small sheds, the northern one with a shingle roof and the southern thatched. The northeast corner of the southern shed is about 58 meters (190 feet) distant. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] set just west of a brush corral, 37.13 meters (121.8 feet) from the station in azimuth 237° 57′ 40″.

Garcia (Starr County, C. V. Hodgson, 1917).—About 2 miles north-northwest of Garcia post office, 2 miles north of the military wagon road, about one-half mile south of a cleared field with a large, lone mesquite tree in the center, 20 meters (66 feet) east of a wire fence, and 17 meters (56 feet) west of the center of a ranch road which leaves the military road 0.7 mile west of Garcia post office at the southwest corner of some cleared fields and runs north. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 19.19 meters (63.0 feet) from the station in azimuth 189° 07′ 55″.

Monument (Starr County, C. V. Hodgson, 1917).—About 3 miles east of Riogrande on a rocky point of the terrace or bench, 150 meters (490 feet) north of the military road. A brick monument, easily visible from the road, is 12.9 meters (42.3 feet) from the station in azimuth 124° 26′ 46″. Monument R. P. 4, International Boundary Commission Survey, a few meters north of the road, is 150.58 meters (494.0 feet) from the station in azimuth 82° 57′ 12″. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 11.76 meters (38.6 feet) from the station in azimuth 228° 36′ 50″.

Corpus (Starr County, C. V. Hodgson, 1917).—About 5.5 miles north-northeast of Riogrande, 150 meters (490 feet) west of the Riogrande-Corpus Christi wagon road, and one-fourth mile south-southwest of a Mexican ranch house in a small basinlike depression. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 17.54 meters (57.5 feet) from the station in azimuth 216° 36′ 05″.

Grande (Starr County, C. V. Hodgson, 1917).—On a hill 1 mile northwest of the post office at Riogrande. It is best found by taking the road up the hill past the cemetery at Riogrande. The station is about 10 meters (33 feet) south of the road with the steeple of the Methodist Church in line with the southwest corner of the large school building at Riogrande. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 9.44 meters (31.0 feet) from the station in azimuth 309° 03′ 55″.

Hebron (Starr County, C. V. Hodgson, 1917).—About 6½ miles northwest of Riogrande, on the highest of a group of brush-covered hills. Best found by going west on the military road 5½ miles from Riogrande, then north on a road along the east side of a wire fence for 4.4 miles to the point where the road passes over the ridge. The station is on this ridge about one-fourth mile to the eastward and north, and about 10 meters south of the beginning of the short steep slope to the north, and is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 13.045 meters (42.80 feet) from the station in azimuth 241° 43′ 35″.

Ringgold (Starr County, C. V. Hodgson, 1917).—About 5 miles west of Riogrande, one-third mile south of the military wagon road and 4½ meters (15 feet) west of the east fence of a wide road leading from the military road to the river. The southeast corner of a Mexican hut is 72 meters (236 feet) from the station in azimuth 151° 13′. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1]

[1] See p. 33.

with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 30.740 meters (100.85 feet) from the station in azimuth 95° 56′ 26″.

Garcena (Starr County, C. L. Garner, 1917).—On the highest part of a ridge about 9 miles north-northwest from Riogrande, 7 miles northeast of Roma, and 3 miles north of a military wagon road leading west from Riogrande. To reach the station, take the road leading north through a lane just east of a small frame house about 1 mile west of a Mexican settlement; about one-half mile from the military road take the left fork; and one-half mile farther the left fork again to a fenced, uncultivated lot about 3 miles from the military road; and follow the ridge to the right one-half mile to the station. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 15.935 meters (52.28 feet) from the station in azimuth 249° 06′.

Gorgora (Starr County, C. L. Garner, 1917).—About 1¼ miles from Roma and 400 meters (1300 feet) from an old road leading northeast from Roma. To reach the station, enter a field near a barn on the east side of town and follow the road across the south end of the field about one-half mile to the pasture and then to the top of the ridge. A reddish knob 1¼ miles northeast from town will be seen from the entrance to the field. The station is on the top of the first knob beyond this and about one-third mile distant. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 12.015 meters (41.39 feet) from the station in azimuth 175° 54′.

Roma (Starr County, C. L. Garner, 1917).—On the top of a flat ridge 4½ miles north of Roma, three-fourths mile north of the point where the military road for Zapata forks to the left, 14 meters (45 feet) east of the Roma-Hebronville wagon road and 4 meters (13 feet) east of the east fence along this road. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 13.52 meters (44.4 feet) from the station in azimuth 9° 14′.

Chinges (Starr County, C. L. Garner, 1917).—On top of a flat hill, one-half mile south of Banchez ranch and one-third mile west of the wagon road leading from the oil wells in this vicinity to Riogrande via the Riogrande-Hebronville road. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 23.99 meters (72.2 feet) from the station in azimuth 235° 26′.

Banchez (Starr County, C. L. Garner, 1917).—On the top of a flat hill, one-eighth mile east of the Riogrande-Hebronville road and about one-half mile northeast of some stock pens. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 13.795 meters (45.26 feet) from the station in azimuth 307° 48′.

Margo (Starr County, C. L. Garner, 1917).—On a flat-topped hill, the highest point in the vicinity, about 10 miles north of Roma, one-half mile west of the Roma-Hebronville wagon road. To reach the station, take the new road which turns to the northwest from the Roma-Hebronville road about 200 meters (655 feet) south of a sharp turn to the east around a fence and Mexican house; follow the new road one-half mile to a point where the brush on the west side of the road is very scattering; turn to the left and follow ridge to the top, one-fourth mile distant. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 15.90 meters (52.2 feet) from the station in azimuth 69° 00′.

Labra (Starr County, C. L. Garner, 1917).—About 16 miles northwest from Roma, 100 meters (330 feet) east of the Riogrande-Laredo military road, at a point where there is a wire fence on each side of the road, and about 200 meters (655 feet) east of board gates, painted pink, on each side of the road. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 10.057 meters (33.00 feet) from the station in azimuth 190° 48′.

Burros (Starr County, C. L. Garner, 1917).—On the highest point of the ridge to the north of the Los Burros ranch, about 15 miles north of Roma, and 1 mile east of the Starr-Zapata county line. The station is best reached by following the Roma-Hebronville road about 9½ miles from Roma to a point where the road forks; follow the left road, which is new and straight, for about 4 miles, to a point where it is crossed by a road from the southwest; cross this road and go about one-half mile to the shoulder of a hill where several roads come together. A rocky knob is just to the north. Leave the road and go to the west of the rocky knob and follow the ridge about 2 miles to the station, which is in a fairly open spot. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet

[1] See p. 33.

in concrete, as described in note 11a,[1] 14.99 meters (49.2 feet) from the station in azimuth 152° 41′.

Flores (Starr County, C. L. Garner, 1917).—On top of a flat ridge 50 meters (165 feet) west of a wire fence said to be the Starr-Zapata county line. The station is best reached by going to station Burros and following the ridge to the westward. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 16.700 meters (54.79 feet) from the station in azimuth 239° 01′.

Presa (Zapata County, C. L. Garner, 1917).—On the top of a ridge about 2 miles northeast of La Presa ranch, 10 miles northeast of Falcon post office, and one-third mile west of the road from La Presa ranch to the north. At La Presa ranch, about 100 meters (330 feet) south of the house, take the road to the east and follow about 3 miles over a very steep hill and to a point about 1¼ miles beyond the hill. The station is on top of a flat hill at the west of the road and is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 9.52 meters (31.2 feet) from the station in azimuth 346° 10′.

Roleta (Zapata County, C. L. Garner, 1917).—About 5 miles northwest of Lopeno post office and 3 miles north of the military road. To reach the station from the eastward, follow the military road 5 miles northwest of Lopena through a deep arroyo and over or around a steep rocky hill, one-half mile beyond which a dim road turns to the north; follow this road 2½ miles to the top of a hill, where the station is 50 meters (165 feet) east of the road. The hill slopes downward very sharply about 500 meters (1650 feet) north of the station. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 10.335 meters (33.91 feet) from the station in azimuth 308° 47′.

Ale (Zapata County, C. L. Garner, 1917).—About 4 miles north of the military road and 2 miles southwest of the Alehandrenas ranch. The station is best reached by following the military road about 1 mile beyond Roleta to a draw between two hills where the road forks; take the left fork leading to the north and follow for about 1½ miles to the top of a ridge, where the station is in an open place on the top of the ridge, just east of the highest mesquite trees and about one-eighth mile west of the road. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 10.815 meters (35.48 feet) from the station in azimuth 153° 09′.

Evanito (Zapata County, C. L. Garner, 1917).—In a bare place at the highest point on a ridge, 11 miles east of north from Lopeno post office, 2 miles west of Evanito ranch, 1 mile north of a road leading from Evanito ranch to the military road and 1 mile north of a shack, stock pens, and dirt tank. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 8.970 meters (29.43 feet) from the station in azimuth 159° 26′.

Rafael (Zapata County, C. L. Garner, 1917).—On the highest hill in the vicinity about 6 miles southeast of Zapata, 2 miles northwest of the Sabinito ranch, and 2 miles north of the military road, and 75 meters (250 feet) south of the upper road which branches from the military road about one-fourth mile east of the Sabinito ranch. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 11.300 meters (37.07 feet) from the station in azimuth 229° 08′.

Humaran (Zapata County, C. L. Garner, 1917).—About 10 miles east of Zapata. Best reached by leaving the military road one-fourth mile east of the Sabanito ranch, which is about 7 miles southeast of Zapata, and following the road to the north to the point where it winds westward around a flat hill grown thick with mesquite trees. The station is on the highest point of the hill about one-eighth mile east of the road and is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 14.480 meters (47.51 feet) from the station in azimuth 356° 42′.

Zapata (Zapata County, C. L. Garner, 1917).—About 1 mile east of the town of Zapata, 20 meters (65 feet) south of the military road, on top of the highest point in the vicinity and where the road leading northeast branches from the military road. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 9.535 meters (31.28 feet) from the station in azimuth 14° 11′.

Moleno (Zapata County, C. L. Garner, 1917).—About 6 miles north of east from Zapata. The station is best reached by taking the military road east from Zapata

[1] See p. 33.

for about 1 mile to a fork of the road; here take the left road leading northeast for about 3 miles to two gates, take the road to the left through a lane for 2.4 miles to an old deserted ranch and field, follow the fence line leading about northeast to the top of a flat hill. The station is on the highest part of the hill 100 meters (330 feet) west of the fence and is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 12.21 meters (40.1 feet) from the station in azimuth 329° 43′.

Urebeno (Zapata County, C. L. Garner, 1917).—About 15 meters (50 feet) to the east of the highest point on the hill, 6 miles northwest of Zapata and 200 meters (655 feet) north of the military road, and just to the north of the point where the military road passes over and between two knobs. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 12.313 meters (40.40 feet) from the station in azimuth 52° 17′.

Feora (Zapata County, C. L. Garner, 1917).—On the highest point of a flat-top ridge, 8 miles northwest of Zapata, and 30 meters (100 feet) south of the military road. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 12.440 meters (40.81 feet) from the station in azimuth 339° 26′.

Loma (Zapata County, C. L. Garner, 1917).—On the top of a flat ridge in the edge of mesquite trees, 3½ miles northeast of the San Maguil ranch, and 250 meters (820 feet) west of a wire fence leading northeast from the ranch. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 18.360 meters (60.24 feet) from the station in azimuth 51° 56′.

Ygnacio (Zapata County, C. L. Garner, 1917).—About 3½ miles northeast of San Ygnacio and 1 mile east of the wagon road from San Ygnacio to La Union ranch. The station is best reached by following the military road one-third mile east from San Ygnacio and there taking the first road leading to the northeast for 2 miles to a dim road crossing. Turn sharply to the left, and follow a crooked road northeast to the top of a ridge. Leave the road and follow the top of the ridge about one-half mile to the station, which is in heavy mesquite. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 8.975 meters (29.45 feet) from the station in azimuth 316° 09′.

Union (Zapata County, C. L. Garner, 1917).—About 12 miles northeast of San Ygnacio, 1¼ miles northeast of La Union ranch, and 50 meters (160 feet) west of an old road leading north from La Union ranch. The station may be located by inquiry at La Union ranch. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 4.02 meters (13.2 feet) from the station in azimuth 38° 01′.

Dan (Zapata County, C. L. Garner, 1917).—About 10 miles northeast of the Corralitos ranch on the military road and 1 mile north of a prominent single knob which is the western extremity of a long even ridge extending to the east. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 10.433 meters (34.23 feet) from the station in azimuth 357° 08′.

Dolores (Zapata County, C. L. Garner, 1917).—On the top of the easternmost of several hills in an open spot about 3 miles north of the Mexican village of Dolores, one-half mile west of the military road, and opposite the 16-mile post from Laredo. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] about 16 meters (50 feet) from the station in azimuth 253° 57′.

George (Webb County, C. L. Garner, 1917).—On the highest point of a flat-top ridge, about 15 miles east of Laredo, 4 miles east of the Colorado ranch and on property belonging to this ranch, and 250 meters (800 feet) north of the road passing through the ranch. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 12.030 meters (39.47 feet) from the station in azimuth 171° 36′.

Fort (Webb County, C. L. Garner, 1917).—On top of the highest hill in the vicinity and about 25 meters (80 feet) from the downward slope of the hill, about 7 miles southeast of Laredo and one-half mile south of the main traveled road. The station is best reached from Laredo by taking the military road about 3 miles south toward Zapata, where a road turns sharp to the east through a lane with irrigated fields on either side; follow this road about 3 miles to the top of a divide between two hills; here go through the gate and follow the old road one-fourth mile; then turn off

[1] See p. 33.

to the left and follow the ridge to the top of the hill and station. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 14.342 meters (47.05 feet) from the station in azimuth 253° 32′.

Casbeer (Webb County, C. L. Garner, 1917).—On top of the most prominent hill in the vicinity, 1 mile northeast of an old wagon road and 1 mile north of the Texas-Mexico Railway. To reach the station, follow the directions for station Taylor to the top of the hill, then continue on the road for 1½ miles to a large dirt tank, and bear north of east across country to the top of the hill and station. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 8.140 meters (26.71 feet) from the station in azimuth 78° 10′.

Taylor (Webb County, C. L. Garner, 1917).—About 10 miles due east of Laredo, 2 miles north of the Texas-Mexico Railway, 4 miles north of east of the target range, and 1¼ miles north of an old wagon road, on top of the highest rocky hill in this vicinity. To reach the station from Laredo, take the road along the street-car tracks about 4 miles toward the target range; about one-half mile before the range is reached the road forks, take the left road which passes between the stables and shacks at the range, downhill, through a gate, across railroad, past an old ranch and shack, to the south of a dirt tank, along a rough road about 4½ miles from the target range to the top of a hill, then to the left along the backbone of the ridge to the station. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 8.465 meters (27.77 feet) from the station in azimuth 151° 38′.

Laredo (Webb County, C. L. Garner, 1917).—On the southern end of a group of knobs in the east suburbs of Laredo, 200 meters (655 feet) west of a windmill, and on a range with the Mexican Presbyterian Church and about halfway between the radio masts. The station is on the highest part of the hill and about 15 meters (50 feet) south of the road passing over the hill. The station is marked by a bronze tablet in concrete, as described in note 2,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 11.525 meters (37.81 feet) from the station in azimuth 3° 42′. The station was reported destroyed in 1922.

Laredo astronomic (Webb County, G. R. Putnam, 1895; J. E. McGrath, 1919).—The longitude station is 62.627 meters (205.469 feet) north and 43.034 meters (141.186 feet) west of Laredo north wireless tower and is marked by a brick pier, 17 by 27 inches on top, with 24 inches of the pier below the surface of the earth and 36 inches above it. A brass plate, 8 by 11 inches, bolted to the top of the pier bears the following inscription: "U. S. Coast and Geodetic Survey, Latitude 27° 30′ 29″.7, Longitude 99° 31′ 02″.58."

Orvil (Webb County, C. L. Garner, 1917).—About 1½ miles east of Orvil railway station, one-half mile north of a windmill on the southern end of a group of knobs which are covered with low brush and prickly pear. A new straight road leads across the railway at Orvil railway station to a windmill about 1¼ miles distant and just east of the road. The hill on which the station is located can be seen from the windmill, and it is about 300 meters beyond the nearest hills. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 13.95 meters (45.77 feet) from the station in azimuth 54° 18′.

Knob (Webb County, C. L. Garner, 1917).—About 6 miles direct and 9 miles by road northwest of Laredo, 1½ miles south of the Minera-Laredo wagon road, one-half mile east of the Rio Grande, and 300 meters north of a wire fence, on top of the highest and most prominent knob in this vicinity. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 13.56 meters (44.49 feet) from the station in azimuth 139° 34′.

Fieldings (Webb County, C. L. Garner, 1917).—About 12 miles direct or 15 miles by road west of north from Laredo, 1 mile east-northeast of Clifton's ranch house, 1½ miles east-northeast of the Laredo-Eagle Pass wagon road, on the top of the highest and most prominent hill in the vicinity. It is best reached from Laredo by following the Laredo-Minera wagon road to a fork of the road at the railroad crossing; take the right-hand road, cross the railroad and follow 1 mile to a ranch house; passing in front of the ranch house follow an old road 1½ miles to the top of the hill to the eastward where the station is located. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 20.25 meters (66.44 feet) from the station in azimuth 343° 06′.

[1] See p. 33.

Davis (Webb County, C. L. Garner, 1917).—On the highest point of a flat hill among mesquite brush and cactus, 10 miles by road from Webb railroad station, 3 miles southeast of Marguerita ranch, and one-half mile south of the old road leading eastward from Marguerita ranch. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 13.833 meters (45.38 feet) from the station in azimuth 334° 45′.

Tordillo (Webb County, C. L. Garner, 1917).—About 5 miles east of the Minera railroad station, 3 miles north of the Laredo-Minera wagon road, and 1 mile east of a wagon road leading from Minera to Tordillo settlement. To reach the station, go to the Laredo-Santo Tomas mines road at a point opposite the mines at Minera on the top of a hill, where there is a wire fence and gate to the east; go through the gate and follow the main traveled road northeast 3 miles to an iron gate and wire fence; take the right-hand road to the west of the fence and follow 1 mile to where the road bears southeast; turn eastward and follow the top of the ridge to the station, which is on the top of the most prominent hill in the vicinity. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 14.85 meters (48.72 feet) from the station in azimuth 319° 58′.

Coleman (Webb County, C. L. Garner, 1917).—About 4 miles northeast of Minera. To reach this station, follow the directions for reaching station Tordillo; passing the iron gate one-half mile, go through a fence and follow a dim road northward 1½ miles to a dirt tank; from here follow the ridge to the north to the highest point of the south end of the ridge. This is a flat ridge, and the station is surrounded by brush and prickly pear. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 13.005 meters (42.67 feet) from the station in azimuth 317° 42′.

Tajone (Webb County, C. L. Garner, 1917).—About 6 miles northwest of the Webb railroad station, one-half mile southwest of the Webb-Jefferies ranch road, and one-half mile northwest of the windmill on the Tajone ranch. The station is best reached from Webb by taking the Jefferies ranch road 5 miles to a ridge, where there is a windmill one-eighth mile to the west; about one-third mile beyond turn off to the left, and the station is on the highest point of the ridge one-half mile distant. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 12.540 meters (41.14 feet) from the station in azimuth 216° 37′.

Thomas (Webb County, C. L. Garner, 1917).—The station is best reached from the Santo Tomas mines by following the Santo Tomas mines-Carrizo Springs road north about 11 miles, past the Casa Blanca and Thomas ranches, to the top of a flat hill three-fourths mile north of the Thomas ranch. The station is about 25 meters east of the road, where there is practically no vegetation. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 14.710 meters (48.26 feet) from the station in azimuth approximately 339°.

Willie (Webb County, C. L. Garner, 1917).—In an open spot about 100 meters north of the sharp decline to the south, on the first prominent hill north of station Thomas, the south side of which hill shows as a white bluff. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 8.81 meters (28.9 feet) from the station in azimuth 154° 43′.

Brewster (Webb County, C. L. Garner, 1917).—On the highest point of the most prominent hill in the vicinity, about 6 miles east of the Webb-Jefferies ranch and Asherton road, and 2 miles south by west from the Brewster ranch headquarters. To reach the station from the west, follow the Laredo-Asherton or Eagle Pass wagon road to the junction with the road from the Santo Tomas mines; take the road leading northeast, pass Brewster's trap and dirt tank, turning to the south through a dim road to a junction with a road from the west; turn back to the northward and follow the road to a white rocky hill, where the station is about 200 meters north of the road. From the point of leaving the Laredo-Eagle Pass wagon road it is about 7 miles to the station. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 16.422 meters (53.88 feet) from the station in azimuth 50° 36′.

Cup (Webb County, C. L. Garner, 1917).—About 6 miles west of the Galvan ranch and 5 miles west of the Laredo-Eagle Pass wagon road, on the highest and most prominent hill in the vicinity. To reach the station from the Espejo ranch, follow the road eastward 1 mile to a fork; take the road to the south around a fence corner and follow

[1] See p. 33.

9 miles to a windmill and dirt tank; then south across country 1½ miles to the highest hill, where the station is located. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 14.072 meters (46.17 feet) from the station in azimuth 237° 34′.

Galvan (Webb County, C. L. Garner, 1917).—About 4 miles northeast of the Galvan ranch headquarters, 5 miles east of the Webb-Jefferies ranch and Eagle Pass road, on the eastern and highest knob of a long ridge extending from the vicinity of the ranch and culminating at this point. A prominent white rocky knob, the last to the east, is 200 meters east of the station. The station is best reached from the Galvan ranch by following the Encinal road one-fourth mile to a dim road leading to the south through sand; follow this for 4 miles through a gate and over rocky ridges to the end of the ridge. There is an old dirt tank one-fourth mile south of the station. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 13.372 meters (43.87 feet) from the station in azimuth 353° 50′.

Twin (Webb County, C. L. Garner, 1917).—About 25 miles south of Asherton and 3.5 miles south of the Espejo ranch, 15 meters from the sharp descent on the east of the northern of twin flat-top hills, easily distinguished and known locally as Las Hermanas. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 16.340 meters (53.61 feet) from the station in azimuth 314° 35′.

Cat (Demmit County, C. L. Garner, 1917).—About 18 miles southwest of Asherton and one-third mile north of the road from the Catarina ranch to the settlement of Dentonio. To reach the station from Catarina ranch, go west 4 miles to a fork of the road, take the right-hand road leading to the westward for about 300 meters, then turn to the north and follow the ridge to the top of the hill. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 9.204 meters (30.20 feet) from the station in azimuth 271° 30′.

Big (Webb County, C. L. Garner, 1917).—About 25 miles southwest of Asherton, 9 miles south of Dentonio settlement, 1 mile southwest of Catarina goat ranch. The station is on the top of a flat hill in an open space with a windmill about one-half mile distant in azimuth 227° 56′. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 16.885 meters (55.40 feet) from the station in azimuth 323° 11′. To reach the station from Dentonio, go south about 9 miles to a windmill, tank, and gate; passing through the gate follow the left-hand fork of the road about three-fourths mile to a goat camp and one-third mile through thin brush to the station.

Tom (Demmit County, C. L. Garner, 1918).—To reach the station from Dentonio follow the directions for reaching station Big to the windmill, tank, and fork of the road; take the right-hand road and follow 1¼ miles to the highest point of the flat ridge, where the station will be found 50 meters east of the road in an open place covered with white shale rock broken to small pieces. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 18.359 meters (60.23 feet) from the station in azimuth 103° 18′.

Dentonio (Demmit County, C. L. Garner, 1918).—About 1½ miles southeast of Dentonio. To reach the station from Dentonio, take the road south for Catarina ranch 1¼ miles across a small valley and up a fairly steep hill; turn to the east and follow the ridge one-half mile to the station, which is on the highest part and at the eastern extremity of the highest hill in the vicinity. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 11.210 meters (36.78 feet) from the station in azimuth 171° 40′.

Carlow (Demmit County, C. L. Garner, 1918).—On a long flat ridge extending northeast and southwest. The station may be reached from Dentonio by following the Carrizo Springs road 3 miles to corner of a wire fence on the west side of the road, windmill, and wood tank about 50 meters west of the road, and a dim road crossing turn into this road to the east and follow 1 mile across a small valley to a hill on which the station is located. It is 10 meters south of a single Spanish dagger plant, 40 meters from the sharp decline to the south, and 40 meters from the decline to the west. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 12.954 meters (42.50 feet) from the station in azimuth 307° 07′.

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[1] See p. 33.

Barr (Demmit County, C. L. Garner, 1918).—About 6 miles southwest of Dentonio on a white rocky hill, the highest in the vicinity, and 9 meters north of what appears to be an old road. To reach the station from Dentonio, take the road west past the post office for 3½ miles to a fork of the road; take the right-hand road leading through a gate to the westward for 6.6 miles to a point where the road crosses over a hill and descends into a small valley; crossing the first ditch or arroyo turn to the right, where the station is located on the top of a hill about 150 meters north of the road. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 12.258 meters (40.22 feet) from the station in azimuth 239° 06′.

English (Demmit County, C. L. Garner, 1918).—About 13 miles south by west from Carrizo Springs, 7 miles northwest of Dentonio, one-half mile south of the Carrizo Springs-English ranch road, and one-half mile south-southwest from an old windmill derrick, the only one in this vicinity, on the highest point of a bare and very flat hill. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 13.237 meters (43.43 feet) from the station in azimuth 144° 00′.

Indio (Demmit County, C. L. Garner, 1918).—About 4 miles southwest of the old Indio ranch, 15 miles northwest of Blocker's ranch, and one-half mile east of the Eagle Pass-Blocker ranch road, on a very flat ridge and in an open place. From McFarland ranch take the road south 9.2 miles past Lopez tank on the west side of the road and turn through the brush to the east 0.6 mile to the station. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 9.410 meters (30.87 feet) from the station in azimuth 175° 13′.

Glass (Maverick County, C. L. Garner, 1918).—About 22 miles southwest of Carrizo Springs, 2½ miles northwest of the Glass ranch headquarters, on a small rocky hill practically bare, but surrounded at a distance of about 30 meters by mesquite trees. From the Glass ranch take the road to the northwest 1½ miles to a board gate; turn to the right and follow along the east side of the fence about three-fourths mile to a second board gate. Passing through the gate follow the fence on the right until the hill covered with small white rock is seen. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 15.830 meters (51.94 feet) from the station in azimuth 214° 49′.

Farland (Maverick County, C. L. Garner, 1918).—On the highest part of a flat rocky ridge, one-half mile west of the Eagle Pass-Blocker ranch road, and 165 meters east of a wire fence and telephone line supported on poles nailed to the fence posts. From Lopez tank follow the Blocker ranch road one-half mile, turn to the right and follow up the ridge one-half mile to the station. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 13.420 meters (44.03 feet) from the station in azimuth 92° 46′.

Mack (Maverick County, C. L. Garner, 1918).—About 1½ miles south of the McFarland stock pens. To reach the station from Lopez tank, take the left fork of the road, about 100 meters north of the tank, for about 1 mile to a wire fence and gate; turn to the south and follow the ridge to the station, about 100 meters south of the gate and 10 meters east of the fence. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 8.785 meters (28.82 feet) from the station in azimuth 92° 59′.

Kennedy (Maverick County, C. L. Garner, 1918).—About 7 miles north of the McFarland ranch house on the top of a very flat hill with no distinctive features. To reach the station from McFarland pens, take the road leading eastward to Glass ranch, passing through the board gate to the east of the dirt tank, and just north of the gate take the left road leading in a northeast direction and follow to a large dirt tank, around which are tall willows; here turn to the left and go across hills and small valleys about 3 miles past a second dirt tank to the station. The second dirt tank is about three-fourths mile from the station in azimuth 326° 12′. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 12.808 meters (42.02 feet) from the station in azimuth 172° 26′.

Silo (Maverick County, C. L. Garner, 1918).—About 2 miles north of the Indio ranch, 102 meters west of the Indio ranch-Eagle Pass road on the highest hill in the vicinity. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 13.485 meters (44.24) feet from the station in azimuth 87° 59′.

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[1] See p. 33.

Davidson (Maverick County, C. L. Garner, 1918).—To reach the station from Eagle Pass, take the Carrizo Springs wagon road east 12.5 miles to the top of a reddish hill which appears very steep from the east; pass through a wide wire gate in the fence to the south and follow this road 3.3 miles and turn to the east across a flat ridge 0.4 mile to the station. An old windmill and shack plainly visible bear S. 20° E. from the station. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 12.960 meters (42.52 feet) from the station in azimuth 125° 16′.

Eagle (Maverick County, C. L. Garner, 1918).—To reach the station from Eagle Pass, follow the Eagle Pass-San Antonio road about 3 miles northeast to the first gate; here turn to the right and follow a dim road 1 mile up the divide to the top of the ridge, where the station is located at the northwest extremity. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 11.782 meters (38.65 feet) from the station in azimuth 231° 47′. There is a rock cairn 8.8 meters (28.9 feet) from the station in azimuth 324° 32′.

Pass (Maverick County, C. L. Garner, 1918).—About 3 miles east-northeast from Eagle Pass on the top of the shoulder of the highest hill in the vicinity. From Eagle Pass take the Carrizo Springs road 2¾ miles to the first hill east of the Eagle Pass Clubhouse; turn to the north through a wire fence and follow along the ridge one-half mile to the station. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 11.552 meters (37.90 feet) from the station in azimuth 152° 03′.

Laplace (Maverick County, C. L. Garner, 1918).—On "Hillcrest," the first hill northeast of Eagle Pass, about one-half mile from the courthouse, 90 meters northeast and 24 meters south from the road encircling the hill, 10 meters north of the range formed by the standpipe on the hill and the Eagle Pass Clubhouse and on range with the courthouse and the southern end of the express office. The station is marked by a bronze tablet in concrete, as described in note 1a,[1] with a reference mark, a bronze tablet, as described in note 12a,[1] set in solid rock 4 meters north of road, 39.990 meters (131.20 feet) from the station in azimuth 181° 11′. The standpipe is 100 meters from the station in azimuth 311° 22′. The longitude station (1919) is 3.52 meters (11.55 feet) true south from the triangulation station and is marked by a temporary wooden pier.

Lone (Maverick County, C. L. Garner, 1918).—The station is best reached from Eagle Pass by taking the San Antonio road for 8 miles to the point where the road starts to drop from the top of the ridge to the valley by a fairly steep grade, a lone tree can be seen on the hill to the east, turn east and follow the ridge 400 meters from the road to the highest point of the hill, where the station is located. The lone tree is about one-fourth mile distant in azimuth 69° 00′. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 16.100 meters (52.82 feet) from the station in azimuth 260° 05′.

Nine (Maverick County, C. L. Garner, 1918).—Located 8.4 miles northwest of Eagle Pass post office, 5 meters south of wire fence and telephone line at side of road, and 20 meters west of sign, "9 miles to Hewitts Café, Eagle Pass, Texas." The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 13.252 meters (43.48 feet) from the station in azimuth 319° 43′.

Paloma (Maverick County, C. L. Garner, 1918).—Located 1½ miles east of the Paloma railroad station, three-fourths mile northeast of Paloma ranch, 29 meters northwest of the road leading from the Paloma ranch to the Eagle Pass-San Antonio road, and 125 meters west of a board gate through the wire fence, on the highest hill in the vicinity. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 16.147 meters (52.98 feet) from the station in azimuth 343° 13′.

Burr (Maverick County, C. L. Garner, 1918).—About 16 miles by road north of Eagle Pass, on top of a very flat ridge covered with heavy mesquite trees. To reach the station from Eagle Pass, take the Del Rio road 8.5 miles to a gate on the north side of the road with a sign "Brackettville," passing through the gate follow the road 5 miles, keeping to the left to the second board gate, passing through this gate turn to the left through the brush and follow the ridge 1⅛ miles northwest to a wire gate, which is 95 meters east of the station. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 13.492 meters (44.26 feet) from the station in azimuth 126° 13′.

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[1] See p. 33.

Pen (Maverick County, C. L. Garner, 1918).—About 6 miles northwest of the Paloma railroad station, 3½ miles northwest of the old Burr or Stone ranch, 425 meters east of the stock pens on this ranch, between the forks of a road 9 meters west and 150 meters east of them. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 13.765 meters (45.16 feet) from the station in azimuth 190° 59′.

Wiffp (Maverick County, C. L. Garner, 1918).—About 18 miles north by west from Eagle Pass, 3 miles northeast of the Lehman ranch, and 1½ miles south of the Wiffp ranch on a prominent rocky knob, 300 meters west of the road leading from the Wiffp ranch to the Eagle Pass-Lehman road. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 10.280 meters (33.73 feet) from the station in azimuth 277° 38′.

White (Maverick County, C. L. Garner, 1918).—On the opposite side of the dry lake from station Lake. A white windmill easily seen in this vicinity is 120 meters from the station in azimuth 176° 55′. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 10.401 meters (34.12 feet) from the station in azimuth 84° 18′.

Lake (Maverick County, C. L. Garner, 1918).—On the west side of a dry lake and 200 meters north of a windmill and tank. The station is best reached by leaving the Lehman ranch-Spofford road at a point about 2 miles southwest of Las Moras Creek and following for 6 miles a road leading to the south past the ruins of a house and stock pens to a windmill and dirt tank and the dry lake. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 11.435 meters (37.52 feet) from the station in azimuth 277° 23′.

Jamerson (Kinney County, C. L. Garner, 1918).—In a pasture 180 meters southwest from the Jamerson ranch, 230 meters west of the Lehman ranch-Spofford road. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 11.735 meters (38.50 feet) distant in azimuth 48° 16′. The Jamerson ranch windmill is distant 180 meters in azimuth 205° 00′.

Towne (Kinney County, C. L. Garner, 1918).—About 10 miles north of the Lehman ranch, one-half mile northeast of McDonald's ranch house, windmill, and tank, on the highest point and in a place practically bare and covered with rock. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 12.123 meters (39.77 feet) distant in azimuth 53° 44′. The windmill at the McDonald ranch is distant about 1 mile in azimuth 26° 52′.

Dixie (Kinney County, C. L. Garner, 1918).—About 2 miles northeast of the Del Rio-Eagle Pass road, 2½ miles northeast of the Dixie schoolhouse and 300 meters west of the Dixie-Bracketville wagon road on the top of the highest point in the vicinity. From Dixie follow the Dixie-Bracketville road 2 miles to the place where the road ascends a hill; turn off to the west and follow the ridge to the top of the hill and the station. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 15.840 meters (51.97 feet) from the station in azimuth 104° 55′.

Peters (Kinney County, C. L. Garner, 1918).—About 7 miles southwest of Kinney railway station on the Southern Pacific Railroad, 15 miles southwest of Bracketville, 1 mile east of the Dixie-Bracketville road, three-fourths mile south of the Peters ranch, and 70 meters west of a road from that ranch. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 9.620 meters (31.56 feet) from the station in azimuth, 104° 29′. The windmill on the Peters ranch is 0.75 mile distant in azimuth 159° 17′.

Ross (Kinney County, C. L. Garner, 1918).—About 13 miles east of Del Rio, 5 miles southwest of Johnstone railway station and 5 miles northeast of the old Rose ranch. From Del Rio follow the Del Rio-Eagle Pass wagon road about 5 miles; turn to the east for 1 mile to a red balanced gate; passing through the gate, take the right-hand road for 10 miles to an iron gate; here take the road leading north for 2½ miles through a board gate; then turn off to the north and follow across a ridge one-half mile to the station, which is on the highest point in a bare rocky place. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 14.340 meters (47.05 feet) from the station in azimuth 219° 56′.

[1] See p. 33.

Bracket (Kinney County, C. L. Garner, 1918).—About 4 miles northeast of Bracketville on the highest point of Las Moras Mountain. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet set in solid rock, as described in note 12a,[1] 15.53 meters (50.95 feet) from the station in azimuth 8° 39′.

Dobkins (Val Verde County, C. L. Garner, 1918).—About 6 miles east of Del Rio, 3½ miles southwest of Johnstone railway station, and 1½ miles northwest of Dobkins tank. From Del Rio follow the Eagle Pass road 5 miles southeast; then take the road turning to the left for about 1½ miles to a wire fence and red balanced gate; passing through the gate, take the left-hand road leading north along the east side of the fence for one-fourth mile to Dobkins dirt tank; going around the tank to the east, pass through the gate 100 meters north of the tank, and follow the road three-fourths mile northwest to the shoulder of a hill; turn west and follow the ridge to the station, which is on top of the hill. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 15.158 meters (49.73 feet) distant in azimuth 202° 53′.

Hamilton (Val Verde County, C. L. Garner, 1918).—About 21 miles by road northeast of Del Rio and 1½ miles west of the Hamilton ranch house. Best reached from the Hamilton ranch by taking the road 250 meters south of the stock pens, which are one-fourth mile west of the ranch house, and, following it through a gate to the top of a ridge one-half mile, then turn to the north and follow the ridge to the top of the hill about one-fourth mile. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet set in concrete, as described in note 11a,[1] 18.390 meters (60.33 feet) distant in azimuth 208° 26′.

Johnstone (Val Verde County, C. L. Garner, 1918, 1919).—About 8½ miles east of Del Rio, 12 meters south of the Southern Pacific Railway tracks at Johnstone siding, 15 meters east of the station board, and 3 meters north of the wire fence on the north side of the main road. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 6.742 meters (22.12 feet) from the station in azimuth 268° 43′. Precise level bench mark E31 is 220.35 meters (722.93 feet) distant in azimuth 248° 08′. The longitude station (1919) is 6.578 meters (21.58 feet) west and 2.722 meters (8.93 feet) south of the triangulation station and is marked by a temporary wooden pier.

Moore (Val Verde County, C. L. Garner, 1918).—About 13 miles by road north of Del Rio and three-fourths mile west of the Del Rio-Ab Rose ranch road. To reach the station from Del Rio, follow the Ab Rose ranch road 11 miles to a point in a small valley where there is a gate on either side of the road and a windmill near a yellow earth embankment 1 mile northeast; turn west through the gate and follow a dim road to the windmill; cross an abandoned railroad grade, and the station is 300 meters west on top of a bare and prominent hill. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 10.37 meters (34.02 feet) distant in azimuth 130° 06′.

Kelly (Val Verde County, C. L. Garner, 1918).—Located 60 meters west of the Del Rio-Sonora road, 1 mile north of the point where the Comstock road turns to the west from the Del Rio-Sonora road, and 7 miles north of Del Rio and 4 meters south of the wire fence dividing the pastures. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] set under the wire fence, 10.275 meters (33.71 feet) from the station in azimuth 287° 49′.

Mark (Val Verde County, C. L. Garner, 1918).—On top of a prominent flat-top knob, 28 miles by road north of Del Rio, 3.5 miles north of Markwood ranch, one-half mile east of the Del Rio-Sonora road, and 400 meters south of a road leading from the Del Rio-Sonora road to the east. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 15.205 meters (49.88 feet) from the station in azimuth 57° 18′.

Feely (Val Verde County, E. H. Pagenhart, 1918).—About 12 miles southeast of Comstock and 2½ miles south of Feely, a station on the Southern Pacific Railway, on the highest point of hills westward of the wagon road leading south from Feely. The station is marked by a bronze tablet in concrete, as described in note 2,[1] with a reference mark, a bronze tablet in bowlder, as described in note 12c,[1] set flush with the ground 9.90 meters (32.48 feet) distant in azimuth 4° 06′. There is a cairn 5.20 meters (17.1 feet) from the station in azimuth 103° 27′.

McNutt (Val Verde County, E. H. Pagenhart, 1918).—About 7 miles by road north of Comstock, 1½ miles west of the Comstock-Juno wagon road, on the highest point of ground about one-half mile north of McNutt ranch house, and 18 meters west of a ranch road leading north from headquarters. The station is marked by a

[1] See p. 33.

bronze tablet in concrete, as described in notes 1a and 8a,[1] with a reference mark, a bronze tablet in bowlder, as described in note 12c,[1] set nearly flush with the ground 12.97 meters (42.55 feet) distant in azimuth 310° 04′. There is a 7-foot cairn 9 meters from the station in azimuth 43°. McNutt windmill is distant 0.7 mile in azimuth 22° 05′.

Harrison (Val Verde County, E. H. Pagenhart, 1918).—About 52 miles by road north of Del Rio, 6 miles west from the point on the Del Rio-Sonora road where the Dry Devils River road leads to the west, 5 miles west of the Harrison ranch, 3 miles west of Anderson ranch, 1 mile southwest of the wagon road leading from the Harrison ranch to the Faucett ranch at the point where the road crosses the divide, and located on quite a prominent brush-covered ridge, about the highest in the vicinity. The station is marked by a bronze tablet in outcrop of rock, as described in note 2,[1] with a reference mark, a bronze tablet in bowlder, as described in note 12c,[1] 11.34 meters (37.20 feet) distant in azimuth 294° 44′. There is a cairn 8.80 meters (28.87 feet) distant in azimuth 331° 40′.

Jim (Val Verde County, E. H. Pagenhart, 1918).—About 8 miles north of Comstock, in the McNutt pasture, and 100 meters east of a new wire fence. The station is marked by a bronze tablet in outcrop of rock, as described in note 2,[1] with a reference mark, a bronze tablet in bedrock, as described in note 12a,[1] 10.15 meters (33.30 feet) from the station in azimuth 306° 13′. There is a 7-foot cairn about 7 meters from the station in azimuth 11° 23′.

Blue (Val Verde County, E. H. Pagenhart, 1918).—About 31 miles by road west of north from Comstock, 3 miles west of the Comstock-Ozono ridge road, one-fourth mile south of the Roberts ranch, and located on a prominent knob, known as Blue Hill. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7a,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 14.68 meters (48.16 feet) distant in azimuth 114° 54′. The Roberts windmill is distant one-third mile in azimuth 160° 28′.

Tippetts (Val Verde County, E. H. Pagenhart, 1918).—About 7 miles northeast of Langtry and 1 mile south of Tippetts ranch on the highest hill in the vicinity. Marked by a bronze tablet in concrete, as described in notes 1a and 7a,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 9.91 meters (32.51 feet) distant in azimuth 24° 00′. The west gable of Tippetts ranch house is distant 1¼ miles in azimuth 188° 28′.

Babb (Val Verde County, E. H. Pagenhart, 1918).—About 19 miles north of Langtry, 15 miles south of Pandale post office, 10 miles south of the Pandale-Langtry crossing of the Pecos River, on the Babb ranch 1½ miles northwest of headquarters, and about 1½ miles northeast of "Highland C" windmill. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7a,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 10.37 meters (34.02 feet) distant in azimuth 335° 17′. An 8-foot cairn is 8 meters from the station in azimuth 292° 50′.

Proctor (Val Verde County, E. H. Pagenhart, 1918).—On a smooth level ridge about 4 miles south from Pumpville, 3 miles west of north from the Hamilton ranch, and 10 meters east of the Pumpville-Hamilton-Langtry wagon road. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7a,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 11.51 meters (37.76 feet) distant in azimuth 13° 59′.

Ike (Val Verde County, E. H. Pagenhart, 1918).—On the highest point of a ridge 20 miles by road north from Langtry on the "Bill Ike" Babb ranch, 2 miles north of "Highland C" windmill, and one-fourth mile northeast of the ranch road leading northwest from this windmill. It is marked by a bronze tablet in concrete, as described in notes 1a and 7a,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 9.35 meters (30.68 feet) distant in azimuth 233° 33′. There is a scrub cedar distant 4.4 meters in azimuth 150° 43′, and a small clump of cedars is distant 11 meters in azimuth 333° 36′.

Bassett (Val Verde County, E. H. Pagenhart, 1918).—About 10 miles north of Pumpville, 7 miles by road north from the old Bassett headquarters ranch, one-half mile south of ranch house and windmill belonging to W. I. Babb, on the second range of hills passed in going north from the old Bassett headquarters, on a prominent knob just west of the road, the highest point of this knob being distant about one-half mile. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7a,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 14.02 meters (46 feet) from the station in azimuth 266° 20′. A small cairn is 10 meters from the station in azimuth 102° 53′.

Hoddy (Terrell County, E. H. Pagenhart, 1918).—About 38 miles northeast from Dryden, 15 miles by road northwest from Pumpville, 8 miles north from the old

[1] See p. 33.

Bassett headquarters ranch, 2 miles east of north of Bassett's 7-mile windmill, 200 meters east of a wagon road on the highest point in the vicinity. The remains of a stone fireplace built by the light keeper, 20 meters west of the station, shows from the road. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7a,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 7.78 meters (25.52 feet) from the station in azimuth 52° 42′.

Peggy (Terrell County, E. H. Pagenhart, 1918).—About 10 miles southeast of Dryden, 2 miles southeast from Taylor's ranch, on the highest point of a long flat ridge extending east and west and 20 meters north of the Dryden-Muces Spring road. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7a,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 10.11 meters (33.17 feet) from the station in azimuth 97° 33′.

Hen (Terrell County, E. H. Pagenhart, 1918).—About 6 miles by road north from Dryden, 1 mile west of the Dryden-Sheffield road, one-half mile southwest of a dirt tank, and 100 meters east of an old stone quarry. The station is marked by a bronze tablet in concrete, as is described in notes 1a and 7a,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 8.50 meters (27.89 feet) from the station in azimuth 238° 40′. A windmill near the road is 1½ miles from the station in azimuth 273° 57′.

Eldridge (Terrell County, E. H. Pagenhart, 1918).—About 4 miles southwest from Dryden on the highest knoll in the vicinity. The station is marked by a bronze tablet in concrete, as is described in notes 1a and 7a,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 11.70 meters (38.39 feet) from the station in azimuth 81° 41′.

Dryden east base (Terrell County, E. H. Pagenhart, 1918; 1919).—On the first ridge about three-fourths mile east of Dryden on the prolongation of the north rail tangent of the main track of the Southern Pacific Railway. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7a,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 45.97 meters (150.82 feet) distant in azimuth 58° 04′. The longitude station (1919) is 12.34 meters (40.48 feet) true north from the triangulation station and is marked by a temporary wooden pier.

Dryden west base (Terrell County, E. H. Pagenhart, 1918).—On the Southern Pacific Railway right of way at the first curve about 4 miles west of Dryden, at the point of intersection of tangents of north rail. The station is marked by a bronze tablet in concrete, as described in note 1a.[1] The reference mark is precise level bench mark N27, which is a bronze disk set in a concrete post, 128.94 meters (423.03 feet) from the station, about 14 meters south of the track near mile pole 498 and in azimuth 81° 22′ from the station.

Road (Terrell County, E. H. Pagenhart, 1918).—About 14 miles southeast from Sanderson, 6 miles south of the Southern Pacific Railway, 300 meters east of the Sanderson-Twin Butte road 2 miles south from a masonry tank. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7a,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 11.85 meters (38.88 feet) from the station in azimuth 268° 20′. An 8-foot cairn stands 16 meters from the station in azimuth 88° 57′.

Sanderson (U. S. G. S.) (Terrell County, E. H. Pagenhart, 1918).—About 4 miles northeast of Sanderson. To reach the station, follow the Sanderson-Sheffield wagon road 2½ miles from Sanderson to a byroad leading northeast; follow this past a windmill and tank and continue up the valley 1½ miles to summit; from here the station is 1 mile east on the highest point in the vicinity. The station is marked by a Geological Survey triangulation disk set in a bowlder. Reference mark No. 1 is described in note 12c as being a bronze tablet in a bowlder and is 34.05 meters (111.71 feet) distant in azimuth 217° 50′; No. 2 is a drill hole with an 8-inch arrow, cut in an outcrop on the east slope of the hill and 4 meters lower than the station, distant 28.75 meters (94.32 feet) in azimuth 312° 35′; No. 3 is a drill hole, with a 14-inch arrow, cut in a flat rock on the south side of the hill and 4 meters lower than the station, distant 37.70 meters (123.69 feet) in azimuth 22° 47′.

New (Terrell County, E. H. Pagenhart, 1918).—About 6 miles southwest of Emerson, on the southern end of a flat-topped knob on the ridge which is about 1 mile northwest from the summit of the grade leading up from the first creek which is crossed by the road going south from Emerson. This is the westernmost of several ridge roads leading south from the dirt tank three-fourths mile west of Emerson. The station is marked by a bronze tablet in bedrock, as described in note 2,[1] with a reference mark, a bronze tablet in bedrock, as described in note 12a,[1] 12.09 meters (39.66 feet) from the station in azimuth 135° 01′. There is a cairn 32.0 meters (105 feet) distant in azimuth 180° 59′.

[1] See p. 33.

Dry (Brewster County, E. H. Pagenhart, 1918).—About 6 miles west of Longfellow, 1½ miles south from the old Purinton beef well in Dry Valley, on the highest point of the first hill on the south side of Dry Valley, which is the highest hill in the vicinity and 5 meters from the north cap rock. The station is marked by a bronze tablet in bedrock, as described in note 2,[1] with a reference mark, a bronze tablet in bowlder, as described in note 12c,[1] set on the northern edge of the cliff, 31.59 meters (103.64 feet) distant in azimuth 120° 24′.

Pyle (Pecos County, E. H. Pagenhart, 1918).—About 15 miles northwest from Longfellow, 5 miles northeast from the old Purinton ranch, 3 miles north from the old Baxter ranch, now headquarters for Pyle ranch, 1 mile southeast from Bull trap mill and tank in Big Canyon, on top of the mesa, and about three-fourths mile from a dim road which leads up and across the mesa. The station is marked by a bronze tablet in bowlder, as described in notes 4 and 9c,[1] with a reference mark, a bronze tablet in bowlder, as described in note 12c,[1] 19.54 meters (64.11 feet) distant in azimuth 156° 47′.

Brown (Brewster County, E. H. Pagenhart, 1918).—About 4 miles northeast of Haymond, 2½ miles southwest from Brown's goat ranch in Dry Valley, on the southernmost and highest of the Housetop Mountains, 10 feet from the sheer west face, and about 5 meters north of a U. S. Geological Survey cairn. The station is marked by a bronze tablet in bowlder, as described in notes 4 and 8a,[1] with a reference mark, a bronze tablet in bowlder, as described in note 12c,[1] 19.93 meters (65.39 feet) distant in azimuth 217° 59′.

Nation (Pecos County, E. H. Pagenhart, 1918).—About 15 miles north from Marathon and three-fourths mile east of the Marathon-Fort Stockton road, 1 mile north from the Pumpkin Center schoolhouse, on a prominent rounded knob at the southwest end of the range of hills. The station is marked by a bronze tablet in bowlder, as described in notes 4 and 8a,[1] with a reference mark, a bronze tablet in bowlder, as described in note 12c,[1] set flush with the ground on the eastern slope of the knob, 1½ meters lower than the station, and distant 11.71 meters (38.42 feet) in azimuth 288° 20′.

Madera (Pecos County, E. H. Pagenhart, 1917).—About 20 miles south of Fort Stockton, 2 miles southeast of Elsinore Cattle Co. headquarters, one-half mile east of the Fort Stockton-Marathon road, on the southeastern one of the two tops of the Sierra Madre Mountains. The station is marked by a bronze tablet in bedrock, as described in note 2,[1] with a reference mark, a bronze tablet in bedrock, as described in note 12a,[1] set on the southwest end of the ridge and 1 meter lower than the station, distant 17.38 meters (57.02 feet) in azimuth 4° 29′.

Chancellor (Pecos County, E. H. Pagenhart, 1917).—About 20 miles southwest of Fort Stockton, 3 miles due east from Chancellor, near the highest point of a small conical hill, known locally as "Pikes Peak." The Chancellor-Elsinore ranch road passes 1 mile south of the station. The station is marked by a standard bronze tablet set in the flat top of rock flush with the ground. The reference mark, a bronze tablet in bedrock, as described in note 12a,[1] is set 2 inches above the ground, 3 meters north of the highest point of the hill, and 5.24 meters (17.19 feet) distant from the station in azimuth 28° 33′.

Ord (U. S. G. S.) (Brewster County, E. H. Pagenhart, 1917).—About 12 miles southeast of Alpine, 2 miles east of the Alpine-Terlingua road, and on the highest point of Mount Ord. The station mark is that of the U. S. Geological Survey station, which is a triangle and the letters U. S. chiseled in a flat rock flush with the ground about the center of the ridge. The reference mark, a bronze tablet in bowlder, as described in note 12c,[1] and is in an outcrop about 2 feet high, distant 12.68 meters (41.60 feet) distant from the station in azimuth 338° 04′. A U. S. Geological Survey cairn on the eastern end of the top is 16.4 meters (53.8 feet) from the station in azimuth 337° 07′.

Beard (Pecos County, E. H. Pagenhart, 1917).—About 50 miles south of west from Fort Stockton, 20 miles northwest from Hovey, a town on the Kansas City, Mexico & Orient Railroad, 5 miles northwest from Stone's ranch, which is located about 2 miles north of the Fort Stockton-Lympia Creek-Fort Davis road on the highest point of Beard Mountain, which forms a knob at its northeastern end, and immediately north of a large rocky outcrop which marks the highest point of the mountain. The station is marked by a bronze tablet in bowlder, as described in note 4,[1] with a reference mark, as described in note 12,[1] set in the outcrop mentioned above, 1 meter above the station, and distant 2.76 meters (9.06 feet) in azimuth 120° 30′.

Star (Jeff Davis County, E. H. Pagenhart, 1917).—About 15 miles south of Balmorhea, a town on the Pecos Valley & Toyahvale Railway, 18 miles north of Fort Davis, near the center, east and west, of a flat-topped mesa known as "Star Mountain" and about 15 meters from the north cliff. The station is marked by a bronze tablet in bed-

[1] See p. 33.

rock, as described in note 2,[1] with a reference mark, a bronze tablet in a bowlder, as described in note 12c,[1] set in a rock about 2 feet square and 18 inches high about midway of the ridge north and south, 14.06 meters (46.13 feet) distant from the station in azimuth 158° 22′. The U. S. Geological Survey triangulation station is about 40 meters south of the north edge of the cliff and is a flat-topped rock 18 inches by 12 inches almost flush with the ground, and is 28.32 meters (92.91 feet) distant from the station in azimuth 80° 49′. A lone trimmed cedar tree is 27 meters distant in azimuth 82° 18′.

Baldy (Jeff Davis County, E. H. Pagenhart, 1917).—*About 25 miles northwest of* Marfa, 15 miles east from Valentine, 10 meters east from the west end of a narrow-topped ridge about 3 meters wide at the station, 3 meters east of a large hole. The station is marked by a bronze tablet in bedrock, as described in note 2,[1] with a reference mark, as described in note 12,[1] set on the south side of the cliff one-half meter lower than the station, at a distance of 5.43 meters (17.81 feet) in azimuth 296° 37′. Reference mark No. 2 is the U. S. Geological Survey triangulation station, which is marked by a triangle 6 inches on a side with a small knob in the middle cut in the rock with the letters U. S., and is distant 5.60 meters (18.4 feet) in azimuth 267° 44′. A small hole on range to the U. S. Geological Survey station mark is distant 5.095 meters (16.716 feet).

Newman (Jeff Davis County, J. S. Hill, 1909; 1917).—About 11 miles direct S. 3° E. from the section house at San Martine, a station on the Texas & Pacific Railway, about 2 miles south of the northwest end of Davis Mountains and about 2 miles south by east of J. W. McElroy's place. The station is marked by a cap station mark screwed to the top of a 3-inch iron pipe 2½ feet long set in the ground with the earth and rock well tamped about it. The underground mark is described in note 8a.[1] The reference mark is a 20-penny nail driven flush in the top of a hard rock at the edge of a bluff and is 26.125 meters (85.71 feet) from the station in azimuth 223° 17′. Other distances and azimuths are as follows: High peak, about three-fourths mile, 263° 35′; Newman, U. S. Geological Survey, about 300 meters (984 feet), 55° 40′; Gomez Peak, about 1½ miles, 188° 15′. A blazed pine tree is 2.04 meters (6.7 feet) east of the station.

Krouse (El Paso County, J. S. Hill, 1909; 1917).—*About 8½ miles N. 15° W. from* Boracho, a station on the Texas & Pacific Railway, on the highest peak near the western end of a very prominent ridge which is about 7 miles north of the railroad and parallel with it, about 1 mile east of the Krouse zinc mine. The station is marked by a cap station mark screwed to the top of a 3-inch iron pipe 2½ feet long set in the ground with the earth and rock well tamped about it. The underground mark is described in note 8a.[1] The reference mark, a cross cut in the top of a rock flush with the ground, is 6.49 meters (21.29 feet) from the station in azimuth 95° 18′. The cairn at the U. S. Geological Survey station Krouse is 4.16 meters (13.65 feet) distant in azimuth 68° 42′.

Chispa (Jeff Davis County, J. S. Hill, 1909; 1917).—On the highest peak of the mountains about 4 miles north by west from Chispa, a town on the Southern Pacific, and 2 miles northwest of the railroad at the nearest point. The station is identical with one of the U. S. Geological Survey reference marks, a bronze bench-mark tablet, which marks the station. The reference mark is identical with another of the Geological Survey reference marks, a cross cut in the top of a large flat rock, and is 5.51 meters (18.08 feet) from the station in azimuth 336° 51′. The U. S. Geological Survey station Chispa, marked by a cairn, is about 3 meters (9.84 feet) from the station in azimuth 312° 18′.

SUPPLEMENTARY POINTS.

Isabel (Webb County, C. L. Garner, 1917).—About 1.7 miles west by north of San Isabel railroad station, 200 *meters north of the* Laredo-Minera wagon road at a point where the road is cut across the hills to the northward of cultivated fields in which there are a number of tenant houses painted red. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a,[1] 25 meters (82 feet) distant in azimuth 180°.

Red (Dimmit County, C. L. Garner, 1918).—*About 7 miles north of west from* Dentonio, 500 meters north of an old windmill in the Salzanora pasture. The station is marked by a bronze tablet in concrete, as described in notes 1a and 7c,[1] with a reference mark, a bronze tablet in concrete, as described in note 11a.[1]

Word (Val Verde County, E. H. Pagenhart, 1918).—About 33 miles east of north from Comstock, 6 miles east of north from the lower Word ranch, 4 *miles south from* Martin's ranch. The station is probably marked with a standard bronze disk, as described in note 1a.[1]

Banco (Hidalgo County, C. V. Hodgson, 1917).—On the west side of the military wagon road, 2½ miles direct or 5 miles by road west of south from *Mamie* triangulation station. The station is the concrete Banco monument No. 17 of the Rio Grande Survey.

[1] See p. 33.

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	277.67335	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	347.76833	6	511.81000	6	675.85167
7	22.96583	7	187.00750	7	351.04917	7	515.09083	7	679.13250
8	26.24667	8	190.28833	8	354.33000	8	518.37167	8	682.41333
9	29.52750	9	193.56917	9	357.61083	9	521.65250	9	685.69417
10	32.80833	60	196.85000	110	360.89167	160	524.93333	210	688.97500
1	36.08917	1	200.13083	1	364.17250	1	528.21417	1	692.25583
2	39.37000	2	203.41167	2	367.45333	2	531.49500	2	695.53667
3	42.65083	3	206.69250	3	370.73417	3	534.77583	3	698.81750
4	45.93167	4	209.97333	4	374.01500	4	538.05667	4	702.09833
5	49.21250	5	213.25417	5	377.29583	5	541.33750	5	705.37917
6	52.49333	6	216.53500	6	380.57667	6	544.61833	6	708.66000
7	55.77417	7	219.81583	7	383.85750	7	547.89917	7	711.94083
8	59.05500	8	223.09667	8	387.13833	8	551.18000	8	715.22167
9	62.33583	9	226.37750	9	390.41917	9	554.46083	9	718.50250
20	65.61667	70	229.65833	120	393.70000	170	557.74167	220	721.78333
1	68.89750	1	232.93917	1	396.98083	1	561.02250	1	725.06417
2	72.17833	2	236.22000	2	400.26167	2	564.30333	2	728.34500
3	75.45917	3	239.50083	3	403.54250	3	567.58417	3	731.62583
4	78.74000	4	242.78167	4	406.82333	4	570.86500	4	734.90667
5	82.02083	5	246.06250	5	410.10417	5	574.14583	5	738.18750
6	85.30167	6	249.34333	6	413.38500	6	577.42667	6	741.46833
7	88.58250	7	252.62417	7	416.66583	7	580.70750	7	744.74917
8	91.86333	8	255.90500	8	419.94667	8	583.98833	8	748.03000
9	95.14417	9	259.18583	9	423.22750	9	587.26917	9	751.31083
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	2,168.63083	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	2	2,073.48667	2	2,237.52833	2	2,401.57000
3	1,748.68417	3	1,912.72583	3	2,076.76750	3	2,240.80917	3	2,404.85083
4	1,751.96500	4	1,916.00667	4	2,080.04833	4	2,244.09000	4	2,408.13167
5	1,755.24583	5	1,919.28750	5	2,083.32917	5	2,247.37083	5	2,411.41250
6	1,758.52667	6	1,922.56833	6	2,086.61000	6	2,250.65167	6	2,414.69333
7	1,761.80750	7	1,925.84917	7	2,089.89083	7	2,253.93250	7	2,417.97417
8	1,765.08833	8	1,929.13000	8	2,093.17167	8	2,257.21333	8	2,421.25500
9	1,768.36917	9	1,932.41083	9	2,096.45250	9	2,260.49417	9	2,424.53583
540	1,771.65000	590	1,935.69167	640	2,099.73333	690	2,263.77500	740	2,427.81667
1	1,774.93083	1	1,938.97250	1	2,103.01417	1	2,267.05583	1	2,431.09750
2	1,778.21167	2	1,942.25333	2	2,106.29500	2	2,270.33667	2	2,434.37833
3	1,781.49250	3	1,945.53417	3	2,109.57583	3	2,273.61750	3	2,437.65917
4	1,784.77333	4	1,948.81500	4	2,112.85667	4	2,276.89833	4	2,440.94000
5	1,788.05417	5	1,952.09583	5	2,116.13750	5	2,280.17917	5	2,444.22083
6	1,791.33500	6	1,955.37667	6	2,119.41833	6	2,283.46000	6	2,447.50167
7	1,794.61583	7	1,958.65750	7	2,122.69917	7	2,286.74083	7	2,450.78250
8	1,797.89667	8	1,961.93833	8	2,125.98000	8	2,290.02167	8	2,454.06333
9	1,801.17750	9	1,965.21917	9	2,129.26083	9	2,293.30250	9	2,457.34417

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

Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.
750	2,460.62500	800	2,624.66667	850	2,788.70833	900	2,952.75000	950	3,116.79167
1	2,463.90583	1	2,627.94750	1	2,791.98917	1	2,956.03083	1	3,120.07250
2	2,467.18667	2	2,631.22833	2	2,795.27000	2	2,959.31167	2	3,123.35333
3	2,470.46750	3	2,634.50917	3	2,798.55083	3	2,962.59250	3	3,126.63417
4	2,473.74833	4	2,637.79000	4	2,801.83167	4	2,965.87333	4	3,129.91500
5	2,477.02917	5	2,641.07083	5	2,805.11250	5	2,969.15417	5	3,133.19583
6	2,480.31000	6	2,644.35167	6	2,808.39333	6	2,972.43500	6	3,136.47667
7	2,483.59083	7	2,647.63250	7	2,811.67417	7	2,975.71583	7	3,139.75750
8	2,486.87167	8	2,650.91333	8	2,814.95500	8	2,978.99667	8	3,143.03833
9	2,490.15250	9	2,654.19417	9	2,818.23583	9	2,982.27750	9	3,146.31917
760	2,493.43333	810	2,657.47500	860	2,821.51667	910	2,985.55833	960	3,149.60000
1	2,496.71417	1	2,660.75583	1	2,824.79750	1	2,988.83917	1	3,152.88083
2	2,499.99500	2	2,664.03667	2	2,828.07833	2	2,992.12000	2	3,156.16167
3	2,503.27583	3	2,667.31750	3	2,831.35917	3	2,995.40083	3	3,159.44250
4	2,506.55667	4	2,670.59833	4	2,834.64000	4	2,998.68167	4	3,162.72333
5	2,509.83750	5	2,673.87917	5	2,837.92083	5	3,001.96250	5	3,166.00417
6	2,513.11833	6	2,677.16000	6	2,841.20167	6	3,005.24333	6	3,169.28500
7	2,516.39917	7	2,680.44083	7	2,844.48250	7	3,008.52417	7	3,172.56583
8	2,519.68000	8	2,683.72167	8	2,847.76333	8	3,011.80500	8	3,175.84667
9	2,522.96083	9	2,687.00250	9	2,851.04417	9	3,015.08583	9	3,179.12750
770	2,526.24167	820	2,690.28333	870	2,854.32500	920	3,018.36667	970	3,182.40833
1	2,529.52250	1	2,693.56417	1	2,857.60583	1	3,021.64750	1	3,185.68917
2	2,532.80333	2	2,696.84500	2	2,860.88667	2	3,024.92833	2	3,188.97000
3	2,536.08417	3	2,700.12583	3	2,864.16750	3	3,028.20917	3	3,192.25083
4	2,539.36500	4	2,703.40667	4	2,867.44833	4	3,031.49000	4	3,195.53167
5	2,542.64583	5	2,706.68750	5	2,870.72917	5	3,034.77083	5	3,198.81250
6	2,545.92667	6	2,709.96833	6	2,874.01000	6	3,038.05167	6	3,202.09333
7	2,549.20750	7	2,713.24917	7	2,877.29083	7	3,041.33250	7	3,205.37417
8	2,552.48833	8	2,716.53000	8	2,880.57167	8	3,044.61333	8	3,208.65500
9	2,555.76917	9	2,719.81083	9	2,883.85250	9	3,047.89417	9	3,211.93583
780	2,559.05000	830	2,723.09167	880	2,887.13333	930	3,051.17500	980	3,215.21667
1	2,562.33083	1	2,726.37250	1	2,890.41417	1	3,054.45583	1	3,218.49750
2	2,565.61167	2	2,729.65333	2	2,893.69500	2	3,057.73667	2	3,221.77833
3	2,568.89250	3	2,732.93417	3	2,896.97583	3	3,061.01750	3	3,225.05917
4	2,572.17333	4	2,736.21500	4	2,900.25667	4	3,064.29833	4	3,228.34000
5	2,575.45417	5	2,739.49583	5	2,903.53750	5	3,067.57917	5	3,231.62083
6	2,578.73500	6	2,742.77667	6	2,906.81833	6	3,070.86000	6	3,234.90167
7	2,582.01583	7	2,746.05750	7	2,910.09917	7	3,074.14083	7	3,238.18250
8	2,585.29667	8	2,749.33833	8	2,913.38000	8	3,077.42167	8	3,241.46333
9	2,588.57750	9	2,752.61917	9	2,916.66083	9	3,080.70250	9	3,244.74417
790	2,591.85833	840	2,755.90000	890	2,919.04167	940	3,083.98333	990	3,248.02500
1	2,595.13917	1	2,759.18083	1	2,923.22250	1	3,087.26417	1	3,251.30583
2	2,598.42000	2	2,762.46167	2	2,926.50333	2	3,090.54500	2	3,254.58667
3	2,601.70083	3	2,765.74250	3	2,929.78417	3	3,093.82583	3	3,257.86750
4	2,604.98167	4	2,769.02333	4	2,933.06500	4	3,097.10667	4	3,261.14833
5	2,608.26250	5	2,772.30417	5	2,936.34583	5	3,100.38750	5	3,264.42917
6	2,611.54333	6	2,775.58500	6	2,939.62667	6	3,103.66833	6	3,267.71000
7	2,614.82417	7	2,778.86583	7	2,942.90750	7	3,106.94917	7	3,270.99083
8	2,618.10500	8	2,782.14667	8	2,946.18833	8	3,110.23000	8	3,274.27167
9	2,621.38583	9	2,785.42750	9	2,949.46917	9	3,113.51083	9	3,277.55250

PART II.

GENERAL STATEMENT.

The remaining pages of this publication are devoted to a description of field methods, tabulations of cost data for the various operations, and to a discussion of errors and methods of adjustment. The condition equations and other data used in making the adjustments are also included.

While these may be of little interest to the engineer who desires only the geographic positions of control points in some particular area, there are a number of reasons why they should be published. The methods employed in the field work are of interest and value to local organizations carrying on detailed triangulation. Cost data for all public work should be published for the information of those interested and as an evidence that the work is being performed economically. For the information of those using the data the size of the errors in the observations and the distribution of the discrepancies in the adjustment should be evident in the published results. Finally, the condition equations and other adjustment data should be published in order that future work may be started with certainty at any point without recourse to the original data, and publication of complete results is the best insurance against loss of original records by fire or otherwise. In any future reprints of the data for this arc of triangulation only the preceding portions of this publication need be printed.

The methods employed in the field will be described very briefly first.

RECONNAISSANCE AND SIGNAL BUILDING.

Detailed specifications for reconnaissance for precise triangulation, such as governed the selection of the stations on this arc, are given in U. S. Coast and Geodetic Survey Special Publication No. 19. In brief, the principal requirements are that such stations and figures should be selected as to make the total cost of reconnaissance, building, and observing a minimum, that the R_1 between bases (see p. 2) should be about 100 and should not exceed 150, that Laplace stations should be provided at intervals of from four to six figures, that connections to precise level bench marks should be provided at intervals of 100 to 150 miles, and that if the line of a figure in the direction of progress is more than 40 miles in length, then additional stations, which need not be occupied, should be interpolated.

From Harlingen to Samfordyce the triangulation traverses a very flat country, as the Rio Grande Valley in this vicinity is rather broad. There is also a tall growth of mesquite, and tall towers were necessary in order to make the stations intervisible. From Samfordyce to Del Rio the country is of a gently rolling character, very sparsely settled, and covered with a growth of mesquite averaging not more than 15 feet in height. Although the terrain is comparatively even and unbroken there are a series of benches on

the north side of the Rio Grande, averaging from 5 to 10 miles in width, which afforded a means of extending a scheme of triangulation with small figures. Except for the military road, following the north side of the Rio Grande, the roads in this section were in very bad condition for traffic of any kind. The mountainous character of the country to the west of Del Rio made it comparatively easy to extend triangulation over that region.

Early in July, 1917, Signalman J. S. Bilby completed the organization of a signal-building party at Harlingen and started the reconnaissance and signal building on the eastern end of the arc. Connection to the ninety-eighth meridian arc of precise triangulation was made at stations Donna and Rio, from which points the scheme follows the Gulf Coast Railroad to its termination at Samfordyce. From Samfordyce the triangulation closely follows the Rio Grande to the vicinity of Devils River and thence along or near the Southern Pacific Railroad to the connection with the Texas-California arc of precise triangulation at stations Chispa, Krouse, and Newman. Railroads were utilized whenever possible, as it has been found that precise triangulation can be executed at a much smaller cost when the scheme follows a railroad and there is the additional consideration that triangulation stations established near a railroad are more readily available for future uses.

The lengths were invariably carried ahead by means of quadrilaterals or central-point figures instead of single triangles. The lengths of lines, especially for the eastern two-thirds of the arc, were governed almost entirely by the topographic conditions encountered and the required strength of figure. (See p. 2.) Except near the western end of the arc, the lines were made as long as possible in order that the cost of the work should be a minimum.

Mr. Bilby was in charge of both the reconnaissance and signal building and so arranged his parties that both classes of work were carried on simultaneously from the same base. On the eastern end of the scheme there were 18 signals which elevated the instrument an average of about 45 feet, with superstructures 20 feet higher which were used by the light keepers to support the lamps. Nearly all the remaining signals to the southeastward of Del Rio were built to elevate the instrument to an average height of about 15 feet to clear the brush, as the hills on which the stations are located are flat on top and difficult to clear. At most of the stations west of Del Rio it was necessary to build stands for the instrument only, the observer standing on the ground while making the observations. For a full description of the tall signals and the methods of constructing them the reader should consult Appendix No. 4 of the report for 1903 and Special Publication No. 54 of the U. S. Coast and Geodetic Survey.

Four automobile trucks, two 1½-ton and two ¾-ton, were used in the transportation of the party, materials, and supplies except in a few places where deep sand made it necessary to use teams. Teams, however, were hard to secure in this part of the country and were used very little on the building work. The observer on reconnaissance sometimes used a saddle horse in order to be able to travel cross-country.

Actual building was begun on July 2, 1917, and continued until December 1, 1917, when the party reached the vicinity of Sanderson,

Tex., and joined onto the reconnaissance and signal building which had been done by another party, as mentioned in the following paragraph.

E. H. Pagenhart, hydrographic and geodetic engineer, was in charge of the reconnaissance to the westward of the vicinity of Sanderson. This end of the arc is in mountainous country, and the lines are much longer than on the eastern end. Tripods for the support of the instrument were the only signals needed, the observer standing on the ground while making the observations.

Connection to the Texas-California triangulation was made at stations Chispa, Krouse, and Newman. Along the scheme, connection was made to various stations of the U. S. Geological Survey and the International Boundary Commission (United States and Mexico).

Some of the principal cost factors for the reconnaissance and signal building are tabulated below. Since the two operations were carried on simultaneously by one party, no division of the costs have been made.

Length of main scheme, in statute miles	550
Number of points selected in main scheme	130
Total cost	$11413.38
Cost per mile of progress	$20.75
Cost per main scheme station selected	$87.80

HORIZONTAL ANGLE OBSERVATIONS.

INSTRUCTIONS GOVERNING THE OBSERVATIONS.

The instructions for the observation of horizontal angles on precise triangulation are given in detail in U. S. Coast and Geodetic Survey Special Publication No. 19 and will not be repeated here. In brief, such instruments and methods are used as will insure that the maximum closing error of a triangle is not much greater than 3″ with an average of about 1″. The frequency of bases, strength of figures, and accuracy of angle measures must be such that the measured length of a base will not differ by more than 1 part in 25 000 from the length as computed through the triangulation from the preceding base.

The general instructions for precise triangulation as given in Special Publication No. 19 were amended for this arc in the following particulars:

All observations for horizontal angles between precise stations were to be made at night, unless to do so would materially delay the party. In order to minimize the effect of temperature on the instrument, the circle was shifted approximately 195° in azimuth between each two positions, thus making the alternate settings 180° from those shown in the table in page 35 of Special Publication No. 19.

An effort was made to make all observations for elevations between the hours of 1 and 4 in the afternoon, the period of greatest constancy in refraction, but the instructions permitted some of the observations of vertical angles to be made at night, provided a portion of the observations had been made during daylight, and providing also that those stations which had been observed upon during the day were reobserved at night, along with the remaining stations. In that manner a rough measure was obtained of the change in refraction between the day and night observations, and the night

observations could be corrected accordingly. The errors of the trigonometric leveling will be discussed later (p. 110), but it may be said here that night observations for elevations are unsatisfactory, even with the precautions indicated above.

Azimuths of precise or primary accuracy were to be observed at intervals of from 40 to 80 miles. At the Laplace stations azimuth observations were to be made on two nights with an accuracy for the station represented by a probable error of not more than $\pm 0''.3$, while at the primary azimuth stations a probable error not greater than $0''.5$ was permitted, and the observations could be made on a single night. In no case were a night's observations for azimuth to depend upon less than 10 positions of the circle.

The observations for the Rio Grande arc were made as follows: C. V. Hodgson, hydrographic and geodetic engineer, occupied 19 stations at the eastern end of the arc between August 28 and September 28, 1917. E. H. Pagenhart, hydrographic and geodetic engineer, occupied 32 stations at the western end of the arc between November 23, 1917, and March 2, 1918. The writer, starting from Mr. Hodgson's work at the eastern end of the arc and connecting with that done by Mr. Pagenhart at the western end, occupied 79 stations between October 3, 1917, and March 2, 1918.

INSTRUMENTS AND METHODS.

The instrumental equipment and camp outfit for these parties were practically the same as for all precise triangulation of recent years, with the one exception that Wanschaff direction theodolites were used for the horizontal angle measurements. These instruments have 8-inch exposed circles with two micrometers and, due to their compactness and to the fact that they weigh less than the Coast and Geodetic Survey 12-inch direction theodolites, are very suitable for this class of work. They are equipped with an accurate vertical circle and may be used for observing vertical angles, as was done along this arc. This avoids the necessity for transporting an additional instrument, the vertical circle, for this purpose. The main objection to the Wanschaff theodolite is the exposed horizontal circle, which in a dusty country requires constant attention to keep clean.

ORGANIZATION OF PARTY.

The parties were organized at the opposite ends of the arc; the party at the western end by Mr. Pagenhart and the one at the eastern end by Mr. Hodgson. The latter party was afterwards transferred to the writer in the vicinity of Riogrande. With the exception of a few changes caused by men being called to the Army by the draft these parties remained intact and were in the field continuously until the completion of the work. Each party consisted of the chief of party, one recorder, two truck drivers, and seven light keepers.

A minimum of six light keepers are required to maintain an efficient party on this class of work, but it is desirable to have seven or in special cases as many as eight. Where the figures of the scheme are quadrilaterals there are, of course, only six light keepers in use all the time, but on nearly all schemes of triangulation there will be many

stations from which there are more than five lights to be observed, and the extra light keepers are then used to great advantage. If there are insufficient light keepers to have one at each station, it becomes necessary to transfer one of the light keepers to the station which has not been observed after his regular station has been completed, and the observing party is thus delayed at least one day. As an observing party usually costs about $75 a day, it will be seen that a saving of two days during a month will more than pay for an extra light keeper.

It is the usual plan in moving light keepers to transfer the ones who are at the stations in the rear, on which the observations have been completed, to the new stations ahead of those already manned by light keepers. Any other method makes it necessary to move all the light keepers at the same time, and unless a country has especially favorable transportation facilities this can not be done economically and efficiently.

TRANSPORTATION OF OBSERVING PARTIES.

As was noted under the heading "Reconnaissance and Signal Building," the facilities for transportation along the arc were not sufficient to be depended upon for the requirements of the work. It was therefore necessary to provide for the transportation of all units of the party at all times and for the transportation of the necessary materials and supplies. Automobile trucks were decided upon as the best means of transportation, and as the season happened to be a very dry one even for that country they proved very successful. Teams were not available in many localities, and the hauling in of forage would doubtless have offset any initial advantage they might have shown.

Two trucks were used by each of the observing parties, and one additional truck was used by each party for moving light keepers. The width of the scheme and the average length of line on the eastern part of the arc made this plan especially suitable, for it was possible to move the light keepers to their new stations quickly enough for them to show their lights on the same day. An observing party on this class of work needs trucks to carry a total of 2500 pounds of personal and camp equipment, including 25 gallons of gasoline and 5 gallons of lubricating oil and the usual accessories. For localities where bases of supply are so far apart that more than 25 gallons of gasoline will be needed, a sufficient allowance for this weight and cubical contents must be taken into consideration, and regard should also be had for the additional quantities of provisions required. The weight of 2500 pounds is on the basis of provisions for four men for one week.

It has been found that two ¾-ton trucks are most suitable for an observing party, as they provide ample space and carrying capacity for all necessary equipment and supplies, even in the isolated sections of the country. In localities where supplies may be secured practically every day it is possible to get along with two ½-ton trucks, but there will be times when these trucks will be overloaded or the progress of the work delayed because of insufficient carrying capacity. Under these conditions one ¾-ton and one ½-ton truck will be more economical.

In the case of the truck for the transportation of the light keepers it has been found that one ¾-ton truck works to advantage. The minimum requisite here is for a truck which will carry two light keepers and their equipment without being fully loaded. A light keeper's outfit on the average weighs from 600 to 700 pounds. It frequently becomes necessary for the truck to move as many as three light keepers at the same time, and with the ¾-ton truck of the best make this can be done by carrying only as much of the equipment as is absolutely necessary for the light keepers to have for the first few days' work at their stations. The remainder of the equipment can be taken at some later time.

Fortunately for the progress of the work along this arc there were practically no rains during the season, and many of the roads, which would otherwise have been impassable, were in fair condition. A few stretches of sand were encountered, where it was necessary to hire teams to move from station to station, but these were not of frequent occurrence. Frequently it was necessary to pack for distances of from 1 to 2 miles to stations which could not be reached by truck.

The personal equipment of the various members of the parties was reduced to a minimum, and the general property and instruments were such as would barely meet the needs of the party.

TIME SPENT ON OBSERVING.

As stated on page 62, the first observing party started work on August 28, 1917, and the final observations were made on March 2, 1918. The total time, as for one party, spent in making the observations was 9¼ months. This time includes five days spent in opening lines of sight or elevating signals on obscured lines. During this time 130 stations were occupied, 6 stations were reoccupied to obtain better triangle closures, and 4 Laplace and 6 primary azimuths were observed. The average progress was 14 stations per month.

The western end of the scheme is in a mountainous country, where the progress was relatively slow due to the conditions encountered. On the eastern end of the arc, where there were no mountains and trucks could be driven close to the stations, the average was 16 stations per month, with a maximum of 18 during the calendar month of January. From October 10 to November 9, 21 stations were occupied by the writer, and from January 15 to February 14, 20 stations.

Delays caused by unfavorable weather amounted to about five days of every month. Other causes of delays were such as truck troubles, light keepers quitting without notice, light keepers after a move not being able to find their stations before darkness, and an insufficient number of light keepers.

ACCURACY SECURED.

The average closing error for the 267 triangles in this work is 1″.02, and the maximum 3″.43.

The results of this work confirm the statement made in some of the earlier publications of this Bureau, that the required average closure of 1″.00 or less in precise triangulation can be attained with the proper care and instruments even when the stations are occupied on only one day.

STATEMENT OF COSTS.

The principal elements of the costs of the observing on this arc can be readily seen from the tabulation below.

Total expenses (except for bases)	$15,712.25
Linear miles of progress through scheme	550
Cost per mile of progress	$28.57
Number of square miles covered	9,400
Cost per square mile	$1.67
Number of stations of main scheme	130
Cost per station occupied	$120.90
Points whose geographic position were determined	402
Cost per point determined	$39.10

BASE MEASUREMENTS.

Besides the two fixed lengths of previously adjusted triangulation to which this arc of triangulation is connected at its ends there are five bases which control the lengths along the arc. One of these bases was measured along the track of the Southern Pacific Railroad and required an expansion figure to connect it with the main scheme. Each of the remaining four bases is itself a side of one of the figures of the main scheme. This latter method of selecting bases is very practical for triangulation having small figures, since it makes unnecessary the expansion figure of the usual base net where there is apt to be considerable loss in strength of figure.

METHODS USED.

The measurement was made with 50-meter invar tapes, using the same methods which have been employed for several years in the U. S. Coast and Geodetic Survey. These methods are indicated in brief by the following extracts from the instructions given in Special Publication No. 19.

Very little increase in the average accuracy of the lengths of the triangle sides in the triangulation connected with a base will result from increasing the accuracy of the base measurement beyond that represented by a probable error of 1 part in 500 000 in the length of the base. The following limits of accuracy are selected with a view of attaining a probable error but little, if any, greater than 1 part in 500 000. You will strive to keep as far within these limits as is possible by the use of good judgment and skill, but you will restrict the time and money expended upon each operation substantially to that required to keep barely within them.

Four invar tapes are to be standardized at the Bureau of Standards both before and after the measurement of the bases. Each base is to be measured with three of these invar tapes used in daylight or at night. A base shall be measured in sections approximately 1 kilometer in length, except that one shorter section may be used. Each section of a base shall be measured with at least two different invar tapes. Different pairs of invar tapes shall be used on different sections, so that the three tapes used on the base shall thereby be thoroughly intercompared. Two, and only two, measurements of each section shall be made, unless the discrepancy between these two measurements exceeds 20 millimeters $\sqrt{K}$ (in which K is the length of the section in kilometers), in which case additional measurements must be made until two are obtained which agree within this limit. The fourth invar tape standardized is to be retained for use in case of serious damage to any of the three tapes with which the measurements would otherwise be made.

Such precautions should be taken to secure accurate horizontal and vertical alignment of the tapes and the determination of the tension applied to the tapes as is necessary to insure that the errors arising from these sources on a base shall each be less than 1 part in 1 000 000.

STANDARDIZATION OF TAPES.

The five base lines along the Rio Grande arc were all measured with the same set of tapes—invar base tapes Nos. 516, 517, and 521. A fourth tape, No. 522, was carried along as a reserve tape, but was not used. The lengths of the working tapes when supported at the 0, 25, and 50 meter points were determined by the Bureau of Standards in March, 1919, to be as follows:

$T_{516} = 50.008679$ meters at 29°.2 C.
$T_{517} = 50.010049$ meters at 29°.1 C.
$T_{521} = 50.009419$ meters at 29°.3 C.

The corresponding values from a standardization made in 1916 and reduced to the temperatures of the 1919 standardization are:

$T_{516} = 50.009362$ meters at 29°.2 C.
$T_{517} = 50.009760$ meters at 29°.1 C.
$T_{521} = 50.010018$ meters at 29°.3 C.

In computing the lengths of the base lines along the Rio Grande arc a direct mean of the above values was used. This is in accordance with the present practice in the Survey, which assumes that the difference in length of a tape from the two standardizations is not a function of the elapsed time between the standardizations, but is rather due to errors in the standardizations themselves and to changes which may occur in the tapes while they are actually being used in the field. However, in making the following computations no progressive values were assigned the various tapes at the different base lines, the agreement between the values from the two standardizations being sufficiently close to justify using the same value for all the bases. These values were as follows:

$T_{516} = 50.009020$ meters at 29°.2 C.
$T_{517} = 50.009904$ meters at 29°.1 C.
$T_{521} = 50.009718$ meters at 29°.3 C.

REDUCTION TO SEA LEVEL.

The formula used for reducing the measured length of a base line to its length at sea level is:

$$C = -S\frac{h}{r} + S\frac{h^2}{r^2} - S\frac{h^3}{r^3} + \ldots$$

in which C is the reduction to sea level for a section of length S and mean elevation h, and r is the radius of curvature of the section in question. In the following computations this correction was not applied to each section separately, but was computed for the entire base line and applied as a single correction. This was also done in the case of the corrections for inclination of the tape. This was merely an expedient for convenience in computing. It will also be noted that another expedient was the handling in the computations of as long a section as conditions permitted. Continuous measures along the base line on any one day with the same tape were summed up as one section regardless of its length.

Computation of base lines.

SANFORDYCE BASE LINE.

Section.	Date.	Dir. of meas.	Tape No.	Uncorrected length.		Temp.	Corrections.			Reduced length.	Adopted length.	(v).	(vv).
				Tape lengths.	Meters.		Temp.	Tape.	Set-up. Setback.				
	1918					°C.	*Meters.*	*Meters.*	*Meters.*	*Meters.*	*Meters.*	*mm.*	*mm.*
Eltoro–80	Apr. 17	F	516	80	4000	25.4	−0.0054	+0.7216	+0.8669	4001.5831		+32.3	1043.29
	Apr. 17	B	517	80	4000	36.2	+ .0091	+ .7923	+ .8464	4001.6478	4001.6154	−32.4	1049.76
80–Fordyce	Apr. 17	F	517	72½	3625	30.5	+ .0016	+ .7180	+ .4722	3626.1918		+ 5.4	29.16
	Apr. 17	B	521	72½	3625	33.5	+ .0106	+ .7046	+ .4873	3626.2025	3626.1972	− 5.3	28.09

Sum	7627.8126
Correction for inclination	−.1376
Reduction to sea level	−.0997
Adopted length of base line, meters	7627.5753

Mean elevation of base line above sea level=83 meters. The probable error of the Samfordyce base line is ±22.1 mm., which corresponds to an error of 1 part in 345 000.

ZAPATA BASE LINE.

Feoro–80	Apr. 12	F	521	80	4000	19.6	−0.0159	+0.7774	−7.0785	3993.6830		− 3.1	9.61
	Apr. 12	B	516	50	4000	23.2	− .0085	+ .7216	−7.0334	3993.6767	3993.6799	+ 3.2	10.24
80–120	Apr. 12	F	516	40	2000	28.4	− .0006	+ .3608	− .7497	1999.6105		+ .3	.09
	Apr. 12	B	517	40	2000	27.6	− .0010	+ .3962	− .7841	1999.6111	1999.6108	− .3	.09
120–140	Apr. 12	F	517	20	1000	22.8	− .0020	+ .1981	− .5674	999.6287		− 3.5	12.25
	Apr. 12	B	517	20	1000	22.7	− .0020	+ .1981	− .5743	999.6218	999.6252	+ 3.4	11.56
140–Loma	Apr. 12	F	516	10	500	29.4	.0000	+ .0902	+4.1000	504.1902		+ .4	.16
	Apr. 12	B	517	10	500	29.4	.0000	+ .0990	+4.0920	504.1910	504.1906	− .4	.16

Sum	7497.1065
Correction for inclination	−1.5795
Reduction to sea level	− .1598
Adopted length of base line, meters	7495.3672

Mean elevation of base above sea level=136 meters. The probable error of the Zapata base line is ±3.2 mm., which corresponds to an error of 1 part in 2 342 000.

CARRIZO SPRINGS BASE LINE.

Section.	Date.	Dir. of meas.	Tape No.	Uncorrected length. Tape lengths.	Uncorrected length. Meters.	Temp.	Corrections. Temp.	Corrections. Tape.	Corrections. Set-up. Setback.	Reduced length.	Adopted length.	(v).	(vv).
	1918.					°C.	*Meters.*	*Meters.*	*Meters.*	*Meters.*	*Meters.*	*mm.*	*mm.*
English–60	Apr. 4	F	517	60	3000	23.6	−0.0053	+0.5942	+0.3990	3000.9879		−13.7	187.69
	Apr. 4	B	521	60	3000	26.2	− .0038	+ .5831	+ .3812	3000.9605	3000.9742	+13.7	187.69
60–120	Apr. 5	F	521	60	3000	26.0	− .0041	+ .5831	− .0473	3000.5317		− 8.5	72.25
	Apr. 5	B	516	60	3000	28.9	− .0003	+ .5412	− .0262	3000.5147	3000.5232	+ 8.5	72.25
120–160	Apr. 5	F	516	40	2000	29.5	+ .0002	+ .3608	− .0161	2000.3449		+ 8.7	75.69
	Apr. 5	B	517	40	2000	28.7	− .0003	+ .3962	− .0337	2000.3622	2000.3536	− 8.6	73.96
160–Barr	Apr. 6	F	516	42¼	2125	19.4	− .0074	+ .3834	+ .4732	2125.8492		+ 8.8	77.44
	Apr. 6	B	517	42¼	2125	23.5	− .0038	+ .4209	+ .4498	2125.8669	2125.8580	− 8.9	79.21

Sum	10 127.7090
Correction for inclination	−1.0897
Reduction to sea level	− .4048
Adopted length of base line, meters	10 126.2145

Mean elevation of base line above sea level = 254 meters. The probable error of the Carrizo Springs base line is ±13.7 mm., which corresponds to an error of one part in 739 000.

PALOMA BASE LINE.

Wiffp–20	Mar. 31	B	517	20	1000	26.8	−0.0007	+0.1981	+0.5434	1000.7408		+ 1.1	1.21
	Mar. 31	F	516	20	1000	30.7	+ .0005	+ .1804	+ .5605	1000.7414		+ 0.5	.25
	Mar. 31	B	517	20	1000	30.3	+ .0004	+ .1981	+ .5449	1000.7434	1000.7419	− 1.5	2.25
20–80	Mar. 31	F	516	60	3000	22.2	− .0075	+ .5412	− .3106	3000.2231		+ 5.4	29.16
	Mar. 31	B	517	60	3000	25.3	− .0036	+ .5942	− .3567	3000.2339	3000.2285	− 5.4	29.16
80–100	Mar. 31	F	517	20	1000	31.2	+ .0007	+ .1981	+ .0630	1000.2618		− 0.6	.36
	Mar. 31	B	521	20	1000	26.8	− .0010	+ .1944	+ .0677	1000.2611		+ 0.1	.01
	Apr. 1	B	521	20	1000	26.3	− .0012	+ .1944	+ .0674	1000.2606	1000.2612	+ 0.6	.36
100–Pen	Mar. 31	F	517	61	3050	30.6	+ .0015	+ .6041	−6.2674	3044.3382		−12.2	148.84
	Mar. 31	B	521	61	3050	28.3	− .0013	+ .5928	−6.2777	3044.3138	3044.3260	+12.2	148.84

Sum	8045.5576
Correction for inclination	−.9313
Reduction to sea level	−.3402
Adopted length of base line, meters	8044.2861

Mean elevation of base line above sea level = 270 meters. The probable error of the Paloma base line is ±9.0 mm., which corresponds to an error of one part in 894 000.

DRYDEN BASE LINE.

Dryden east base–20	Mar. 18	F	521	20	1000	22.0	−0.0030	+0.1944	− 0.1140	1000.0774	.....	+ 1.0	1.00
	Mar. 18	B	516	20	1000	19.7	− .0034	+ .1804	− .0976	1000.0794	1000.0784	− 1.0	1.00
20–40	Mar. 18	F	521	20	1000	25.1	− .0018	+ .2625	+ .0020	1000.2627	.....	− 1.4	1.96
	Mar. 18	B	516	20	1000	21.4	− .0029	+ .2474	+ .0332	1000.2477	.....	+13.6	184.96
	Mar. 19	F	521	20	1000	12.9	− .0068	+ .2625	+ .0120	1000.2677	.....	− 6.4	40.96
	Mar. 19	B	517	20	1000	20.9	+ .0001	+ .2619	+ .0051	1000.2671	1000.2613	− 5.8	33.64
40–60	Mar. 18	F	521	20	1000	24.3	− .0021	+ .2680	.0000	1000.2659	.....	+ 3.8	14.44
	Mar. 18	B	516	20	1000	21.5	− .0029	+ .2528	+ .0043	1000.2542	.....	+15.5	240.25
	Mar. 19	F	521	20	1000	13.3	− .0066	+ .2680	+ .0235	1000.2849	.....	−15.2	231.04
	Mar. 19	B	517	20	1000	27.8	− .0006	+ .2371	− .0016	1000.2649	.....	+ 4.8	23.04
	Mar. 20	F	521	20	1000	22.7	− .0027	+ .2680	+ .0060	1000.2713	.....	− 1.6	2.56
	Mar. 20	B	517	20	1000	21.3	− .0027	+ .2671	+ .0127	1000.2771	1000.2697	− 7.4	54.76
60–80	Mar. 18	F	521	20	1000	23.4	− .0025	+ .2680	.0000	1000.2655	.....	− 2.6	6.76
	Mar. 18	B	516	20	1000	22.2	− .0024	+ .2528	+ .0055	1000.2559	.....	+ 7.0	49.00
	Mar. 19	F	521	20	1000	16.3	− .0054	+ .2680	+ .0015	1000.2641	.....	− 1.2	1.44
	Mar. 19	B	517	20	1000	26.0	− .0012	+ .2671	+ .0003	1000.2662	1000.2629	− 3.3	10.89
80–Dryden west base	Mar. 20	F	521	53	2650	17.8	− .0126	+ .6844	+25.1618	2675.8336	.....	+ 4.5	20.25
	Mar. 20	B	517	53	2650	23.5	− .0032	+ .6837	+25.1641	2675.8426	2375.8381	− 4.5	20.25

Sum	6676.7104
Correction for inclination	−.6358
Reduction to sea level	−.6860
Adopted length of base line, meters	6675.3886

Mean elevation of base line above sea level=656 meters. The probable error of the Dryden base line is ±5.5 mm., which corresponds to an error of 1 part in 1 214 000.

STATEMENT OF COSTS.

In the third column of the following table is given the number of days spent in measuring each of the five bases. This includes the time spent in traveling between bases and in preparing them for measurement, as well as all delays incident to the work. In the last two columns of the table are given cost data for the bases. These costs do not include the cost of standardizing the tapes which is about $800 to be divided among the five bases.

Name of base.	Length of base.	Time spent in preparing and measuring base.	Total cost.	Cost per kilometer.
	Meters.	*Days.*	*Dollars.*	*Dollars.*
Samfordyce	7627.5753	5	453.65	60
Zapata	7495.3672	7	608.59	81
Carrizo Springs	10 126.2145	5	453.65	45
Paloma	8044.2861	9	763.68	95
Dryden	6675.3886	8	620.36	93
Total		34	2899.93	

ACCORD OF BASES.

In the following table the discrepancies developed between bases are given in terms of the seventh decimal place of logarithms and are also expressed as ratios. A plus sign before the discrepancy means that the base named on the same line is longer as measured than as computed through the intervening triangulation from the base named on the preceding line. In the solution of the normal equations of the least-squares adjustment each length equation was eliminated immediately after all angle and side conditions in that section of the arc between the bases involved had been eliminated. The discrepancies given below are the amounts then remaining. The exact discrepancy for each length equation can only be determined after considerable computation, and it would probably not vary much from the value below.

Name of base.	Probable error of length as measured.	Discrepancy between bases in seventh decimal place of logarithms.	Discrepancy between bases expressed as a ratio.
Donna-Rio[1]			
Samfordyce	1/345 000	+ 18	1/241 000
Zapata	1/2 342 000	− 6	1/723 000
Carrizo Springs	1/739 000	+ 60	1/72 000
Paloma	1/894 000	− 62	1/70 000
Dryden	1/1 214 000	+ 54	1/80 000
Chispa-Krouse[1]		−101	1/43 000

[1] This is a line of previously adjusted triangulation to which the Rio Grande arc is connected.

ASTRONOMIC WORK.

LAPLACE POINTS.

A Laplace point is a station of the triangulation at which the astronomic azimuth has been observed and the astronomic longitude has been determined.

A Laplace azimuth is an observed astronomic azimuth corrected for the prime vertical component of the deflection of the vertical. This deflection is the angle formed by the actual plumb-line direction with the normal to the reference spheroid at the point of observation.

It is possible to carry the geodetic longitudes throughout a continuous system of triangulation with very little error, but the geodetic azimuth is affected by the accidental errors of the observations of horizontal directions and also by the systematic error which seems almost always to be present in an arc of triangulation. The effect on the azimuth is, in general, of such a magnitude that it is very desirable that true or Laplace azimuths be introduced into the scheme and held in the adjustment of the triangulation. This was done in the triangulation covered by this report. The Laplace azimuths are at stations Laredo, Laplace, Johnstone, and Dryden east base.

AZIMUTHS.

The observations for azimuth were made simultaneously with the observation of horizontal angles except at Laplace stations, where the second night's work usually consisted of observations for azimuth only. An 8-inch Wanschaff direction theodolite with two micrometers was used by each of the parties for horizontal angle measurements, and the methods employed for the determination of the astronomic azimuth of a direction were the same as outlined in Special Publication No. 14. The determination of time for use in the computation of azimuth was made with a small vertical circle, which was usually mounted on a stand built especially for that instrument and placed approximately on the north-and-south line passing through the triangulation station. The objection to using the same stand for both instruments is that considerable time is lost in shifting from one instrument to the other, and in partially cloudy weather this is a very serious objection. The completion of a station in one night often depends on the rapidity with which the observer can go from one operation to the other, and a few moments gained in this manner often means a saving of several days during a season.

There are 10 azimuth stations of precise or primary accuracy along this arc. Four of these are Laplace stations, and the azimuths determined at these four entered directly into the adjustments. At the six other stations observations were made on one night only, and the results are used only for the determination of deflections in the prime vertical.

The degree of accuracy required for a Laplace azimuth is that the probable error for the observations at a station shall not exceed $\pm 0''.3$, a condition which can easily be secured by observations on two nights under favorable conditions. For primary azimuths the

observations need not be made on more than one night, and the requirements are that the probable error shall not exceed $\pm 0''.5$.

Program of occupation of azimuth stations.

Station.	Observer.	Date of occupation.	Number of positions.	Probable error.
		1917.		"
Monument	C. V. Hodgson	Sept. 22, 23	29	±0.22
Zapata	C. L. Garner	Oct. 31	17	±0.27
Laredo	do	Nov. 22, 23	28	±0.22
Star	E. H. Pagenhart	Dec. 9	12	±0.44
Dentonio	C. L. Garner	Dec. 27	14	±0.25
Pyle	E. H. Pagenhart	Dec. 31	10	±0.44
		1918.		
Dryden east base	do	Jan. 18, 22	22	±0.23
Laplace	C. L. Garner	Jan. 22, 23	30	±0.26
Blue	E. H. Pagenhart	Feb. 11	12	±0.23
Johnstone	C. L. Garner	Feb. 13, 14	31	±0.27

The following table gives for each azimuth station its geographic position, the geodetic azimuth of a line of the main scheme of the triangulation, the astronomic azimuth, the difference between the astronomic and geodetic azimuths, A–G, the negative cotangent of the geodetic latitude of the station occupied ($-\cot \phi'$), and finally A–G (P. V.) as the deflection in the prime vertical. The table is arranged like those shown in the two publications of the U. S. Coast and Geodetic Survey on the figure of the earth.[1]

In each case the azimuth and triangulation stations are coincident. The mark used was a signal lamp accurately centered over the triangulation station at the distant end of the line for which the azimuth is given. As the azimuth observations are made at the same time as the horizontal angle observations the cost is included with the cost of the triangulation. (See pp. 65 and 79.)

The astronomic azimuths have been corrected for the elevation of the station sighted upon but not for the variation of the pole.

[1] "The figure of the earth and isostasy from measurements in the United States" and "Supplementary investigation in 1909 of the figure of the earth and isostasy."

Deflections in prime vertical.

Station.	Geodetic latitude.	Geodetic longitude.	Geodetic azimuth.	To station—	Astronomic azimuth.	A–G.	$-\text{Cot } \phi'$.	A–G. (P. V.)
	° ′ ″	° ′ ″	° ′ ″		″	″		″
Monument	26 21 16.683	98 46 02.964	180 59 16.97	Corpus	17.17	+0.20	−2.0183	−0.40
Zapata	26 52 49.422	99 17 49.676	195 59 49.12	Moleno	51.03	+1.91	−1.9728	−3.77
Laredo	27 30 37.041	99 29 17.480	187 10 01.05	Orvil	03.83	+2.78	−1.9202	−5.34
Dentonio	28 18 32.500	99 56 12.573	175 26 45.65	Carlow	45.61	−0.04	−1.8566	+0.07
Laplace	28 42 46.426	100 29 33.719	167 44 41.32	Nine	41.71	+0.39	−1.8254	−0.72
Johnstone	29 22 38.529	100 46 11.628	203 04 43.27	Hamilton	43.79	+0.52	−1.7764	−0.93
Blue	30 03 20.872	101 20 11.653	82 27 47.20	Babb	44.73	−2.47	−1.7282	+4.10
Dryden east base	30 02 39.865	102 05 55.380	167 48 19.16	Hen	[1] 21.37	+2.21	−1.7290	−3.83
Pyle	30 21 49.417	102 40 23.661	137 49 51.56	Madera	55.75	+4.19	−1.7068	−7.15
Star	30 46 38.779	103 47 39.306	66 40 53.00	Baldy	50.54	−2.46	−1.6790	+4.13

[1] Actual value is 20″.72, but due to an error 21″.37 was used in the adjustment.

LONGITUDES.

There are four longitude stations along the Rio Grande which are connected with triangulation stations Laredo, Laplace, Johnstone, and Dryden east base, respectively.

The station at Laredo was determined telegraphically from Austin in 1895 by parties under assistants G. R. Putnam and E. Smith, using Coast and Geodetic Survey transits Nos. 18 and 19. As the transit micrometer was not in use at that time the observers changed stations in order to eliminate personal equation.

The astronomic longitudes of the three other stations were telegraphically determined in 1919 by parties under J. E. McGrath and W. B. Fairfield, hydrographic and geodetic engineers, using Bamberg broken telescope transits Nos. 20 and 21. These are equipped with self-registering micrometers for the time determinations. For full description of this type of instrument and the methods employed see U. S. Coast and Geodetic Survey Special Publication Nos. 35 and 14.

These four stations, together with stations Stanton and Baracho of the Texas-California arc of precise triangulation, form a longitude chain extending from Austin to El Paso, Tex. Austin and El Paso are base stations in the longitude net of the United States (see Appendix No. 2 of the report for 1897), and the observations along this arc close a loop. The corrections for closure are shown in the following tabulation for the various stations:

Difference of longitude between Austin and Laredo.

Date of exchange of time signals.	Observer.		Difference of longitude.	v.
	Western station, *Laredo.*	Eastern station, *Austin.*		
1895.			*m.* *s.*	*s.*
Apr. 20	G. R. Putnam	E. Smith	7 07.108	−0.040
May 1			07.157	+ .009
May 2			07.168	+ .020
May 6			07.141	− .007
May 7			07.165	+ .019
May 9	E. Smith	G. R. Putnam	07.105	− .043
May 10			07.144	− .004
May 12			07.182	+ .034
May 14			07.153	+ .005
May 17			07.156	+ .008
Weighted mean			7 07.148 ±0.006	

The Laredo station was established in 1895. Transit No. 18 was mounted on a brick pier 62.627 meters (2″.035) north and 43.034 meters (1″.568) west of Laredo north wireless tower triangulation station. (See description on p. 40.)

At Austin transit No. 19 was mounted over the station established in 1895. (See Appendix 2 of the report for 1897, pp. 239 and 254.)

	h.	*m.*	*s.*
Laredo transit (1895) to Austin transit (1895)	0	07	07.148
Correction for loop closure			−0.008
Adjusted difference	0	07	07.140
Longitude Austin transit (1895), 1897 adjustment[1]	6	30	57.024
Longitude Laredo transit (1895), adjusted	6	38	04.164
	99°	31′	02″.46
Reduction to Laredo north wireless tower triangulation station			−1.57
Longitude of Laredo north wireless tower triangulation station	99	31	00.89

[1] See Appendix 2 of the report for 1897.

Difference of longitude between Laredo and Laplace.

Date of exchange of time signals.	Observer.		Difference of longitude.	v.
	Western station, *Laplace.*	Eastern station, *Laredo.*		
1919.			m. s.	s.
June 4	W. B. Fairfield	J. E. McGrath	3 54.035	+0.002
June 11			54.053	−.016
June 12			54.022	+.015
Mean			3 54.037 ±0.006	

At Laplace a new station was established. Bamberg transit No. 21 was mounted on a temporary wooden pier 3.52 meters (0″.114) due north of Laplace triangulation station. (See description on p. 44.)

At Laredo, Bamberg transit No. 20 was mounted over the station of 1895. (See p. 74.)

	h.	m.	s.
Laplace transit (1919) to Laredo transit (1895–1919)	0	03	54.037
Correction for loop closure			−0.008
Adjusted difference	0	03	54.029
Longitude Laredo transit (1895), adjusted	6	38	04.164
Longitude Laplace transit (1919), adjusted	6	41	58.193
	100°	29′	32″.90
Reduction to Laplace triangulation station			0.00
Longitude Laplace triangulation station	100	29	32.90

Difference of longitude between Laplace and Johnstone.

Date of exchange of time signals.	Observer.		Difference of longitude.	v.
	Western station, *Johnstone.*	Eastern station, *Laplace.*		
1919.			m. s.	s.
July 10	J. E. McGrath	W. B. Fairfield	1 06.500	+0.034
July 11			06.575	−.041
July 12			06.552	−.018
July 13			06.509	+.025
Mean			1 06.534 ±0.012	

At Johnstone a new station was established. Bamberg transit No. 20 was mounted on a temporary wooden pier 6.578 meters (0″.24) west and 2.722 meters (0″.09) south of Johnstone triangulation station. (See description on p. 46.)

At Laplace, Bamberg transit No. 21 was mounted over the new station of 1919. (See above.)

	h.	m.	s.
Johnstone transit (1919) to Laplace transit (1919)	0	01	06.534
Correction for loop closure			−0.007
Adjusted difference	0	01	06.527
Longitude Laplace transit (1919), adjusted	6	41	58.193
Longitude Johnstone transit (1919), adjusted	6	43	04.720
	100°	46′	10″.80
Reduction to Johnstone triangulation station			−0.24
Longitude Johnstone triangulation station	100	46	10.56

Difference of longitude between Johnstone and Dryden east base.

Date of exchange of time signals.	Observer.		Difference of longitude.	v.
	Western station, *Dryden east base,*	Eastern station, *Johnstone.*		
1919.			m. s.	s.
Aug. 8	W. B. Fairfield	J. E. McGrath	5 18.687	−0.002
Aug. 10			18.680	+ .005
Aug. 11			18.688	− .003
Mean			5 18.685 ±0.002	

At Dryden east base a new station was established. Bamberg transit No. 21 was mounted on a temporary wooden pier 12.34 meters (0″.40) north of Dryden east base triangulation station. (See description on p. 48.)

At Johnstone, Bamberg transit No. 20 was mounted on the temporary pier of the 1919 station. (See p. 75.)

	h.	m.	s.
Dryden east base transit (1919) to Johnstone transit (1919)	0	05	18.685
Correction for loop closure			−0.008
Adjusted difference	0	05	18.677
Longitude Johnstone transit (1919) adjusted	6	43	04.720
Longitude Dryden east base transit (1919), adjusted	6	48	23.397
	102°	05′	50″.96
Reduction to Dryden east base triangulation station			0.00
Longitude Dryden east base triangulation station	102	05	50.96

Difference of longitude between Dryden east base and Stanton.

Date of exchange of time signals.	Observer.		Difference of longitude.	v.
	Western station, *Dryden east base.*	Eastern station, *Stanton.*		
1919.			m. s.	s.
Sept. 2	W. B. Fairfield	J. E. McGrath	1 18.061	−0.033
Sept. 4			18.022	+ .006
Sept. 5			18.016	+ .012
Sept. 6			18.013	+ .015
Mean			1 18.028 ±0.007	

At Dryden east base, Bamberg transit No. 21 was mounted over the new station of 1919. (See above.)

At Stanton, Bamberg transit No. 20 was mounted on the concrete pier of the 1911 station. (See U. S. Coast and Geodetic Survey Special Publication No. 11, p. 103.) This pier is 2.26 meters (0″.07) due south of Stanton triangulation station.

	h.	m.	s.
Dryden east base transit (1919) to Stanton transit (1911–1919)	0	01	18.028
Correction for loop closure			+0.007
Adjusted difference	0	01	18.035
Longitude Dryden east base transit (1919), adjusted	6	48	23.397
Longitude Stanton transit (1911–1919), adjusted	6	47	05.362
	101°	46′	20″.43
Reduction to Stanton triangulation station			.00
Longitude of Stanton triangulation station	101	46	20.43

Difference of longitude between Stanton and Boracho.

Date of exchange of time signals.	Observer.		Difference of longitude.	v.
	Western station, *Boracho.*	Eastern station, *Stanton.*		
1911.			m. s.	s.
Oct. 30	C. V. Hodgson	E. Smith	10 28.367	+0.060
Oct. 31			28.451	−.024
Nov. 5			28.462	−.035
Mean			10 28.427 ±0.020	

At Boracho transit No. 19 was mounted on the concrete pier of the new station of 1911. (See U. S. Coast and Geodetic Survey Special Publication No. 11, pp. 103, 104.) This pier is 6.565 meters (0″.213) due south of Boracho triangulation station.

At Stanton a new station was established. Transit No. 2 was mounted on a concrete pier. (See U. S. Coast and Geodetic Survey Special Publication No. 11, p. 103.)

	h.	m.	s.
Boracho transit (1911) to Stanton transit (1911–1919)	0	10	28.427
Correction for loop closure			−0.008
Adjusted difference	0	10	28.419
Longitude Stanton transit (1911–1919), adjusted	6	47	05.362
Longitude Boracho transit (1911), adjusted	6	57	33.781
	104°	23′	26″.72
Reduction to Boracho triangulation station			0.00
Longitude Boracho triangulation station	104	23	26.72

Difference of longitude between Boracho and El Paso.

Date of exchange of time signals.	Observer.		Difference of longitude.	v.
	Western station, *El Paso.*	Eastern station, *Boracho.*		
1911.			m. s.	s.
Oct. 21	E. Smith	C. V. Hodgson	8 23.845	−0.066
Oct. 22			23.759	+.020
Oct. 23			23.816	−.037
Oct. 24			23.696	+.083
Mean			8 23.779 ±0.022	

At El Paso Coast and Geodetic Survey transit No. 2 was mounted on a concrete pier 0″.56 north and 0ˢ.166 west of the station of 1892–93–95, which is now lost. (See Special Publication No. 11, p. 77.) This pier is 2.275 meters (0″.074) due south of triangulation station West. (See p. 76 of Special Publication No. 11.)

At Boracho transit No. 19 was mounted over the new station of 1911. (See above.)

	h.	m.	s.
El Paso transit (1892–93–95) to Boracho transit (1911)	0	08	23.613
Correction for loop closure			−0.008
Adjusted difference	0	08	23.605
Boracho transit (1911), adjusted	6	57	33.781
El Paso transit (1892–93–95), 1897 adjustment[1]	7	05	57.386

[1] See Appendix 2 of the report for 1897.

The following table gives for each astronomic longitude station on the Rio Grande arc of triangulation, the geodetic latitude and longitude, the astronomic longitude, the difference between the astronomic and geodetic longitude, A−G, the cosine of the geodetic latitude, cos ϕ', and finally the deflection in the prime vertical, A−G. (P. V.). In each case the longitude has been reduced to the triangulation station, and the position is for that point.

It will be seen that the deflections in the prime vertical as derived from the longitude determinations are practically identical with those derived from azimuths. (See p. 73.)

The astronomic longitudes have not been corrected for the variation of the pole.

Deflections in prime vertical.

Station.	Geodetic latitude.	Geodetic longitude.	Astronomic longitude.	A−G.	Cos ϕ'.	A−G. (P. V.).
	° ′ ″	° ′ ″	″	″		″
Laredo north wireless tower	27 30 25.279	99 31 06.895	00.89	−6.00	0.8870	−5.32
Laplace	28 42 46.426	100 29 33.719	32.90	−.82	.8770	−.72
Johnstone	29 22 38.529	100 40 11.628	10.56	−1.07	.8714	−.93
Dryden east base	30 02 39.865	102 05 55.380	50.96	−4.42	.8656	−3.83

LATITUDES.

The astronomic latitude at Laredo, Tex., was determined in 1895 by a party under Assistant G. R. Putnam. The instrument used was zenith telescope No. 6. (See Special Publication No. 14 of the U. S. Coast and Geodetic Survey.)

The latitudes of the three other Laplace stations on the Riogrande arc were determined during the occupation of the stations for longitude. The observations were made with the Bamberg broken telescope transit used for the time observations. This instrument may be used for the determination of latitude by the Horrebow-Talcott method in much the same manner as the zenith telescope except in some minor details. The general methods followed are those given in U. S. Coast and Geodetic Survey Special Publication No. 14.

The program of occupation of the latitude stations is given in the following table:

Program of occupation of latitude stations.

Station.	Observer.	Date of occupation.	Number of pairs observed.	Probable error.
				″
Laredo	G. R. Putnam	(1895)	20	±0.06
		1919.		
Laplace	W. B. Fairfield	June 14	14	± .15
Johnstone	J. E. McGrath	July 30, 31	12	± .19
Dryden east base	W. B. Fairfield	Aug. 15	14	± .09

In computing the deflections of the vertical in the meridian (see table below) the latitude station was reduced to the triangulation station in each case. The descriptions of the triangulation stations may be found by consulting the index.

The following table gives the geodetic latitude and longitude of each station, the astronomic latitude reduced to sea level, and the astronomic latitude minus the geodetic, A−G. The astronomic latitude at Laredo has been corrected for the variation of the pole, but this correction has not been applied at the three other stations.

Deflections in the meridian.

Station.	Geodetic latitude.	Geodetic longitude.	Astronomic latitude.	A−G.
	° ′ ″	° ′ ″	″	″
Laredo north wireless tower	27 30 25.279	99 31 06.895	28.05	+2.77
Laplace	28 42 46.426	100 29 33.719	44.00	−2.43
Johnstone	29 22 38.529	100 46 11.628	39.20	+.67
Dryden east base	30 02 39.865	102 05 55.380	41.25	+1.39

ANALYSIS OF COSTS, FIELD AND OFFICE.

For the purposes of showing unit costs in condensed form and of comparing the relative costs of the various operations connected with the determination of geodetic control points, there follows a tabulation of these factors:

Kind of operation.	Total cost.	Cost per point determined (402).	Cost per mile of progress. (550).	Cost per square mile. (9400).
	Dollars.	*Dollars.*	*Dollars.*	*Dollars.*
Reconnoissance and signal building	11 413.38	28.39	20.75	1.21
Triangulation and azimuth observations	15 712.25	39.09	28.57	1.67
Base measurements	2899.93	7.21	5.27	.31
Latitude and longitude observations	2800.00	6.97	5.09	.30
Total, field	*32 825.56*	*81.66*	*59.68*	*3.49*
Office computation	4100.00	10.20	7.45	.44
Compiling and publishing (estimated)	2000.00	4.97	3.64	.21
Total, office	6100.00	15.17	11.09	.65
Total, field and office	*38 925.56*	*96.83*	*70.77*	*4.14*

Different arcs of triangulation show great divergence in the cost per point and the cost per square mile, both of which are largely dependent on the length of lines in the scheme. The cost per mile of progress through the middle of the scheme, however, is relatively constant and furnishes a good basis for comparison and also for the estimation of costs. The ninety-eighth meridian arc (after 1901) cost $63, the Texas-California arc $32, the one hundred and fourth meridian arc $39, and the Utah-Washington arc $30 per mile. The corresponding cost from the above table is approximately $45. It should be noted that for this comparison the costs of the observing and signal building only are used, and the other items entering into the total cost of the field work are not included.

In considering the cost of the work along the Rio Grande arc it should be remembered that it was done during the first year of this country's participation in the World War, when the prices of materials and labor were far above normal. The transportation of materials for this arc was also costly.

STATEMENT OF ADJUSTMENTS.

The precise triangulation considered in this publication starts from the line Donna-Rio of the ninety-eighth meridian arc of precise triangulation and ends on the triangle Chispa-Krouse-Newman of the Texas-California arc of precise triangulation. These lines to which the Rio Grande arc is connected are fixed in length, azimuth, and position by previous adjustments. (See Special Publication Nos. 11 and 54.)

No station adjustments were made, these having become unnecessary since the adoption of the present method of supplying missing observations in broken series.

A single least-square adjustment served for the entire main scheme. The five bases and four Laplace azimuths made necessary the use of six length and five azimuth equations. In addition to these there were 198 angle, 73 side, 1 latitude, and 1 longitude equation, or a total of 284 normal equations used in the adjustment of this arc. This is the largest number of equations in any one adjustment so far solved by this Bureau.

ADJUSTMENT OF LAPLACE AZIMUTHS.

In the adjustment of a precise arc of triangulation the Laplace azimuths are computed, and equations are included in the adjustment to hold these azimuths; but in the past it has not been possible to provide for all of the changes which might occur in the adjustment, and the final azimuths often differed by small amounts from the true azimuth. This difficulty has been eliminated in the adjustment of the work covered by this volume by the following method of adjustment devised by O. S. Adams and C. A. Mourhess, mathematicians.

At each of the Laplace stations it was desired to hold fixed, in the least-squares adjustment, the resulting geodetic azimuth. The following method was found to be most satisfactory:

The geodetic azimuth is given by the Laplace equation

$$A_G = A_A + (\lambda_A - \lambda_G) \sin \phi$$

where A_G is the geodetic azimuth, A_A the astronomic azimuth, λ_G the geodetic longitude, λ_A the astronomic longitude, and ϕ the latitude.

Two things must be noted: First, that the best value for λ_G is not known until after the adjustment is completed; and, second, that A_G, the geodetic azimuth, must be corrected by the amount which the azimuth will change, from changes between the azimuths and back azimuths, due to the change in longitude caused by the least-squares adjustment. The change is represented by $+(\lambda'_G - \lambda_G) \sin \phi$, where λ'_G is the longitude computed for use in the formation of the latitude and longitude equations. Then

$$A_G = A'_G + (\lambda'_G - \lambda_G) \sin \phi = A_A + (\lambda_A - \lambda_G) \sin \phi$$

or

$$A'_G = A_A + (\lambda_A - \lambda'_G) \sin \phi$$

The azimuth A'_G computed by this equation is the true geodetic azimuth minus the correction due to the changes between azimuth

and back azimuth, which, if held in the adjustment, will become, due to the above changes, the true geodetic azimuth as defined by the Laplace equations.

ACCORD OF AZIMUTHS AND POSITIONS.

In the least-squares adjustment of the triangulation the azimuth equations which reconciled the computed and Laplace azimuths were placed near the last of the group of normal equations for each section, so that after the conditions relating to triangle closures and ratios of lengths had been satisfied the discrepancies in azimuth became known. These discrepancies are tabulated below. A plus sign indicates that the azimuth computed through the triangulation is larger than the Laplace azimuth by the amount given.

	″
Laredo	+1.07
Laplace	+0.50
Johnstone	−4.54
Dryden east base	−2.07
Fixed azimuth of Texas-California arc	−3.67

The latitude and longitude equations were as usual placed last in the adjustment. In this way the discrepancy in position at the end of the arc after all other conditions had been satisfied became known. This amounted to 0″.50 in latitude and 0″.25 in longitude, the fixed latitude being larger and the fixed longitude smaller than the corresponding computed values. This discrepancy in position when stated as a distance is about 16.8 meters, or 55 feet.

This arc closes a loop of precise triangulation which extends from the mouth of the Rio Grande north along the ninety-eighth meridian to latitude 32° 30′, thence west and southwest to a point about 150 miles southeast of El Paso, and finally along the present arc to the starting point. The total length of the loop is about 1400 miles.

The discrepancy in position developed when this loop was closed is 1 part in about 53 000 of the distance run if only the Rio Grande arc is considered, or 1 part in 134 000 of the distance if the whole loop is considered.

The length discrepancies developed between the different bases are tabulated on page 70.

HORIZONTAL DIRECTIONS AND ELEVATIONS OF TELESCOPE ABOVE THE STATION MARKS.

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

The horizontal directions were all reduced to sea level. The correction for this reduction expressed in seconds is given by

$$\frac{e^2 h \sin 2\alpha \cos^2 \phi}{2\rho \sin 1''}$$

where $e^2 = \frac{(a^2 - b^2)}{a^2}$, a is the earth's equatorial radius and b is the polar semidiameter, h is the height of station observed, ρ is the radius of

curvature of the earth in a plane normal to the meridian, ϕ is the latitude, and α is the azimuth reckoned from the south to the westward.

In the following table are given the lists of observed and adjusted directions and also the elevations of the telescope of the theodolite above the station mark at each of the stations of the precise triangulation considered in this publication. The elevations enable the reader to judge of the amount of building done and they indicate to the engineer or surveyor who may use the station in the future the probable amount of building required by him. In the table is included a column showing the number assigned to each direction in the figure adjustment.

Following the table of horizontal directions and elevations of telescope above the station marks there is given a list of condition equations used in the adjustment of the precise triangulation considered in this publication.

Abstract of horizontal directions and elevations of telescope above the station marks.

Station occupied and elevation of instrument above station mark.	Number of direction.	Object observed.	Observed direction reduced to sea level.			Final seconds after figure adjustment.
			°	′	″	″
Rio, 19.90 meters	1	Handy	0	00	00.00	00.36
	2	San Juan	29	30	40.21	40.16
	3	Donna	35	51	48.97	48.66
Donna, 15.62 meters	4	Rio	0	00	00.00	59.38
	5	Handy	81	12	13.36	14.00
	6	San Juan	161	03	59.76	59.75
San Juan, 15.53 meters	12	Donna	0	00	00.00	00.44
	13	Rio	12	34	52.57	51.65
	14	Handy	58	48	15.84	15.87
	15	Hickley	138	51	12.03	12.00
	16	McAllen	176	06	50.62	51.10
Handy, 15.43 meters	7	Hickley	0	00	00.00	00.12
	8	McAllen	28	53	46.05	46.88
	9	San Juan	65	00	24.80	24.87
	10	Donna	106	20	24.59	23.85
	11	Rio	169	16	41.54	21.25
McAllen, 15.61 meters	22	San Juan	0	00	00.00	59.79
	23	Handy	26	34	47.74	46.90
	24	Hickley	86	33	03.83	03.81
	25	Mamie	151	20	43.13	43.80
	26	Mission	190	49	56.03	56.43
Hickley, 15.52 meters	19	McAllen	0	00	00.00	59.95
	20	San Juan	56	11	17.18	17.19
	21	Handy	91	07	56.91	56.75
	17	Mamie	288	31	25.97	25.88
	18	Mission	317	13	26.18	26.46
Mamie, 15.59 meters	29	Mission	0	00	00.00	00.11
	30	McAllen	62	48	57.71	57.26
	31	Hickley	106	32	43.60	43.52
	27	Pedro	265	43	04.91	04.97
	28	Palo	305	22	15.55	15.92
Mission, 15.61 meters	32	McAllen	0	00	00.00	59.64
	33	Hickley	32	56	33.85	33.85
	34	Mamie	77	41	50.36	50.15
	35	Pedro	125	28	59.28	59.68
	36	Palo	165	36	40.30	40.46
Palo, 14.08 meters	42	Mission	00	00	00.00	00.00
	43	Mamie	37	27	26.12	25.78
	44	Pedro	84	30	45.52	45.55
	45	Fordyce	145	58	17.05	17.42
	46	Eltoro	184	08	10.57	10.52

Abstract of horizontal directions and elevations of telescope above the station marks—Con.

Station occupied and elevation of instrument above station mark.	Number of direction.	Object observed.	Observed direction reduced to sea level.			Final seconds after figure adjustment.
			°	′	″	″
Pedro, 11.05 meters	37	Fordyce	0	00	00.00	00.51
	38	Eltoro	26	37	19.81	19.75
	39	Palo	70	32	18.04	18.96
	40	Mission	125	53	53.33	52.92
	41	Mamie	163	49	48.56	48.50
Fordyce, 15.66 meters	47	Garcia	0	00	00.00	00.08
	48	Pancho	33	42	51.34	51.81
	49	Eltoro	76	47	59.67	60.00
	50	Palo	140	50	53.52	53.09
	51	Pedro	188	51	03.46	03.03
Eltoro, 15.62 meters	52	Palo	0	00	00.00	00.27
	53	Pedro	36	27	36.43	36.36
	54	Fordyce	77	47	14.58	14.29
	55	Garcia	149	39	01.51	01.71
	56	Pancho	194	18	20.42	20.30
Garcia, 15.70 meters	57	Monument	0	00	00.00	00.52
	58	Corpus	51	15	33.50	33.53
	59	Pancho	89	53	49.28	49.10
	60	Eltoro	160	46	14.32	14.38
	61	Fordyce	192	06	27.73	27.31
Pancho, 11.10 meters	62	Eltoro	0	00	59.99	00.40
	63	Fordyce	20	23	46.78	46.46
	64	Garcia	64	28	16.61	16.91
	65	Monument	92	56	19.83	19.80
	66	Corpus	142	14	59.22	58.86
Monument, 1.28 meters	67	Ringgold	0	00	00.00	59.66
	68	Grande	25	00	27.23	27.86
	69	Hebron	31	47	59.55	59.97
	70	Corpus	80	32	48.42	48.59
	71	Pancho	118	19	55.00	54.56
	72	Garcia	179	58	03.72	03.26
Corpus, 11.82 meters	73	Pancho	0	00	00.00	00.67
	74	Garcia	63	35	03.71	03.36
	75	Monument	92	54	15.91	15.85
	76	Grande	139	12	15.04	15.28
	77	Hebron	186	42	58.48	58.03
Grande, 1.38 meters	81	Ringgold	0	00	00.00	00.09
	78	Hebron	03	08	11.31	11.48
	79	Corpus	152	41	08.92	08.87
	80	Monument	230	50	49.05	48.83
Hebron, 2.32 meters	87	Corpus	0	00	00.00	00.60
	88	Monument	37	26	30.55	30.07
	89	Grande	42	56	20.48	20.64
	90	Ringgold	90	19	02.33	02.00
	91	Gorgoro	161	52	16.28	16.38
	92	Garcena	173	35	47.89	47.84
Ringgold, 10.99 meters	82	Gorgoro	0	00	59.99	59.82
	83	Garcena	41	19	43.98	44.33
	84	Hebron	70	44	38.43	38.46
	85	Grande	140	13	45.66	45.85
	86	Monument	166	04	06.89	06.49
Garcena, 1.48 meters	98	Hebron	0	00	00.00	00.04
	99	Ringgold	67	18	20.19	20.16
	100	Gorgoro	162	14	05.66	04.90
	101	Roma	195	02	15.57	15.54
	102	Chinges	200	57	29.11	29.89
Gorgoro, 1.88 meters	93	Roma	0	00	59.99	59.51
	94	Chinges	49	29	05.11	04.82
	95	Garcena	89	53	19.82	20.58
	96	Hebron	95	55	43.91	44.29
	97	Ringgold	133	37	51.89	51.53

Abstract of horizontal directions and elevations of telescope above the station marks—Con.

Station occupied and elevation of instrument above station mark.	Number of direction.	Object observed.	Observed direction reduced to sea level.			Final seconds after figure adjustment.
			°	′	″	″
Roma, 2.47 meters	105	Margo	0	00	00.00	59 85
	106	Banchez	43	59	48.36	47 92
	107	Chinges	51	17	44.72	44 68
	108	Garcena	100	22	09.65	09 79
	109	Gorgoro	157	40	37.83	38 20
	103	Labra	317	19	23.81	23 26
	104	Burros	349	53	01.66	02.30
Chinges, 4.30 meters	110	Garcena	0	00	00.00	59 45
	111	Gorgoro	40	52	18.71	18.88
	112	Roma	65	00	20.20	20.19
	113	Margo	125	15	24.52	24.75
	114	Banchez	179	40	15.28	15.44
Banchez, 3.67 meters	115	Chinges	0	00	00.00	59.85
	116	Roma	58	02	07.57	07.88
	117	Margo	116	23	06.40	06.24
Margo, 1.39 meters	118	Banchez	0	00	59.99	00 24
	119	Chinges	9	12	03.29	03 19
	120	Roma	77	30	14.05	14 00
	121	Labra	177	44	58.92	59 25
	122	Burros	236	03	11.91	11.48
Labra, 2.98 meters	123	Roleta	0	00	59 99	00 55
	124	Flores	61	22	02 23	01 39
	125	Burros	72	11	34 25	34.70
	126	Margo	120	58	50 01	50.02
	127	Roma	158	13	28.21	28.44
Burros, 3.68 meters	128	Margo	0	00	59 99	00 24
	129	Roma	11	29	05.35	05 29
	130	Labra	72	53	32.40	32 89
	131	Flores	153	47	39 92	39 45
	132	Roleta	154	26	54.28	54.23
	133	Presa	218	00	18.69	18.53
Flores, 3.74 meters	135	Presa	0	00	00.01	59 07
	136	Burros	105	09	52.68	53.04
	137	Labra	193	26	13.18	13.21
	134	Roleta	285	52	52.50	53.04
Presa, 3.57 meters	138	Burros	0	00	00.01	01.30
	139	Flores	10	37	28.51	28.29
	140	Roleta	89	15	05.87	06.49
	141	Ale	96	37	54.06	53.94
	142	Evanito	119	09	24.17	23.20
Roleta, 4.83 meters	145	Evanito	0	00	00.01	00.14
	146	Ale	22	06	57.45	57.34
	147	Presa	74	46	42.97	43.43
	148	Burros	101	58	14.30	14.38
	140	Flores	102	02	00.71	59.60
	150	Labra	128	13	19.31	19.38
	143	Rafael	297	41	40.00	39.79
	144	Humaran	338	20	56.17	56.87
Ale, 1.25 meters	153	Evanito	0	00	00.01	59.70
	151	Presa	90	33	24.77	25.09
	152	Roleta	210	30	51.67	51.65
Evanito, 1.37 meters	154	Presa	0	00	59.99	00.72
	155	Ale	66	55	06.57	06.37
	156	Roleta	75	19	01.43	01.15
	157	Rafael	138	00	45.23	45.47
	158	Humaran	203	30	37.96	37.25
Zapata, 1.34 meters	172	Humaran	0	00	00.00	00.85
	173	Rafael	43	48	05.45	05.56
	169	Feora	245	56	44.47	44.15
	170	Urebano	248	14	37.19	37.27
	171	Moleno	291	50	55.15	54.48

Abstract of horizontal directions and elevations of telescope above the station marks—Con.

Station occupied and elevation of instrument above station mark.	Number of direction.	Object observed.	Observed direction reduced to sea level.			Final seconds after figure adjustment.
			°	′	″	″
Moleno. 4.17 meters	174	Humaran	0	00	59.99	59.57
	175	Rafael	45	32	13.39	13.80
	176	Zapata	75	53	58.70	58.77
	177	Urebeno	150	41	04.52	05.01
	178	Feora	168	13	38.04	38.10
	179	Loma	226	49	31.12	31.10
Rafael, 2.36 meters	159	Zapata	0	00	59.99	59.90
	160	Moleno	37	41	03.81	03.93
	161	Humaran	107	43	36.59	36.02
	162	Evanito	148	26	59.11	59.25
	163	Roleta	203	26	54.40	54.80
Humaran, 3.67 meters	164	Evanito	0	00	59.99	00.24
	165	Roleta	30	09	20.95	21.00
	166	Rafael	73	46	45.20	45.39
	167	Zapata	102	15	04.83	04.72
	168	Moleno	138	11	59.73	59.36
Urebeno, 1.34 meters	180	Feora	0	00	59.99	59.98
	181	Loma	81	00	44.88	44.37
	182	Moleno	126	54	05.60	05.36
	183	Zapata	188	30	41.23	42.09
Feora, 3.07 meters	184	Ygnacio	0	00	59.99	58.81
	185	Union	33	26	21.48	21.90
	186	Loma	85	58	23.98	24.09
	187	Moleno	123	42	51.10	51.32
	188	Urebeno	159	16	12.48	12.89
	189	Zapata	165	29	01.87	01.89
Loma, 4.89 meters	190	Moleno	0	00	59.99	59.71
	191	Urebeno	57	58	12.24	12.71
	192	Feora	83	39	30.78	30.58
	193	Ygnacio	137	52	05.95	05.87
	194	Union	189	16	32.12	32.21
Ygnacio, 4.30 meters	195	Dolores	0	00	59.99	59.25
	196	Dan	37	04	03.07	03.13
	197	Union	53	58	22.06	21.98
	198	Loma	136	11	53.48	54.35
	199	Feora	176	01	03.07	02.96
Union, 4.25 meters	200	Loma	0	00	00.00	00.99
	201	Feora	21	51	06.24	06.46
	202	Ygnacio	46	22	03.12	02.65
	203	Dolores	142	22	23.15	22.59
	204	Dan	161	46	10.58	10.39
Dan, 2.50 meters	210	Union	0	00	59.99	00.57
	211	Ygnacio	47	41	34.27	34.12
	212	Dolores	154	37	00.60	06.46
	213	Fort	182	40	34.34	34.26
	214	George	204	11	24.38	24.18
Dolores, 3.59 meters	205	Fort	0	00	00.00	59.75
	206	George	53	17	55.77	55.56
	207	Dan	128	13	58.99	59.74
	208	Union	134	13	05.77	06.13
	209	Ygnacio	164	14	24.77	24.11
George, 6.70 meters	215	Dan	0	00	00.00	00.70
	216	Dolores	55	20	39.30	39.36
	217	Fort	132	01	33.09	33.08
	218	Taylor	163	44	08.62	08.17
	219	Casbeer	171	26	16.73	16.43
Fort 3.60 meters	223	Taylor	0	00	00.02	00.51
	224	Casbeer	13	14	40.64	40.81
	225	George	93	58	25.63	25.84
	226	Dan	120	26	03.52	04.07
	227	Dolores	144	08	37.16	36.86
	220	Laredo	276	24	48.69	48.87
	221	Knob	286	23	48.90	48.36
	222	Orvil	306	34	41.35	40.58

Abstract of horizontal directions and elevations of telescope above the station marks—Con.

Station occupied and elevation of instrument above station mark.	Number of direction.	Object observed.	Observed direction reduced to sea level.			Final seconds after figure adjustment.
			°	′	″	″
Taylor, 3.62 meters	231	Casbeer	0	00	59.99	00.40
	232	George	57	33	19.24	19.26
	233	Fort	111	52	19.23	19.22
	234	Laredo	159	59	06.15	05.42
	235	Knob	190	10	56.97	57.59
	236	Orvil	211	55	07.15	06.86
Casbeer, 3.70 meters	228	George	0	00	00.00	00.91
	229	Fort	59	51	33.57	32.96
	230	Taylor	114	44	34.20	33.90
Laredo, 4.29 meters	238	Orvil	0	00	00.00	59.45
	239	Taylor	81	04	01.50	01.64
	240	Fort	129	22	03.79	04.04
	237	Knob	328	17	49.31	49.45
Knob, 4.53 meters	242	Davis	0	00	00.01	00.58
	243	Orvil	46	13	28.70	28.10
	244	Taylor	107	18	45.19	45.49
	245	Fort	135	23	55.00	55.46
	246	Laredo	144	20	41.80	41.47
	241	Fieldings	330	35	23.19	22.81
Orvil, 4.79 meters	247	Taylor	0	00	59.98	00.30
	248	Fort	26	31	53.44	53.17
	249	Laredo	46	59	58.28	57.14
	250	Knob	97	10	33.75	33.98
	251	Fieldings	155	04	54.69	55.63
	252	Davis	209	32	52.39	52.30
Fieldings, 3.77 meters	253	Tordillo	0	00	59.99	00.05
	254	Coleman	8	15	18.86	19.20
	255	Davis	93	39	17.00	16.88
	256	Orvil	177	02	52.97	52.38
	257	Knob	223	30	25.29	25.60
Davis, 4.83 meters	261	Tordillo	0	00	59.99	00.29
	262	Coleman	12	48	16.44	16.00
	263	Thomas	45	59	26.02	27.16
	264	Tajone	109	34	42.82	42.20
	258	Orvil	276	12	14.85	14.34
	259	Knob	297	36	28.60	28.76
	260	Fieldings	318	20	42.54	42.48
Tordillo, 1.40 meters	265	Coleman	0	00	59.99	00.42
	266	Davis	104	30	42.30	42.32
	267	Fieldings	149	12	08.40	08.03
Coleman, 1.43 meters	268	Thomas	0	00	59.99	00.57
	269	Tajone	88	43	11.95	12.34
	270	Davis	105	31	52.70	51.72
	271	Fieldings	145	40	20.48	20.99
	272	Tordillo	168	12	54.81	54.29
Tajone, 3.71 meters	273	Davis	0	00	00.00	00.34
	274	Coleman	60	24	54.52	55.04
	275	Thomas	104	19	36.89	36.15
	276	Willie	113	41	46.30	46.59
	277	Brewster	147	41	37.62	37.19
Thomas, 3.43 meters	278	Willie	0	00	00.00	00.06
	279	Brewster	46	08	19.73	19.44
	280	Tajone	113	14	55.52	55.74
	281	Davis	125	20	04.76	05.26
	282	Coleman	166	37	04.16	03.67
Willie, 1.38 meters	288	Cup	0	00	59.99	00.55
	289	Galvan	44	24	18.45	18.46
	290	Brewster	64	33	53.80	53.53
	291	Tajone	127	56	53.74	53.18
	292	Thomas	185	19	47.10	47.35
Brewster, 1.37 meters	283	Tajone	0	00	59.99	59.85
	284	Thomas	69	31	24.11	23.61
	285	Willie	82	37	10.40	10.58
	286	Cup	136	05	43.30	43.81
	287	Galvan	206	08	37.80	37.76

Abstract of horizontal directions and elevations of telescope above the station marks—Con.

Station occupied and elevation of instrument above station mark.	Number of direction.	Object observed.	Observed direction reduced to sea level.	Final seconds after figure adjustment.
			° ′ ″	″
Galvan, 3.59 meters	298	Brewster	0 00 00.00	59.45
	299	Willie	36 18 56.93	57.50
	300	Cup	70 23 36.69	36.92
	301	Twin	91 01 42.99	42.93
	302	Cat	142 11 46.01	45.82
Cup, 1.36 meters	293	Twin	0 00 59.98	00.22
	294	Cat	45 31 46.73	46.41
	295	Galvan	126 58 21.55	21.72
	296	Brewster	160 31 50.56	50.65
	297	Willie	222 29 24.94	24.95
Twin, 1.32 meters	303	Big	0 00 59.98	59.97
	304	Tom	5 35 20.02	21.04
	305	Cat	44 16 21.69	21.25
	306	Galvan	128 38 33.21	33.01
	307	Cup	167 02 05.49	05.70
Cat, 1.39 meters	310	Twin	0 00 00.00	00.04
	311	Big	43 26 18.60	18.51
	312	Tom	48 50 55.97	50.80
	313	Dentonio	95 17 00.18	00.36
	314	Carlow	123 28 29.34	29.25
	308	Galvan	315 32 14.69	13.58
	309	Cup	348 17 30.13	30.38
Big, 5.83 meters	315	Tom	0 00 59.99	59.93
	316	Cat	37 52 59.50	59.40
	317	Twin	130 10 20.08	20.25
Tom, 5.99 meters	320	Dentonio	0 00 59.99	59.97
	321	Carlow	1 23 09.24	08.64
	322	Cat	60 00 17.34	17.08
	323	Twin	152 28 20.02	20.70
	324	Big	196 42 39 27	39.37
	318	Barr	316 35 35.17	35.88
	319	English	342 58 02.89	02.28
Barr, 6.51 meters	343	Indio	0 00 59.99	59.59
	344	Farland	13 40 00.41	59.50
	345	Glass	39 02 22.29	22.65
	346	English	89 01 38.82	39.16
	347	Carlow	120 55 30.35	30.32
	348	Tom	199 44 38.59	39.22
English, 4.71 meters	349	Carlow	0 00 59.99	59.27
	350	Tom	55 27 32.62	33.33
	351	Barr	98 22 07.92	07.25
	352	Indio	159 53 54.15	54.58
	353	Farland	179 03 51.24	51.85
	354	Glass	201 26 45.85	45.50
Dentonio, 4.94 meters	341	Cat	0 00 00.00	59.81
	342	Tom	73 33 39.32	39.46
	343	Carlow	256 47 15.29	15.33
Carlow, 3.58 meters	327	Dentonio	0 00 00.00	00.05
	328	Barr	54 32 50.98	51.69
	329	English	104 16 52.70	52.73
	325	Cat	311 24 14.14	13.18
	326	Tom	358 09 32.71	32.84
Indio, 3.55 meters	355	Farland	0 00 59.98	00.18
	356	Glass	49 52 47.70	47.87
	357	English	105 27 08.85	08.63
	358	Barr	134 53 42.29	42.20
Glass, 4.51 meters	359	English	0 00 59.98	00.19
	360	Barr	26 56 05.40	05.86
	361	Indio	82 52 49.04	49.10
	302	Farland	119 26 35.35	35.06
	363	Mack	130 32 39.93	39.25
	364	Kennedy	204 21 09.97	10.24

Abstract of horizontal directions and elevations of telescope above the station marks—Con.

Station occupied and elevation of instrument above station mark.	Number of direction.	Object observed.	Observed direction reduced to sea level.			Final seconds after figure adjustment.
			°	′	″	″
Farland, 4.20 meters	365	Mack	0	00	59.98	00.05
	366	Kennedy	34	35	13.30	12.49
	367	Glass	82	56	39.96	40.47
	368	English	121	07	11.84	12.35
	369	Barr	145	04	48.59	48.70
	370	Indio	176	30	07.45	07.04
Mack, 1.45 meters	371	Silo	0	00	59.98	59.05
	372	Davidson	33	54	27.20	28.24
	373	Kennedy	55	18	12.60	12.31
	374	Glass	109	35	01.53	01.80
	375	Farland	195	32	17.25	17.24
Kennedy, 3.58 meters	376	Glass	0	00	59.98	00.20
	377	Farland	46	43	57.56	57.33
	378	Mack	51	54	39.82	40.00
	379	Silo	126	22	30.68	30.85
	380	Davidson	185	12	21.20	20.87
Silo, 3.59 meters	381	Laplace	0	00	59.98	00.26
	382	Pass	8	27	14.37	14.52
	383	Eagle	11	24	43.84	42.79
	384	Davidson	77	32	07.94	07.78
	385	Kennedy	126	50	09.98	10.75
	386	Mack	177	04	02.05	07.07
Davidson, 4.83 meters	387	Kennedy	0	00	59.98	59.73
	388	Mack	25	18	33.96	35.05
	389	Silo	71	52	07.44	07.07
	390	Pass	146	02	12.17	12.32
	391	Eagle	150	26	55.22	54.29
	392	Lone	173	50	25.40	25.70
Pass, 3.73 meters	402	Lone	0	00	00.02	00.55
	398	Davidson	66	39	09.87	09.86
	399	Silo	103	24	11.42	11.93
	400	Laplace	217	53	21.19	21.23
	401	Eagle	328	50	02.72	01.64
Eagle, 3.59 meters	403	Nine	0	00	59.98	59.20
	404	Paloma	47	37	03.94	04.30
	405	Lone	87	32	30.08	29.75
	406	Davidson	152	47	54.14	54.89
	407	Silo	188	05	43.75	43.28
	408	Pass	230	34	03.80	04.77
	409	Laplace	280	12	29.40	28.91
Lone, 4.91 meters	393	Davidson	0	00	59.98	00.05
	394	Pass	85	32	36.74	37.76
	395	Eagle	91	21	05.15	03.85
	396	Nine	151	20	31.74	31.84
	397	Paloma	210	26	56.76	56.89
Laplace, 1.36 meters	411	Eagle	0	00	00.02	59.92
	412	Pass	19	24	54.98	55.39
	413	Silo	76	28	31.56	31.99
	410	Nine	279	25	14.42	13.69
Nine, 5.61 meters	419	Wilip	0	00	59.98	01.87
	420	Burr	42	54	57.80	56.67
	421	Paloma	75	37	52.81	53.23
	422	Lone	134	10	57.97	58.79
	423	Eagle	166	39	00.99	00.50
	424	Laplace	186	16	45.65	44.11
Paloma, 4.78 meters	414	Lone	0	00	00.00	59.60
	415	Eagle	20	58	41.50	41.35
	416	Nine	62	20	28.68	29.43
	417	Burr	84	54	21.17	20.69
	418	Pen	128	45	26.05	26.33
Burr, 6.41 meters	425	Wilip	0	00	59.98	00.59
	426	Pen	48	53	32.50	32.16
	427	Paloma	122	47	22.92	22.44
	428	Nine	247	30	34.53	34.75

Abstract of horizontal directions and elevations of telescope above the station marks—Con.

Station occupied and elevation of instrument above station mark.	Number of direction.	Object observed.	Observed direction reduced to sea level.			Final seconds after figure adjustment.
			°	′	″	″
Pen, 6.60 meters	429	Paloma	0	00	59.98	00.02
	430	Burr	02	15	04.32	04.26
	431	Wiffp	150	59	59.72	59.72
	432	Lake	204	07	02.12	01.87
	433	White	211	00	32.93	33.18
Wiffp, 4.95 meters	434	Towne	0	00	59.98	00.08
	435	Jamerson	23	53	13.89	14.03
	436	Lake	54	58	59.72	60.01
	437	White	60	36	56.76	57.27
	438	Pen	110	12	33.72	33.57
	439	Burr	158	34	08.08	06.69
	440	Nine	183	00	46.61	46.21
Lake, 7.60 meters	446	White	0	00	00.00	00.07
	447	Pen	03	53	45.67	46.24
	448	Wiffp	129	33	11.29	10.66
White, 6.42 meters	441	Pen	0	00	59.98	00.06
	442	Wiffp	64	23	50.00	50.43
	443	Lake	109	12	42.71	42.60
	444	Towne	144	28	37.39	37.24
	445	Jamerson	186	14	44.42	44.76
Jamerson, 6.42 meters	449	White	0	00	00.02	00.47
	450	Wiffp	21	25	25.00	24.01
	451	Towne	56	17	27.15	26.88
	452	Dixie	127	05	02.18	02.78
	453	Peters	171	12	25.53	25.80
Towne, 6.43 meters	454	Dixie	0	00	59.98	00.36
	455	Peters	40	40	28.51	28.85
	456	Jamerson	73	01	37.93	37.77
	457	White	154	58	03.68	04.07
	458	Wiffp	194	16	21.20	20.27
Dixie, 6.15 meters	459	Ross	0	00	00.00	59.96
	460	Brackett	46	21	33.69	34.11
	461	Peters	64	59	21.08	21.73
	462	Jamerson	102	07	42.69	42.82
	463	Towne	138	18	30.95	29.79
Peters, 6.19 meters	464	Jamerson	0	00	59.98	59.72
	465	Towne	32	43	51.89	52.05
	466	Dixie	98	44	10.08	15.82
	467	Dobkins	102	08	57.07	50.48
	468	Ross	178	31	28.77	30.35
	469	Brackett	253	55	01.36	01.31
Rose, 6.23 meters	475	Dobkins	0	00	59.98	00.43
	476	Hamilton	62	52	53.55	53.92
	477	Brackett	140	35	04.51	04.72
	478	Peters	214	32	41.84	41.22
	479	Dixie	249	46	05.70	05.29
Brackett, 1.37 meters	470	Peters	0	00	00.03	59.78
	471	Dixie	6	38	27.11	26.97
	472	Ross	30	38	52.77	53.40
	473	Dobkins	43	06	53.09	52.97
	474	Hamilton	81	08	43.10	42.99
Johnstone, 4.02 meters	494	Dobkins	0	00	00.03	59.80
	495	Hamilton	154	00	46.92	47.15
Dobkins, 3.93 meters	485	Kelly	0	00	59.97	00.70
	486	Moore	38	31	58.01	57.90
	480	Hamilton	68	44	59.19	59.02
	481	Johnstone	90	06	34.42	34.65
	482	Brackett	129	54	50.47	55.35
	483	Ross	156	51	51.65	52.14
	484	Peters	175	01	59.56	59.36

Abstract of horizontal directions and elevations of telescope above the station marks—Con.

Station occupied and elevation of instrument above station mark.	Number of direction.	Object observed.	Observed direction reduced to sea level.			Final seconds after figure adjustment.
			°	′	″	″
Hamilton, 1.42 meters	487	Brackett	0	00	59.96	00.27
	488	Ross	51	48	02.55	01.93
	489	Johnstone	76	10	40.23	39.08
	490	Dobkins	80	48	16.09	16.21
	491	Moore	118	40	42.24	42.48
	492	Kelly	116	33	54.22	54.54
	493	Mark	199	59	05.45	06.23
Moore, 1.42 meters	496	Dobkins	0	00	00.00	00.06
	497	Kelly	70	03	05.87	05.81
	498	Mark	182	32	50.00	50.15
	499	Hamilton	243	05	27.03	26.89
Kelly, 6.25 meters	500	Feely	0	00	59.97	00.43
	501	McNutt	29	29	58.48	58.86
	502	Mark	82	53	59.69	59.57
	503	Hamilton	128	58	47.08	46.78
	504	Moore	133	03	13.56	13.69
	505	Dobkins	204	28	11.66	11.11
Mark, 1.38 meters	506	Hamilton	0	00	59.97	59.11
	507	Moore	33	08	59.61	59.45
	508	Kelly	50	30	01.50	01.61
	509	Feely	90	43	53.03	52.73
	510	McNutt	130	17	59.70	60.83
	511	Jim	131	59	55.48	55.40
	512	Harrison	205	49	46.70	46.85
Feely, 1.41 meters	513	McNutt	0	00	59.99	00.33
	514	Mark	64	24	22.95	22.68
	515	Kelly	121	16	34.40	34.34
Harrison, 1.47 meters	528	Mark	0	00	59.99	59.43
	529	McNutt	57	29	23.64	24.06
	530	Jim	57	41	39.87	40.13
	531	Blue	106	01	02.31	02.17
Ike, 1.33 meters	554	Babb	0	00	59.97	59.67
	555	Tippetts	40	20	43.04	43.70
	556	Proctor	100	09	31.14	30.75
	557	Bassett	192	40	13.23	13.26
Babb, 1.40 meters	537	Blue	0	00	00.01	59.32
	538	McNutt	42	40	56.26	56.34
	539	Tippetts	71	06	26.14	26.05
	540	Proctor	134	45	38.22	38.90
	541	Ike	204	52	54.78	55.10
	542	Bassett	214	25	21.62	21.34
Blue, 1.40 meters	536	Babb	0	00	00.01	00.04
	532	Harrison	195	59	14.02	13.44
	533	Jim	248	59	07.44	07.98
	534	McNutt	250	51	46.66	46.33
	535	Tippetts	312	34	25.29	25.65
Jim, 1.46 meters	524	Blue	0	00	59.95	59.22
	525	Harrison	78	40	45.79	46.09
	526	Mark	127	09	16.61	16.42
	527	McNutt	252	10	45.08	45.70
Hoddy, 1.35 meters	563	Bassett	0	00	59.98	00.13
	564	Proctor	56	05	16.89	16.63
	565	Peggy	126	44	59.34	59.59
	566	Eldridge	150	44	49.74	49.62
	567	Hen	171	32	23.16	23.13
Bassett, 1.37 meters	558	Babb	0	00	59.96	59.90
	559	Ike	3	07	47.24	47.27
	560	Proctor	62	36	50.95	51.22
	561	Peggy	125	25	47.09	47.24
	562	Hoddy	166	11	44.17	43.76

Abstract of horizontal directions and elevations of telescope above the station marks—Con.

Station occupied and elevation of instrument above station mark.	Number of direction.	Object observed.	Observed direction reduced to sea level.			Final seconds after figure adjustment.
			°	′	″	″
Proctor, 1.31 meters	548	Peggy	0	00	59.98	00.08
	549	Hoddy	57	45	42.21	42.82
	550	Bassett	78	05	34.04	34.27
	551	Ike	106	05	47.88	48.29
	552	Babb	115	49	02.06	01.17
	553	Tippetts	177	42	21.27	21.40
Tippetts, 1.42 meters	546	Blue	0	00	00.05	00.08
	547	McNutt	72	34	51.25	51.33
	543	Proctor	244	04	31.34	32.04
	544	Ike	292	39	13.51	12.86
	545	Babb	298	31	60.08	59.91
Eldridge, 1.33 meters	580	Road	0	00	00.01	00.57
	581	Sanderson	57	39	48.51	49.49
	582	Dryden west base	95	41	23.55	23.16
	583	Hen	117	44	29.25	28.50
	584	Dryden east base	154	39	18.84	18.11
	585	Hoddy	170	00	30.30	30.12
	586	Peggy	217	03	47.71	48.21
Hen, 1.39 meters	573	Hoddy	0	00	59.99	59.74
	574	Peggy	63	01	41.65	41.95
	575	Dryden east base	73	33	58.76	57.78
	576	Eldridge	106	56	25.55	25.55
	577	Dryden west base	119	29	46.95	46.79
	578	Road	137	56	50.91	51.32
	579	Sanderson	199	08	08.30	08.96
Dryden east base, 6.42 meters	587	Eldridge	0	00	00.05	00.34
	588	Dryden west base	40	16	46.93	47.61
	589	Hen	109	42	44.08	43.11
Peggy, 1.35 meters	568	Eldridge	0	00	59.95	00.18
	569	Hen	36	45	58.14	57.38
	570	Hoddy	108	56	53.54	53.07
	571	Bassett	121	25	57.34	57.60
	572	Proctor	160	31	28.30	29.04
Dry 1.51 meters	610	Brown	0	00	00.01	00.22
	611	Pyle	115	23	26.48	26.27
	612	Sanderson	175	45	49.02	49.74
	613	Road	204	57	43.52	42.80
Sanderson, 1.33 meters	593	Hen	0	00	59.96	00.17
	594	Eldridge	27	43	39.46	38.57
	595	Road	55	00	18.58	18.39
	596	New	118	47	06.08	06.20
	597	Dry	150	01	31.97	31.94
	598	Brown	151	18	10.83	10.04
	599	Pyle	186	15	04.25	05.83
Road, 1.36 meters	605	Eldridge	0	00	00.01	58.94
	600	Brown	202	38	16.63	16.75
	601	New	204	42	08.14	08.58
	602	Dry	209	09	30.73	31.03
	603	Sanderson	265	05	26.82	26.89
	604	Hen	328	44	52.11	52.25
Dryden west base, 2.50 meters	590	Hen	0	00	00.05	59.80
	591	Dryden east base	64	38	16.07	15.42
	592	Eldridge	145	23	32.37	33.28
Madera, 1.38 meters	625	Pyle	0	00	59.89	00.32
	626	Nation	55	14	48.26	47.61
	627	Chancellor	165	32	11.03	11.26
Nation, 1.36 meters	630	Pyle	0	00	59.97	59.24
	631	Brown	79	22	00.39	00.14
	632	Ord	153	15	27.50	28.23
	628	Chancellor	241	41	07.55	07.28
	629	Madera	274	36	16.67	17.19

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Station occupied and elevation of instrument above station mark.	Number of direction.	Object observed.	Observed direction reduced to sea level.			Final seconds after figure adjustment.
			°	′	″	″
Pyle, 1.46 meters	621	Dry	0	00	00.08	00.28
	622	Brown	26	34	08.03	07.42
	623	Nation	75	43	59.26	60.07
	624	Madera	115	05	31.99	32.29
	620	Sanderson	276	35	56.15	55.46
Brown 1.34 meters	616	Pyle	0	00	00.11	00.93
	617	Sanderson	35	04	55.62	56.20
	618	Dry	38	02	28.63	28.72
	619	Road	56	28	59.56	57.94
	614	Ord	230	56	45.10	45.22
	615	Nation	308	31	52.55	52.55
Star, 1.22 meters	648	Chancellor	0	00	59.97	00.59
	649	Ord	57	47	21.74	20.08
	650	Baldy	148	46	05.31	05.88
	651	Newman	214	55	42.44	42.31
Beard, 1.21 meters	644	Chancellor	0	00	59.94	00.94
	645	Ord	69	33	46.88	46.86
	646	Baldy	141	19	27.37	26.58
	647	Newman	180	05	12.41	12.22
Ord, 1. 34 meters	638	Baldy	0	00	59.80	00.00
	639	Star	30	58	18.26	18.01
	640	Beard	54	43	03.46	04.20
	641	Chancellor	94	35	37.92	37.40
	642	Nation	126	25	58.52	57.95
	643	Brown	154	56	26.47	26.20
Chancellor, 1.49 meters	633	Madera	0	00	59.90	00.03
	634	Nation	36	47	27.34	27.50
	635	Ord	96	31	32.57	32.76
	636	Star	155	07	03.13	03.51
	637	Beard	167	05	21.36	20.51
McNutt, 5.11 meters	519	Jim	0	00	00.05	59.43
	520	Harrison	6	17	44.07	43.76
	521	Mark	53	16	36.08	35.07
	522	Kelly	100	04	38.69	38.46
	523	Feely	129	18	07.22	07.30
	516	Tippetts	243	59	18.74	19.54
	517	Babb	261	30	59.23	59.71
	518	Blue	289	41	50.93	51.19
New, 1.46 meters	608	Brown	0	00	59.93	00.01
	609	Dry	12	51	05.72	05.93
	606	Sanderson	127	26	19.19	19.02
	607	Road	183	25	14.39	14.27
Chispa, 1.36 meters	.....	Krouse	0	00	00.12	59.66
	664	Newman	38	33	01.75	01.96
	665	Baldy	78	26	52.77	52.90
Krouse, 1.37 meters	.....	Chispa	0	00	00.11	00.18
	662	Newman	271	52	12.42	11.84
	663	Baldy	307	21	02.86	02.63
Newman, 1.36 meters	.....	Krouse	0	00	59.87	59.08
	652	Beard	166	21	45.67	46.98
	653	Star	189	14	04.07	04.06
	654	Baldy	240	32	06.57	06.24
	655	Chispa	306	40	45.00	44.42
Baldy, 1 25 meters	659	Star	0	00	00.11	00.08
	660	Beard	4	31	36.68	36.36
	661	Ord	58	03	02.51	02.84
	656	Chispa	223	29	59.15	58.69
	657	Krouse	272	24	14.54	14.94
	658	Newman	306	27	34.91	35.31

CONDITION EQUATIONS.

No.

1. $0 = -1.04 - (1) + (3) - (4) + (5) - (10) + (11)$.
2. $0 = -0.18 - (1) + (2) - (9) + (11) - (13) + (14)$.
3. $0 = +1.87 - (5) + (6) - (9) + (10) - (12) + (14)$.
4. $0 = +0.28 - (7) + (9) - (14) + (15) - (20) + (21)$.
5. $0 = -1.42 - (7) + (8) - (19) + (21) - (23) + (24)$.

6. $0 = -0.76 - (15) + (18) - (19) + (20) - (22) + (24)$.
7. $0 = -1.10 - (17) + (19) - (24) + (25) - (30) + (31)$.
8. $0 = -0.45 - (18) + (19) - (24) + (26) - (32) + (33)$.
9. $0 = +0.68 - (25) + (26) - (29) + (30) - (32) + (34)$.
10. $0 = -1.01 - (27) + (29) - (34) + (35) - (40) + (41)$.

11. $0 = +0.23 - (28) + (29) - (34) + (36) - (42) + (43)$.
12. $0 = +0.04 - (35) + (36) - (39) + (40) - (42) + (44)$.
13. $0 = +0.15 - (37) + (39) - (44) + (45) - (50) + (51)$.
14. $0 = +0.34 - (38) + (39) - (44) + (46) - (52) + (53)$.
15. $0 = +1.74 - (45) + (46) - (49) + (50) - (52) + (54)$.

16. $0 = -0.26 - (47) + (49) - (54) + (55) - (60) + (61)$.
17. $0 = +0.70 - (48) + (49) - (54) + (56) - (62) + (63)$.
18. $0 = +0.19 - (55) + (56) - (59) + (60) - (62) + (64)$.
19. $0 = +1.89 - (58) + (59) - (64) + (66) - (73) + (74)$.
20. $0 = +0.85 - (57) + (58) - (70) + (72) - (74) + (75)$.

21. $0 = +1.69 - (65) + (66) - (70) + (71) - (73) + (75)$.
22. $0 = +1.70 - (69) + (70) - (75) + (77) - (87) + (88)$.
23. $0 = +0.31 - (68) + (70) - (75) + (76) - (79) + (80)$.
24. $0 = +1.35 - (76) + (77) - (78) + (79) - (87) + (89)$.
25. $0 = -0.48 - (67) + (69) - (84) + (86) - (88) + (90)$.

26. $0 = +0.25 + (78) - (81) - (84) + (85) - (89) + (90)$.
27. $0 = +0.11 - (83) + (84) - (90) + (92) - (98) + (99)$.
28. $0 = +0.11 - (82) + (84) - (90) + (91) - (96) + (97)$.
29. $0 = +1.33 - (82) + (83) - (95) + (97) - (99) + (100)$.
30. $0 = -3.31 - (94) + (95) - (100) + (102) - (110) + (111)$.

31. $0 = -2.20 - (93) + (95) - (100) + (101) - (108) + (109)$.
32. $0 = -1.53 - (101) + (102) - (107) + (108) - (110) + (112)$.
33. $0 = -0.40 - (105) + (107) - (112) + (113) - (119) + (120)$.
34. $0 = +1.06 - (105) + (106) - (116) + (117) - (118) + (120)$.
35. $0 = +0.43 - (113) + (114) - (116) + (117) - (118) + (110)$.

36. $0 = -1.00 - (103) + (105) - (120) + (121) - (126) + (127)$.
37. $0 = -1.52 - (103) + (104) - (125) + (127) - (129) + (130)$.
38. $0 = +0.06 - (121) + (122) - (125) + (126) - (128) + (130)$.
39. $0 = -0.40 - (124) + (125) - (130) + (131) - (136) + (137)$.
40. $0 = +0.11 - (123) + (124) + (134) - (137) - (140) + (150)$.

41. $0 = +0.66 - (123) + (125) - (130) + (132) - (148) + (150)$.
42. $0 = +1.16 - (132) + (133) - (138) + (140) - (147) + (148)$.
43. $0 = +2.21 - (134) + (135) - (139) + (140) - (147) + (149)$.
44. $0 = +1.11 - (140) + (141) - (146) + (147) - (151) + (152)$.
45. $0 = +0.33 - (141) + (142) + (151) - (153) - (154) + (155)$.

46. $0 = +2.27 - (140) + (142) - (145) + (147) - (154) + (156)$.
47. $0 = -1.12 - (143) + (145) - (156) + (157) - (162) + (163)$.
48. $0 = -2.02 - (143) + (144) - (161) + (163) - (165) + (166)$.
49. $0 = +0.30 - (157) + (158) - (161) + (162) - (164) + (166)$.
50. $0 = +0.42 - (160) + (161) - (166) + (168) - (174) + (175)$.

51. $0 = +1.52 - (159) + (161) - (160) + (167) - (172) + (173)$.
52. $0 = -0.70 - (159) + (160) - (171) + (173) - (175) + (176)$.
53. $0 = -0.81 - (170) + (171) - (176) + (177) - (182) + (183)$.
54. $0 = +1.21 - (160) + (171) - (176) + (178) - (187) + (189)$.
55. $0 = +1.16 - (177) + (178) - (180) + (182) - (187) + (188)$.

56. $0 = -0.42 - (177) + (179) - (181) + (182) - (190) + (191)$.
57. $0 = -0.71 - (178) + (179) - (180) + (187) - (190) + (192)$.
58. $0 = -0.43 - (184) + (186) - (192) + (193) - (198) + (199)$.
59. $0 = -0.88 - (184) + (185) - (197) + (199) - (201) + (202)$.
60. $0 = +0.34 - (193) + (194) - (197) + (198) - (200) + (202)$.

61. $0 = +0.59 - (196) + (197) - (202) + (204) - (210) + (211)$.
62. $0 = +0.45 - (195) + (197) - (202) + (203) - (208) + (209)$.
63. $0 = +0.60 - (195) + (196) - (207) + (209) - (211) + (212)$.
64. $0 = -0.26 - (206) + (207) - (212) + (214) - (215) + (216)$.
65. $0 = -0.21 - (205) + (207) - (212) + (213) - (226) + (227)$.

66. $0 = +0.54 - (205) + (206) - (216) + (217) - (225) + (227)$.
67. $0 = +1.77 - (217) + (219) - (224) + (225) - (228) + (229)$.
68. $0 = +1.45 - (218) + (219) - (228) + (230) - (231) + (232)$.
69. $0 = +0.75 - (217) + (218) - (223) + (225) - (232) + (233)$.
70. $0 = +0.30 - (220) + (223) - (233) + (234) - (239) + (240)$.

Condition equations—Continued.

No.

71. 0=−0.39−(222)+(223)−(233)+(236)−(247)+(248).
72. 0=+0.33−(234)+(236)−(238)+(239)−(247)+(249).
73. 0=−1.82−(221)+(223)−(233)+(235)−(244)+(245).
74. 0=−0.72−(234)+(235)−(237)+(239)−(244)+(246).
75. 0=−0.95−(237)+(238)−(243)+(246)−(249)+(250).

76. 0=−1.39−(241)+(243)−(250)+(251)−(256)+(257).
77. 0=+0.82−(242)+(243)−(250)+(252)−(258)+(259).
78. 0=+1.05−(251)+(252)−(255)+(256)−(258)+(260).
79. 0=+0.12−(253)+(255)−(260)+(261)−(266)+(267).
80. 0=+1.55−(253)+(254)−(265)+(267)−(271)+(272).

81. 0=−0.65−(254)+(255)−(260)+(262)−(270)+(271).
82. 0=+0.97−(262)+(263)−(268)+(270)−(281)+(282).
83. 0=+1.37−(262)+(264)−(269)+(270)−(273)+(274).
84. 0=+2.16−(268)+(269)−(274)+(275)−(280)+(282).
85. 0=−2.00−(275)+(276)−(278)+(280)−(291)+(292).

86. 0=−0.45−(275)+(277)−(279)+(280)−(283)+(284).
87. 0=+0.70−(276)+(277)−(283)+(285)−(290)+(291).
88. 0=+0.39−(285)+(286)−(288)+(290)−(296)+(297).
89. 0=−0.62−(285)+(287)−(289)+(290)−(298)+(299).
90. 0=+0.04−(286)+(287)−(295)+(296)−(298)+(300).

91. 0=−0.05−(293)+(295)−(300)+(301)−(306)+(307).
92. 0=−1.43−(294)+(295)−(300)+(302)−(308)+(309).
93. 0=−1.26−(301)+(302)−(305)+(306)−(308)+(310).
94. 0=+0.29−(303)+(305)−(310)+(311)−(316)+(317).
95. 0=−0.08−(303)+(304)−(315)+(317)−(323)+(324).

96. 0=−0.87−(304)+(305)−(310)+(312)−(322)+(323).
97. 0=+0.56−(312)+(313)−(320)+(322)−(341)+(342).
98. 0=−0.51−(313)+(314)−(325)+(327)−(340)+(341).
99. 0=−0.51−(312)+(314)−(321)+(322)−(325)+(326).
100. 0=+0.03−(318)+(321)−(326)+(328)−(347)+(348).

101. 0=−1.34−(319)+(321)−(326)+(329)−(349)+(350).
102. 0=+1.04−(328)+(329)−(346)+(347)−(349)+(351).
103. 0=−1.07−(343)+(346)−(351)+(352)−(357)+(358).
104. 0=−0.55−(345)+(346)−(351)+(354)−(359)+(360).
105. 0=−0.16−(343)+(345)−(356)+(358)−(360)+(361).

106. 0=−2.13−(344)+(346)−(351)+(353)−(368)+(369).
107. 0=+1.16−(352)+(353)−(355)+(357)−(368)+(370).
108. 0=+1.36−(355)+(356)−(361)+(362)−(367)+(370).
109. 0=+0.23−(362)+(363)−(365)+(367)−(374)+(375).
110. 0=−1.43−(362)+(364)−(366)+(367)−(376)+(377).

111. 0=−1.47−(363)+(364)−(373)+(374)−(376)+(378).
112. 0=+0.12−(371)+(373)−(378)+(379)−(385)+(386).
113. 0=+0.41−(372)+(373)−(378)+(380)−(387)+(388).
114. 0=−0.31−(379)+(380)−(384)+(385)−(387)+(389).
115. 0=−0.73−(382)+(384)−(389)+(390)−(398)+(399).

116. 0=+0.89−(383)+(384)−(389)+(391)−(406)+(407).
117. 0=−0.56−(390)+(392)−(393)+(394)+(398)−(402).
118. 0=−0.94−(391)+(392)−(393)+(395)−(405)+(406).
119. 0=−0.59−(394)+(395)−(401)+(402)−(405)+(408).
120. 0=+0.82−(381)+(383)−(407)+(409)−(411)+(413).

121. 0=+2.07−(400)+(401)−(408)+(409)−(411)+(412).
122. 0=+0.66+(403)−(409)−(410)+(411)−(423)+(424).
123. 0=−0.54−(395)+(396)−(403)+(405)−(422)+(423).
124. 0=−0.99−(395)+(397)−(404)+(405)−(414)+(415).
125. 0=−1.58−(396)+(397)−(414)+(416)−(421)+(422).

126. 0=−1.02−(416)+(417)−(420)+(421)−(427)+(428).
127. 0=−0.52−(417)+(418)−(426)+(427)−(429)+(430).
128. 0=+2.13−(425)+(426)−(430)+(431)−(438)+(439).
129. 0=+1.64−(419)+(420)+(425)−(428)−(439)+(440).
130. 0=+1.89−(431)+(432)−(436)+(438)−(447)+(448).

131. 0=−0.61−(432)+(433)−(441)+(443)−(446)+(447).
132. 0=+0.66−(431)+(433)−(437)+(438)−(441)+(442).
133. 0=+0.89−(434)+(437)−(442)+(444)−(457)+(458).
134. 0=+1.52−(435)+(437)−(442)+(445)−(449)+(450).
135. 0=−0.32−(444)+(445)−(449)+(451)−(456)+(457).

136. 0=+0.96−(451)+(452)−(454)+(456)−(462)+(463).
137. 0=−0.46−(451)+(453)−(455)+(456)−(464)+(465).
138. 0=+1.45−(452)+(453)−(461)+(462)−(464)+(466).
139. 0=−3.34−(459)+(461)−(466)+(468)−(478)+(479).
140. 0=−0.61−(459)+(460)−(471)+(472)−(477)+(479).

Condition equations—Continued.

No.

141. 0 = +1.58−(468)+(469)−(470)+(472)−(477)+(478).
142. 0 = −2.55−(467)+(468)+(475)−(478)−(483)+(484).
143. 0 = −1.59−(467)+(469)−(470)+(473)−(482)+(484).
144. 0 = +1.83−(472)+(474)−(476)+(477)−(487)+(488).
145. 0 = −1.32−(475)+(476)−(480)+(483)−(488)+(490).

146. 0 = −2.13−(480)+(481)−(489)+(490)−(494)+(495).
147. 0 = +1.64−(485)+(486)−(496)+(497)−(504)+(505).
148. 0 = −0.20+(480)−(486)−(490)+(491)+(496)−(499).
149. 0 = +1.01+(480)−(485)−(490)+(492)−(503)+(505).
150. 0 = −0.95−(491)+(493)−(498)+(499)−(506)+(507).

151. 0 = −0.73−(497)+(498)−(502)+(504)−(507)+(508).
152. 0 = +0.78−(500)+(502)−(508)+(509)−(514)+(515).
153. 0 = +0.22−(500)+(501)−(513)+(515)−(522)+(523).
154. 0 = −1.26−(509)+(510)−(513)+(514)−(521)+(523).
155. 0 = +0.19−(510)+(511)−(519)+(521)−(526)+(527).

156. 0 = −0.56−(511)+(512)−(525)+(526)−(528)+(530).
157. 0 = +0.10−(510)+(512)−(520)+(521)−(528)+(529).
158. 0 = −1.75−(524)+(525)−(530)+(531)−(532)+(533).
159. 0 = +0.88−(518)+(520)−(529)+(531)−(532)+(534).
160. 0 = −0.20−(516)+(518)−(534)+(535)−(546)+(547).

161. 0 = −0.91−(517)+(518)−(534)+(536)−(537)+(538).
162. 0 = −0.47−(535)+(536)−(537)+(539)−(545)+(546).
163. 0 = −0.92−(530)+(540)−(543)+(545)−(552)+(553).
164. 0 = +2.08−(543)+(544)−(551)+(553)−(555)+(556).
165. 0 = +1.75−(540)+(541)−(551)+(552)−(554)+(556).

166. 0 = +1.15−(540)+(542)−(550)+(552)−(558)+(560).
167. 0 = −1.44−(550)+(551)−(556)+(557)−(559)+(560).
168. 0 = +2.07−(549)+(550)−(560)+(562)−(563)+(564).
169. 0 = +0.11−(548)+(550)−(560)+(561)−(571)+(572).
170. 0 = −2.23−(548)+(549)−(504)+(565)−(570)+(572).

171. 0 = +0.39−(565)+(566)−(568)+(570)−(585)+(586).
172. 0 = −0.56−(565)+(567)−(569)+(570)−(573)+(574).
173. 0 = +0.04−(568)+(569)−(574)+(576)−(583)+(580).
174. 0 = +1.23−(575)+(577)−(588)+(589)−(590)+(591).
175. 0 = −1.61−(582)+(584)−(587)+(588)−(591)+(592).

176. 0 = +0.26−(575)+(576)−(583)+(584)−(587)+(589).
177. 0 = +2.11−(576)+(578)−(580)+(583)−(604)+(605).
178. 0 = +2.17−(576)+(579)−(581)+(583)−(593)+(594).
179. 0 = +0.08−(578)+(579)−(603)+(595)−(603)+(604).
180. 0 = +0.01−(596)+(596)−(601)+(603)−(600)+(607).

181. 0 = +1.51−(595)+(597)−(602)+(603)−(612)+(613).
182. 0 = +2.85−(595)+(598)−(600)+(603)−(617)+(619).
183. 0 = −3.43−(597)+(599)−(611)+(612)−(620)+(621).
184. 0 = −2.21−(598)+(599)−(616)+(617)−(620)+(622).
185. 0 = +1.96−(610)+(611)−(616)+(618)−(621)+(622).

186. 0 = −2.72−(615)+(616)−(622)+(623)−(630)+(631).
187. 0 = −1.22−(614)+(615)−(631)+(632)−(642)+(643).
188. 0 = +2.84−(623)+(624)−(625)+(626)−(629)+(630).
189. 0 = −1.70−(626)+(627)−(628)+(629)−(633)+(634).
190. 0 = +1.02+(628)−(632)−(634)+(635)−(641)+(642).

191. 0 = +2.36−(635)+(636)−(639)+(641)−(648)+(649).
192. 0 = +3.33−(635)+(637)−(640)+(641)−(644)+(645).
193. 0 = −1.84−(638)+(639)−(649)+(650)−(659)+(661).
194. 0 = −0.13−(638)+(640)−(645)+(646)−(660)+(661).
195. 0 = +2.06−(646)+(647)−(652)+(654)−(658)+(660).

196. 0 = +1.75−(650)+(651)−(653)+(654)−(658)+(659).
197. 0 = −1.06−(654)+(655)−(650)+(658)−(664)+(665).
198. 0 = −0.59−(656)+(657)+(662)−(663)−(664)+(665).
199. 0 = +11.70−2.91(1)+18.91(2)−16.00(3)−2.39(9)+3.47(10)−1.08(11)−8.16(12)+0.43(13)−1.27(14).
200. 0 = − 0.06−0.98(7)+2.88(8)−1.90(9)−1.41(19)+4.42(20)−3.01(21)−4.08(22)+4.21(23)−0.13(24).

201. 0 = − 1.02−3.84(17)+6.12(18)−2.28(19)+0.54(24)+2.56(25)−3.10(26)−1.71(29)+1.08(30)+0.63(31).
202. 0 = − 1.45+1.83(34)−1.91(35)+0.08(36)−0.12(39)−2.70(40)+2.82(41)+2.75(42)−4.71(43)+1.96(44).
203. 0 = + 0.22−3.46(37)+4.20(38)−0.74(39)−1.15(44)+3.83(45)−2.68(46)−0.46(52)+2.40(53)−1.94(54).
204. 0 = + 1.78−0.50(47)+2.25(48)−1.75(49)−0.73(59)+4.19(60)−3.40(61)−4.66(62)+5.66(63)−1.00(64).
205. 0 = + 2.81−3.42(64)+3.88(65)−0.46(66)+0.35(70)+1.14(71)−1.49(72)−1.05(73)+4.80(74)−3.75(75).

206. 0 = +16.00−16.24(68)+17.68(69)−1.44(70)−2.01(75)+3.94(76)−1.93(77)−2.20(87)+21.88(88)−19.62(89).
207. 0 = −25.58−4.51(67)+22.19(68)−17.68(69)−0.79(84)+5.13(85)−4.34(86)−21.83(88)+23.82(89)−1.94(90).
208. 0 = + 1.19−2.40(82)+6.14(83)−3.74(84)−0.25(90)+10.14(91)−9.89(92)−17.70(95)+19.90(96)−2.20(97).
209. 0 = − 4.92−3.59(100)+3.27(101)+0.32(102)+0.62(107)+1.35(108)−1.97(109)−2.43(110)+7.13(111) −4.70(112).
210. 0 = +11.73−2.18(105)+18.62(106)−16.44(107)+0.97(112)+1.50(113)−2.47(114)−12.54(118)+13.00(119) −0.46(120).

Condition equations—Continued.

No.

211. 0= − 5.43−2.29(103)+11.80(104)−9.51(105)−1.84(125)+4.61(126)−2.77(127)−9.71(128)+10.36(129) −0.65(130).

212. 0= +2389.49−1(123)+12(124)−11(125)+184(131)−184(132)−1922(148)+1926(149)−4(150).

213. 0= +50.06−1.15(123)+12.16(124)−11.01(125)−0.33(130)+1.35(131)−1.02(133)−11.22(138)+11.64(139) −0.42(140)−4.09(147)+8.37(149)−4.28(150).

214. 0= +18.82−16.25(140)+21.32(141)−5.07(142)−5.18(145)+6.79(146)−1.61(147)−0.90(154)+15.16(155) −14.26(156).

215. 0= − 4.12−1.10(143)+5.30(144)−4.20(145)−2.45(161)+3.93(162)−1.48(163)−3.01(164)+3.62(165) −0.61(166).

216. 0= − 1.40−3.40(159)+2.73(160)+0.67(161)−3.88(166)+6.78(167)−2.90(168)−0.53(174)+3.60(175) −3.07(176).

217. 0= −37.95−52.47(169)+54.68(170)−2.21(171)−0.57(176)+7.23(177)−6.66(178)−2.95(187)+22.28(188) −19.33(189).

218. 0= + 3.12−6.14(177)+6.66(178)−0.52(179)−0.63(186)+2.95(187)−2.32(188)−1.32(190)+5.70(191) −4.38(192).

219. 0= − 2.34−0.15(184)+1.61(185)−1.46(186)−0.29(197)+2.81(198)−2.52(199)−3.24(200)+5.25(201) −2.01(202).

220. 0= + 6.74−1.53(195)+6.93(196)−5.40(197)−20.08(207)+23.72(208)−3.64(209)−6.36(210)+1.92(211) +4.44(212).

221. 0= − 2.34−1.57(205)+2.14(206)−0.57(207)−1.79(212)+5.34(213)−3.55(214)−2.47(225)+4.23(226) −1.76(227).

222. 0= + 6.73−2.56(217)+15.57(218)−13.01(219)−8.95(223)+9.29(224)−0.34(225)−2.19(231)+1.34(232) +0.85(233).

223. 0= − 5.95+11.72(220)−11.96(221)+0.24(223)+1.89(233)−5.51(234)+3.62(235)+2.79(244)−13.37(245) +10.58(246).

224. 0= − 1.88+8.34(220)−11.96(221)+3.62(222)−0.30(243)−13.37(245)+13.67(246)+5.64(248)−7.40(249) +1.76(250).

225. 0= − 4.98−3.62(234)+8.90(235)−5.28(236)−4.29(237)+3.41(238)+0.88(239)+0.26(247)+1.76(249) −2.02(250).

226. 0= − 2.91−2.19(250)+1.32(251)+0.87(252)+1.76(255)+2.00(256)−3.76(257)−5.37(258)+10.93(259) −5.56(260).

227. 0= −17.49−14.65(253)+14.51(254)+0.14(255)−2.37(260)+11.63(261)−9.26(262)−1.09(270)+5.07(271) −3.98(272).

228. 0= −15.15+0.58(268)+6.97(269)−7.55(270)−1.46(273)+0.92(274)+0.54(275)−9.83(280)+12.23(281) −2.40(282).

229. 0= − 8.62−12.76(275)+15.88(276)−3.12(277)−2.93(278)+2.02(279)+0.91(280)−0.27(283)+0.05(284) −8.78(285).

230. 0= − 0.32+1.40(285)+0.76(286)−2.16(287)−2.15(288)+7.88(289)−5.73(290)−3.38(295)+3.18(296) +0.20(297).

231. 0= − 1.19−3.66(293)+2.07(294)+1.59(295)−8.06(300)+9.75(301)−1.69(302)−2.15(308)+10.16(309) −8.01(310).

232. 0= + 7.21−21.52(303)+24.15(304)−2.63(305)−1.84(310)+22.23(311)−20.39(312)−4.49(315)+2.71(316) +1.78(317).

233. 0= +42.46−2.0(312)+5.9(313)−3.9(314)−85.8(320)+87.0(321)−1.2(322)−1.8(325)+65.5(326)−63.7(327).

234. 0= + 5.35−4.25(318)+10.57(319)−6.32(321)+0.01(326)+1.78(328)−2.39(329)−4.18(346)+3.38(347) +0.80(348).

235. 0= − 3.75+8.61(343)−8.65(344)+0.04(346)+1.14(351)−7.20(352)+6.06(353)+1.45(368)−3.45(369) +2.00(370).

236. 0= − 4.03+6.05(343)−8.65(344)+2.60(345)+1.42(360)−4.26(361)+2.84(362)−0.13(367)−3.45(369) +3.58(370).

237. 0= − 7.13−6.09(352)+11.17(353)−5.11(354)−2.35(355)+1.77(356)+0.58(357)+1.19(359)+2.84(361) −4.03(362).

238. 0= +15.40−10.54(362)+10.73(363)−0.19(364)+2.53(373)+0.15(374)−2.68(375)−1.98(376)+25.21(377) −23.23(378).

239. 0= −16.66−1.46(371)+5.37(372)−3.91(373)−1.81(384)+3.56(385)−1.75(386)−3.76(387)+4.45(388) −0.69(389).

240. 0= +17.59−40.74(382)+41.67(383)−0.93(384)−0.42(389)+27.29(390)−26.87(391)−0.29(398)+2.07(399) −1.78(401).

241. 0= −18.57−27.29(393)+32.16(391)−4.87(392)+0.05(393)+20.70(394)−20.75(395)+0.29(398)−3.77(401) +3.48(402).

242. 0= −50.24−14.17(381)+54.91(382)−40.74(383)−2.30(407)+4.09(408)−1.79(409)−5.97(411)+7.33(412) −1.36(413).

243. 0= +55.66−20.70(394)+21.92(395)−1.22(396)+0.81(400)+2.67(401)−3.48(402)−0.35(410)+6.32(411) −5.97(412)−3.31(422)+9.21(423)−5.90(424).

244. 0= − 6.72−0.09(403)+2.51(404)−2.42(405)−4.39(414)+5.49(415)−1.10(416)−1.29(421)+4.60(422) −3.31(423).

245. 0= +27.34−5.07(416)+7.20(417)−2.19(418)−2.26(419)+5.54(420)−3.28(421)−1.11(429)+1.16(430) −0.05(431)−2.31(438)+6.91(439)−4.60(440).

246. 0= + 3.78−1.58(431)+19.00(432)−17.42(433)−20.19(436)+21.35(437)−1.16(438)+0.73(441)+2.12(442) −2.85(443).

247. 0= + 1.56−1.19(434)+2.82(435)−1.63(437)−3.97(449)+5.37(450)−1.40(451)−0.30(456)+2.87(457) −2.57(458).

248. 0= − 4.78−0.04(454)+3.32(455)−2.68(456)−2.78(461)+5.66(462)−2.88(463)−3.60(464)+3.28(465) +0.32(466).

249. 0= + 2.90−0.98(459)+6.24(460)−5.26(461)−15.86(470)+19.41(471)−3.55(472)−0.61(477)+3.59(478) −2.98(479).

250. 0= −38.23−7.17(467)+7.72(468)−0.55(469)−3.55(470)+13.07(472)−9.52(473)−4.14(482)+10.56(483) −6.42(484).

Condition equations—Continued.

No.

251. 0=+16.99−7.79(472)+9.52(473)−1.73(474)−0.07(480)+4.14(482)−4.07(483)−1.66(487)+5.46(488) −3.80(490).

252. 0=− 8.95−3.01(480)−2.04(485)+6.25(486)−3.26(490)+45.02(491)−41.76(492)−29.56(503)+30.27(504) −0.71(505).

253. 0=+ 9.00−41.62(491)+41.76(492)−0.14(493)−1.76(502)+29.56(503)−27.80(504)−3.23(506)+9.97(507) −6.74(508).

254. 0=+ 5.59−3.46(500)+3.72(501)−0.26(502)−2.49(508)+5.04(509)−2.55(510)−0.52(521)+3.76(522) −3.24(523).

255. 0=−27.78+71.0(510)−71.6(511)+0.6(512)+0.7(518)−2.3(519)+1.6(521)+1.3(528)−3.2(530)+1.9(531) +1.6(532)−65.8(533)+64.2(534).

256. 0=+43.17−1(518)+20(519)−19(520)−590(529)+592(530)−2(531)−2(532)+66(533)−64(534).

257. 0=+ 0.10−6.66(516)+10.59(517)−3.93(518)+0.78(534)+1.94(535)−2.67(536)−3.19(545)+1.15(546) +2.04(547).

258. 0=+28.67+2.02(539)+0.76(540)−2.78(541)−1.86(543)+22.31(544)−20.45(345)−11.59(551)+12.29(552) −0.70(553).

259. 0=−29.03−0.76(540)+13.29(541)−12.53(542)−3.96(550)+10.25(551)−12.29(552)−38.50(558)+39.74(559) −1.24(560).

260. 0=−10.61−0.45(548)+5.68(549)−5.23(550)−2.99(563)+1.42(564)+1.57(565)−9.51(570)+12.10(571) −2.59(572).

261. 0=+ 5.03−4.73(565)+10.28(566)−5.55(567)−3.54(568)+2.82(569)+0.72(570)+0.04(573)+2.19(574) −2.83(576).

262. 0=− 4.03−2.04(575)+9.45(576)−7.41(577)−3.93(582)+5.20(583)−1.27(584)−2.48(587)+3.27(588) −0.79(589).

263. 0=+ 1.32−3.58(576)+3.50(578)+0.08(579)−4.01(593)+8.07(594)−4.06(595)+0.18(603)+3.47(604) −3.65(605).

264. 0=+11.92−1.04(595)+7.61(596)−6.57(597)−50.01(601)+51.20(602)−1.19(603)−3.10(606)+24.19(607) −21.09(609).

265. 0=−73.70−154.18(600)+201.72(601)−47.54(602)−116.30(607)+95.77(608)+20.53(609)+3.66(610) −3.66(613)−6.85(618)+6.85(619).

266. 0=−50.85−3.47(596)+97.90(597)−94.43(598)+6.85(600)−6.85(601)+0.96(606)+6.85(607) −16.08(608)+8.27(609)−40.73(617)+47.58(618)−6.85(619).

267. 0=+54.19−91.56(597)+94.43(598)−2.87(599)−2.69(616)+40.73(617)−38.04(618)−0.24(620)+4.45(621) −4.21(622).

268. 0=− 0.04−0.46(614)+2.14(615)−1.68(616)−1.82(622)+4.39(623)−2.57(624)−1.46(625)+0.68(626) +0.78(627)−2.81(633)+4.04(634)−1.23(635)−3.39(641)+7.27(642)−3.88(643).

269. 0=− 3.41−0.55(635)+1.29(636)−0.74(637)−0.78(644)+1.48(645)−0.70(646)+1.33(648)−1.29(649) −0.04(650)+1.31(659)−1.56(660)+0.25(661).

270. 0=+ 2.74−2.02(638)+3.51(639)−1.49(640)−0.69(645)+3.31(646)−2.62(647)−0.04(649)−0.89(650) +0.93(651)−0.25(652)+1.20(653)−0.95(654).

271. 0=− 1.75−2.14(654)+2.14(655)−4.56(662)+4.50(663)+2.09(664)−2.09(665).

272. 0=+ 4.57−(4)+(6)−(12)+(16)−(22)+(26)−(32)+(36)−(42)+(46)−(52)+(56)−(62)+(66)−(73)+(77) −(87)+(92)−(98)+(101)+(103)−(108)+(123)−(127)+(143)−(150)+(159)−(163)+(169) −(173)+(184)−(189)+(195)−(199)+(205)−(209)+(220)−(227)+(238)−(240).

273. 0=− 1.39−(240)+(252)−(258)+(264)−(273)+(277)−(283)+(287)−(298)+(302)−(308)+(314)−(325) +(329)−(349)+(354)−(359)+(364)−(376)+(379)+(381)−(385)+(410)−(413).

274. 0=− 7.39+(419)−(424)+(434)−(440)+(454)−(458)+(459)−(463)+(475)−(479)+(481)−(483)−(494) +(495).

275. 0=− 3.11−(489)+(493)−(506)+(512)−(528)+(531)−(532)+(536)−(537)+(542)−(558)+(562)−(563) +(567)−(573)+(575).

276. 0=+ 0.38−(575)+(579)−(593)+(599)−(620)+(624)−(625)+(627)−(633)+(637)−(644)+(647)−(652) +(655).

277. 0=+ 4.62−2.91(1)+2.91(3)−0.38(5)+0.38(6)−0.98(7)+0.98(9)+1.08(10)−1.08(11)+1.27(12)−1.27(14) −2.77(15)+2.77(16)−0.70(17)+0.70(19)+3.01(20)−3.01(21)+0.13(22)−0.13(24)−2.56(25) +2.56(26)+0.16(27)−0.16(29)+2.20(30)−2.20(31)+0.46(32)−0.46(34)−2.50(35)+2.50(36) −0.74(37)+0.74(39)+2.70(40)−2.70(41)+0.20(42)−0.20(44)−2.68(45)+2.68(46)+1.89(50) −1.89(51)+0.46(52)−0.46(54).

278. 0=− 2.57−0.50(47)+0.50(49)−2.13(55)+2.13(56)−1.69(57)+1.69(58)+3.46(60)−3.46(61)+1.00(62) −1.46(64)+0.46(66)−3.40(67)+3.40(69)−0.35(70)+0.35(72)+1.05(73)−1.05(74)+0.14(75) −0.14(77)−2.40(82)+2.40(83)−0.20(84)+0.20(86)+2.75(87)−2.75(88)−0.25(90)+0.25(92) +2.20(95)−2.20(97)+0.88(98)−0.88(99)−0.94(101)+0.94(102)−2.29(103)+2.29(105)+1.35(108) −1.35(109)+0.98(110)−2.18(112)+1.20(113)+0.83(119)−0.83(120)−1.30(121)+1.30(122) −0.68(123)+0.68(125)+2.77(126)−2.77(127)+0.65(128)−0.65(130)−1.05(132)+1.05(133) +0.03(138)−3.09(140)+3.06(142)−1.10(143)+1.10(145)+4.27(148)−4.27(150)+0.55(154) −0.55(156)−0.96(157)+0.96(158)−2.73(159)+2.73(160)+1.48(162)−1.48(163)+0.61(164) −1.62(166)+1.01(168)−2.04(169)+1.19(171)+0.85(173)+2.07(174)−2.07(175)−1.28(178) +1.28(179)+2.36(187)−2.36(189)+0.23(190)−0.23(192).

279. 0=+ 0.12−0.15(184)+0.15(186)−1.68(193)+1.68(194)−2.79(195)+2.79(196)+2.52(198)−2.52(199) +2.01(200)−1.01(202)−1.00(204)−1.57(205)+1.57(206)+2.90(207)−2.90(209)+1.92(210) −1.92(211)−1.79(212)+1.79(214)+1.45(215)−1.45(216)−3.41(217)+3.41(218)−5.73(221) +5.73(222)+1.76(225)−1.76(227)+1.51(232)−1.14(233)−0.37(236)−0.54(241)+0.57(243) −0.03(245)+4.22(247)−4.22(248)−1.50(251)+1.50(252)−0.17(254)+0.17(255)+2.00(256) −2.00(257)+2.33(258)−2.33(260)+0.25(262)−0.25(264)−0.05(268)+0.05(269)+2.50(270) −2.50(271)+0.92(273)−0.92(274)−2.22(275)+2.22(277)−2.02(278)+2.02(279)+1.57(280) −1.57(282)+0.79(283)−0.79(284)−0.76(286)+0.76(287)−1.00(288)−0.25(290)+1.25(292) +1.59(293)−1.59(295)+1.12(296)−1.12(297)+0.51(298)−0.51(300)−1.69(301)+1.69(302) −2.63(304)+2.63(305)+2.66(306)−2.66(307)+2.15(308)−2.15(310)−0.58(312)+0.58(314) −2.12(318)+2.12(321)−0.09(322)+0.09(323)+1.98(325)−1.98(326)−1.78(328)+1.78(329) +0.42(347)−0.42(348)−0.31(349)+0.31(351).

Condition equations—Continued.

No.

280. 0=−22.17−0.55(344)+0.55(346)−5.11(353)+5.11(354)−1.19(359)+1.19(362)−0.61(363)+0.61(364)
−0.26(365)+0.26(367)+4.74(368)−4.74(369)−1.46(371)+1.46(373)+0.15(374)−0.15(375)
+1.65(376)−1.65(378)−1.27(379)+1.27(380)−0.93(383)+0.93(384)+1.75(385)−1.75(386)
+0.69(387)−0.69(389)−4.87(391)+4.87(392)−0.05(393)+0.05(395)−1.26(396)+1.26(397)
−0.09(403)+0.09(405)+2.97(406)−2.97(407)+1.10(414)−1.10(416)−2.19(417)+2.19(418)
−3.28(420)+3.28(421)+3.31(422)−3.31(423)−1.84(425)+1.84(426)−1.46(427)+1.46(428)
+1.11(429)−1.11(430)+2.31(438)−2.31(439).

281. 0=+ 9.65−1.21(431)+1.21(433)−1.19(434)+1.19(437)+1.01(441)−1.01(442)−2.36(444)+2.36(445)
+1.40(449)−1.40(451)−2.17(452)+2.17(453)−0.64(454)+0.64(456)+2.57(457)−2.57(458)
−0.98(459)+0.98(461)+2.88(462)−2.88(463)−0.32(464)+0.32(466)−0.55(468)+0.55(469)
+3.55(470)−3.28(472)+1.73(474)−1.08(475)+1.08(476)+2.98(478)−2.98(479)+0.89(480)
−0.07(483)−0.82(485)+1.66(487)−1.66(488)−0.24(492)+0.24(493)−1.56(501)+1.56(502)
+0.55(503)−0.55(505)+1.74(506)−1.74(508)−0.54(510)+0.54(512)−2.05(516)+2.05(518)
+1.98(521)−1.98(522)+1.34(528)−3.20(529)+1.86(531)+1.48(532)−1.48(534)−1.94(535)
+1.94(536)+0.72(537)−0.72(539)−0.38(540)+0.38(542)−1.50(543)+1.50(545)+0.66(546)
−0.66(547)−1.33(548)+1.33(549)+1.13(552)−1.13(553)+1.09(558)−0.58(560)−0.51(562)
+1.42(563)−1.42(564)−2.12(565)+2.12(567)−2.82(568)+2.82(569)+1.07(570)−1.07(572)
+1.07(573)−1.07(574)−2.04(575)+2.04(577)−3.15(583)+2.80(584)+0.35(586)−0.76(587)
+0.76 (589)+1.00(590)−1.00(591).

282. 0=−19.94+2.04(575)−2.04(577)−1.16(578)+1.16(579)+1.11(580)+1.69(583)−2.80(584)+0.76(587)
−0.76(589)−1.00(590)+1.00(591)+1.47(593)−1.47(595)−2.87(597)+2.87(599)−1.42(602)
+1.42(603)+3.47(604)−3.47(605)+1.00(610)−1.00(611)+3.77(612)−3.77(613)−1.08(615)
+4.37(616)−2.69(618)+0.24(620)−0.24(621)−2.57(623)+2.57(624)+1.46(625)−0.68(626)
−0.78(627)+0.06(628)+0.40(630)−0.40(631)−0.06(632)+2.81(633)−2.81(634)−0.74(635)
+0.74(637)−1.49(638)+1.49(640)+3.39(641)−3.39(642)+0.78(644)−0.78(645)−2.62(646)
+2.62(647)+0.25(652)−0.25(654)−0.26(656)+0.26(658)+1.56(660)−1.56(661)+2.52(664)
−2.52(665).

283. 0=+30.76252−1.89(1)+1.89(3)−7.62(5)+7.62(6)+3.66(7)−3.66(9)+9.70(10)−9.70(11)−2.76(12)
+2.76(14)−14.39(15)+14.39(16)+4.35(17)−4.35(19)+15.18(20)−15.18(21)−5.94(22)
+5.94(24)−13.55(25)+13.55(26)+6.68(27)−6.68(29)+12.64(30)−12.64(31)−4.88(32)
+4.88(34)−13.23(35)+13.23(36)+4.03(37)−4.03(39)+13.86(40)−13.86(41)−5.52(42)
+5.52(44)−13.55(45)+13.55(46)+4.61(47)−4.61(49)+11.41(50)−11.41(51)−4.08(52)
+4.68(54)−11.79(55)+11.79(56)+1.16(57)−1.16(58)+15.63(60)−15.63(61)−3.05(62)
−4.07(64)+7.12(66)−3.64(67)+3.64(69)+4.82(70)−4.82(72)−2.91(73)+2.91(74)−5.39(75)
+5.39(77)−0.96(82)+0.96(83)+5.10(84)−5.10(86)+1.89(87)−1.89(88)−6.33(90)+6.33(92)
+5.60(93)+0.01(95)−11.61(97)−3.20(98)+3.20(99)−8.05(101)+8.05(102)−0.01(103)
+0.61(105)+9.29(108)−9.29(109)−2.83(110)−5.92(112)+8.75(113)−3.23(119)+3.23(120)
−8.83(121)+8.83(122)+3.69(123)−3.69(125)+12.89(126)−12.89(127)−3.66(128)+3.66(130)
−7.98(132)+7.98(133)−5.23(138)−9.39(140)+14.62(142)+2.62(143)−2.62(145)+16.67(148)
−16.67(150)−3.91(154)+3.91(156)−7.66(157)+7.66(158)−1.42(159)+1.42(160)+9.07(162)
−9.07(163)−3.74(164)−4.04(166)+7.78(168)+0.26(169)+2.89(171)−3.15(173)−0.10(174)
+0.10(175)−8.22(178)+8.22(179)+4.85(184)−4.85(186)+10.96(187)−10.96(189)−4.57(190)
+4.57(192)−9.09(193)+9.09(194)−1.21(195)+1.21(196)+11.26(198)−11.26(199)−0.35(200)
−2.39(202)+2.74(204)+1.75(205)−1.75(206)+11.82(207)−11.82(209)−0.57(210)+0.57(211)
−9.05(212)+9.05(214)−1.81(215)+1.81(216)−12.35(217)+12.35(218)+4.64(220)−4.64(223)
+9.05(225)−9.05(227)−1.85(232)+1.85(233)−8.45(234)+8.45(236)−1.88(237)+1.88(238)
+9.05(239)−9.05(240)+3.92(241)+0.48(243)−4.40(246)−0.88(247)+0.88(249)−7.90(251)
+7.90(252)+4.65(254)−4.65(255)+9.05(256)−9.05(257)−0.26(258)+0.26(260)−4.29(262)
+4.29(264)+4.89(268)−4.89(269)+9.83(270)−9.83(271)−2.99(273)+2.99(274)−8.86(275)
+8.86(277)+1.23(278)−1.23(279)+7.99(280)−7.99(282)−3.24(283)+3.24(284)−6.02(286)
+6.02(287)+3.06(288)−0.45(290)−2.61(292)+7.62(293)−7.62(295)+6.85(296)−6.85(297)
−3.78(298)+3.78(300)−7.58(301)+7.58(302)+0.36(304)−0.36(305)+9.48(306)−9.48(307)
−0.88(308)+0.88(310)−5.49(312)+5.49(314)+1.16(318)−1.16(321)+4.49(322)−4.49(323)
−1.21(325)+1.21(326)−7.27(328)+7.27(329)+3.56(344)−3.56(346)+5.16(347)−5.16(348)
−4.89(349)+4.89(351)−12.07(353)+12.07(354)−6.00(359)+6.00(362)−5.09(363)+5.09(364)
+3.87(365)−3.87(367)+11.85(368)−11.85(369)+2.04(371)−2.04(373)+4.49(374)−4.49(375)
−1.61(376)+1.61(378)−5.90(379)+5.90(380)+2.81(383)−2.81(384)+6.76(385)−6.76(386)
−3.03(387)+3.03(389)−10.59(391)+10.59(392)−4.01(393)+4.01(395)−5.52(396)+5.52(397)
+3.89(403)−3.89(405)+8.35(406)−8.35(407)−2.43(414)+2.43(416)−6.69(417)+6.69(418)
−0.15(420)+0.15(421)+8.45(422)−8.45(423)+1.03(425)−1.03(426)+2.15(427)−2.15(428)
−2.48(429)+2.48(430)−5.31(431)+5.31(433)+2.44(434)−2.44(437)+6.77(438)−6.77(439)
−2.57(441)+2.57(442)−6.54(444)+6.54(445)−2.13(449)+2.13(451)−6.10(452)+6.10(453)
+3.10(454)−3.10(456)+6.96(457)−6.96(458)+2.71(459)−2.71(461)+7.10(462)−7.10(463)
−4.04(464)+4.04(466)−4.26(468)+4.26(469)−0.07(470)−5.40(472)+5.47(474)+2.75(475)
−2.75(476)+7.04(478)−7.04(479)+0.77(480)−3.75(483)+2.98(485)−2.00(487)+2.00(488)
−3.67(492)+3.67(493)+2.35(501)−2.35(502)+4.17(503)−4.17(505)−1.83(506)+1.83(508)
−3.56(510)+3.56(512)+1.82(516)−1.82(518)+5.07(521)−5.07(522)−2.16(528)−2.38(529)
+4.54(531)−2.06(532)+2.06(534)−4.14(535)+4.14(536)−2.30(537)+2.30(539)−2.81(540)
+2.81(542)+1.82(543)−1.82(545)+3.35(546)−3.35(547)+1.74(548)−1.74(549)+3.36(552)
−3.36(553)−1.83(558)−0.39(560)+2.22(562)−1.61(563)+1.61(564)−3.58(565)+3.58(567)
+0.63(568)−0.63(569)+3.36(570)−3.36(572)−1.55(573)+1.55(574)−2.63(578)+2.63(579)
+2.72(580)−0.78(583)−1.94(586)−1.04(593)+1.04(595)−2.87(597)+2.87(599)+1.20(602)
−1.20(603)+3.97(604)−3.97(605)+1.91(610)−1.91(611)+3.68(612)−3.68(613)+0.89(615)
+1.67(616)−2.56(618)−1.30(620)+1.30(621)−2.14(623)+2.14(624)−0.68(625)−0.25(626)
+0.93(627)−1.07(628)+1.68(630)−1.68(631)+1.07(632)−0.20(633)+0.20(634)−0.95(635)
+0.95(637)+0.44(638)−0.44(640)+1.71(641)−1.71(642)−0.25(644)+0.25(645)−0.47(646)
+0.47(647)+0.16(652)−0.16(654)+0.76(660)−0.76(661).

Condition equations—Continued.

No.
284. 0=−110.2383952−17.63(1)+17.63(3)+5.84(5)−5.84(6)−10.57(7)+10.57(9)−3.19(10)+3.19(11)+11.75(12)
−11.75(14)−2.53(15)+2.53(16)−9.44(17)+9.44(19)+3.71(20)−3.71(21)+7.57(22)
−7.57(24)−1.74(25)+1.74(26)−6.35(27)+6.35(29)+0.71(30)−0.71(31)+8.58(32)
−8.58(34)−1.41(35)+1.41(36)−9.34(37)+9.34(39)+2.38(40)−2.38(41)+7.05(42)
−7.05(44)−1.94(45)+1.94(46)−8.45(47)+8.45(49)−0.49(50)+0.49(51)+8.42(52)
−8.42(54)−0.03(55)+0.03(56)−12.07(57)+12.07(58)+4.64(60)−4.64(61)+10.05(62)
−4.70(64)−5.35(66)−17.26(67)+17.26(69)−7.80(70)+7.80(72)+10.21(73)−10.21(74)
+7.25(75)−7.25(77)−14.08(82)+14.08(83)−7.29(84)+7.29(86)+15.57(87)−15.57(88)
+6.00(90)−6.00(92)−6.67(93)+6.79(95)−0.12(97)+9.52(98)−9.52(99)+3.79(101)
−3.79(102)−13.46(103)+13.46(105)−2.50(108)+2.50(109)+9.61(110)−6.60(112)−3.01(113)
+9.15(119)−9.15(120)+2.62(121)−2.62(122)−8.46(123)+8.46(125)+1.88(126)−1.88(127)
+8.41(128)−8.41(130)+3.15(132)−3.15(133)+6.31(138)−10.81(140)+4.50(142)−9.37(143)
+9.37(145)+6.48(148)−6.46(150)+7.83(154)−7.83(156)+3.32(157)−3.32(158)−13.80(159)
+13.80(160)−1.73(162)+1.73(163)+7.87(164)−4.70(166)−3.17(168)−11.82(169)
+3.43(171)+8.39(173)+12.10(174)−12.10(175)+2.28(178)−2.28(179)−6.30(184)
+6.30(186)+0.86(187)−0.86(189)+6.55(190)−6.55(192)+1.05(193)−1.05(194)−13.57(195)
+13.57(196)+1.37(198)−1.37(199)+11.44(200)−2.84(202)−8.60(204)−9.84(205)+9.84(206)
+2.68(207)−2.68(209)+11.18(210)−11.18(211)+0.48(212)−0.48(214)+9.50(215)
−9.50(216)−4.31(217)+4.31(218)−5.79(220)+5.79(223)−0.32(225)+0.32(227)+9.43(232)
−9.43(233)+0.58(234)−0.58(236)−14.35(237)+14.35(238)+0.19(239)−0.19(240)
−6.42(241)+0.66(243)+5.76(246)+10.51(247)−10.51(249)+0.82(251)−0.82(252)
−5.21(254)+5.21(255)+0.60(256)−0.60(257)+11.19(258)−11.19(260)+5.42(262)
−5.42(264)−4.80(268)+4.80(269)+2.13(270)−2.13(271)+7.18(273)−7.18(274)−1.22(275)
+1.22(277)−9.77(278)+9.77(279)−0.34(280)+0.34(282)+6.62(283)−6.62(284)+2.35(286)
−2.35(287)−7.04(288)−0.67(290)+7.71(292)−1.37(296)+1.37(297)+5.63(298)−5.63(300)
−0.05(301)+0.05(302)−10.70(304)+10.70(305)+2.80(306)−2.80(307)+9.74(308)−9.74(310)
+2.63(312)−2.63(314)−9.10(318)+9.10(321)−4.20(322)+4.20(323)+9.01(326)
−9.01(326)−0.34(328)+0.34(329)−5.17(344)+5.17(346)−2.80(347)+2.80(348)
+3.21(349)−3.21(351)−7.93(353)+7.93(354)+1.05(359)−1.05(362)+2.37(303)−2.37(364)
−4.32(365)+4.32(367)+7.72(368)−7.72(369)−6.90(371)+6.90(373)−3.30(374)+3.30(375)
+7.53(376)−7.53(378)+0.76(379)−0.76(380)−5.59(383)+5.59(384)+0.45(385)−0.45(386)
+5.13(387)−5.13(389)−7.26(391)+7.26(392)+3.22(393)−3.22(395)+0.50(390)−0.50(397)
−3.48(403)+3.48(405)+3.29(406)−3.29(407)+5.54(414)−554(410)−1.59(417)+1.59(418)
−10.32(420)+10.32(421)+4.05(422)−4.05(423)−6.08(425)+6.08(426)−6.31(427)+6.31(428)
+5.51(429)−5.51(430)+0.46(431)−0.46(433)−5.47(434)+5.47(437)+1.96(438)−1.96(439)
+5.14(441)−5.14(442)−2.04(444)+2.04(445)+5.77(449)−5.77(451)−1.08(452)+1.08(453)
−4.13(454)+4.13(456)+2.50(457)−2.50(458)−4.72(459)+4.72(461)+3.29(462)−3.29(463)
+2.07(464)−2.07(466)+1.38(468)−1.38(469)+9.74(470)−10.77(472)+1.03(474)−4.33(475)
+4.33(476)+3.53(478)−3.53(479)+1.81(480)+1.99(483)−3.80(485)+5.88(487)−5.88(488)
+1.81(492)−1.81(493)−4.92(501)+4.92(502)−1.01(503)+1.01(505)+5.57(506)−5.57(508)
+0.88(510)−0.88(512)−4.76(516)+4.76(518)+2.01(521)−2.01(522)+4.16(528)−5.58(529)
+1.42(531)+4.40(532)−4.40(534)−1.32(535)+1.32(536)+2.79(537)−2.79(539)+1.10(540)
−1.10(542)−3.06(543)+3.06(545)−0.31(546)+0.31(547)−3.12(548)+3.12(549)+0.25(552)
−0.25(553)+3.18(558)−0.82(560)−2.36(562)+3.05(563)−3.05(564)−1.04(565)+1.04(567)
−4.61(508)+4.61(509)−0.95(570)−0.95(572)+2.87(573)−2.87(574)+0.24(578)−0.24(579)
−1.71(583)+1.71(580)+3.04(593)−3.04(595)−1.02(597)+1.02(599)−2.64(602)+2.64(603)
+2.78(604)−2.78(605)−0.10(610)+0.10(611)+2.73(612)−2.73(613)−2.35(615)+3.07(016)
−1.32(618)+1.42(620)−1.42(621)−0.83(623)+0.83(624)+1.85(625)−0.45(626)−1.40(627)
+0.50(628)−0.60(630)+0.60(631)−0.50(632)+2.75(633)−2.75(634)+0.87(635)−0.87(637)
−0.76(638)+0.76(640)+1.55(641)−1.55(642)+1.38(644)−1.38(645)+0.69(646)−0.69(647)
+0.53(652)−0.53(654)+0.20(660)−0.20(661).

COMPUTED CORRECTIONS TO OBSERVED DIRECTIONS.

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

Table of corrections to observed directions.

Number of direction.	Correction to direction.	Number of direction.	Correction to direction.	Number of direction.	Correction to direction.	Number of direction.	Correction to direction.
1	+0.357	16	+0.477	31	−0.083	46	−0.051
2	−0.051	17	−0.088	32	−0.358	47	+0.079
3	−0.306	18	+0.281	33	+0.001	48	+0.467
4	−0.620	19	−0.049	34	−0.210	49	+0.325
5	+0.637	20	+0.013	35	+0.402	50	−0.435
6	−0.017	21	−0.157	36	+0.166	51	−0.436
7	+0.121	22	−0.210	37	+0.508	52	+0.272
8	+0.828	23	−0.842	38	−0.057	53	−0.068
9	+0.074	24	−0.021	39	+0.020	54	−0.291
10	−0.734	25	+0.673	40	−0.416	55	+0.203
11	−0.288	26	+0.400	41	−0.060	56	−0.116
12	+0.440	27	+0.058	42	−0.001	57	+0.521
13	−0.918	28	+0.371	43	−0.340	58	+0.031
14	+0.032	29	+0.104	44	+0.025	59	−0.182
15	−0.031	30	−0.450	45	+0.367	60	+0.056

Table of corrections to observed directions—Continued.

Number of direction.	Correction to direction.	Number of direction.	Correction to direction.	Number of direction.	Correction to direction.	Number of direction.	Correction to direction.
61	−0.425	126	+0.009	191	+0.473	256	−0.591
62	+0.408	127	+0.227	192	−0.200	257	+0.309
63	−0.326	128	+0.253	193	−0.080	258	−0.509
64	+0.300	129	−0.064	194	+0.088	259	+0.162
65	−0.029	130	+0.487	195	−0.737	260	−0.056
66	−0.354	131	−0.470	196	+0.056	261	+0.307
67	−0.339	132	−0.049	197	−0.080	262	−0.437
68	+0.632	133	−0.157	198	+0.874	263	+1.147
69	+0.424	134	+0.544	199	−0.113	264	−0.615
70	+0.172	135	−0.937	200	+0.993	265	+0.433
71	−0.434	136	+0.361	201	+0.222	266	−0.069
72	−0.454	137	+0.032	202	−0.467	267	−0.364
73	+0.666	138	+1.289	203	−0.500	268	+0.583
74	−0.358	139	−0.221	204	−0.189	269	+0.397
75	−0.090	140	+0.623	205	−0.252	270	−0.980
76	+0.234	141	−0.718	206	−0.210	271	+0.515
77	−0.452	142	−0.972	207	+0.751	272	−0.515
78	+0.177	143	−0.213	208	+0.363	273	+0.341
79	−0.046	144	+0.702	209	−0.652	274	+0.524
80	−0.218	145	+0.125	210	+0.579	275	−0.735
81	+0.088	146	−0.109	211	−0.154	276	+0.291
82	−0.106	147	+0.403	212	−0.145	277	−0.421
83	+0.349	148	+0.077	213	−0.085	278	+0.060
84	+0.034	149	−1.111	214	−0.196	279	−0.291
85	+0.185	150	+0.065	215	+0.704	280	+0.224
86	−0.403	151	+0.323	216	+0.056	281	+0.499
87	+0.595	152	−0.017	217	−0.607	282	−0.492
88	−0.478	153	−0.306	218	−0.450	283	−0.135
89	+0.159	154	+0.730	219	−0.303	284	−0.511
90	−0.330	155	+0.024	220	+0.181	285	+0.174
91	+0.099	156	−0.281	221	−0.534	286	+0.511
92	−0.045	157	−0.238	222	−0.765	287	−0.040
93	−0.480	158	−0.712	223	+0.491	288	+0.565
94	−0.291	159	−0.085	224	+0.174	289	+0.019
95	+0.757	160	+0.119	225	+0.212	290	−0.267
96	+0.376	161	−0.574	226	+0.545	291	−0.564
97	−0.362	162	+0.138	227	−0.306	292	+0.248
98	+0.043	163	+0.401	228	+0.907	293	+0.239
99	−0.035	164	+0.247	229	−0.606	294	−0.321
100	−0.761	165	+0.053	230	−0.301	295	+0.165
101	−0.031	166	+0.185	231	+0.403	296	−0.095
102	+0.784	167	−0.105	232	+0.013	297	+0.011
103	−0.545	168	−0.371	233	+0.016	298	−0.546
104	+0.643	169	−0.320	234	−0.729	299	+0.575
105	−0.148	170	+0.080	235	+0.623	300	+0.226
106	−0.437	171	−0.722	236	−0.295	301	−0.065
107	−0.036	172	+0.853	237	+0.146	302	−0.189
108	+0.144	173	+0.110	238	−0.547	303	−0.009
109	+0.379	174	−0.424	239	+0.149	304	+0.421
110	−0.547	175	+0.414	240	+0.252	305	−0.433
111	+0.172	176	+0.076	241	−0.381	306	−0.196
112	−0.012	177	+0.499	242	+0.562	307	+0.217
113	+0.225	178	−0.542	243	−0.603	308	−1.108
114	+0.164	179	−0.021	244	+0.300	309	+0.250
115	−0.146	180	−0.014	245	+0.460	310	+0.040
116	+0.308	181	−0.515	246	−0.336	311	−0.094
117	−0.162	182	−0.330	247	+0.319	312	+0.825
118	+0.249	183	+0.860	248	−0.208	313	+0.178
119	−0.104	184	−1.185	249	−1.142	314	−0.093
120	−0.051	185	+0.418	250	+0.233	315	−0.062
121	+0.331	186	+0.109	251	+0.947	316	−0.103
122	+0.424	187	+0.217	252	−0.089	317	+0.165
123	+0.558	188	+0.414	253	+0.004	318	+0.710
124	−1.241	189	+0.028	254	+0.341	319	−0.604
125	+0.447	190	−0.281	255	−0.123	320	−0.020

Table of corrections to observed directions—Continued.

Number of direction.	Correction to direction.	Number of direction.	Correction to direction.	Number of direction.	Correction to direction.	Number of direction.	Correction to direction.
321	−0.596	396	+0.099	461	+0.047	526	−0.192
322	−0.264	397	+0.129	462	+0.132	527	+0.625
323	+0.677	398	−0.010	463	−1.162	528	−0.552
324	+0.008	399	+0.514	464	−0.258	529	+0.425
325	−0.904	400	+0.044	465	+0.161	530	+0.263
326	+0.132	401	−1.080	466	−0.854	531	−0.135
327	+0.048	402	+0.533	467	−0.589	532	−0.577
328	+0.752	403	+0.780	468	+1.558	533	+0.541
329	+0.033	404	+0.304	469	−0.050	534	−0.335
340[1]	+0.044	405	−0.329	470	−0.258	535	+0.357
341	−0.187	406	+0.747	471	−0.143	536	+0.024
342	+0.143	407	−0.474	472	+0.036	537	−0.095
343	−0.402	408	+0.004	473	−0.128	538	+0.074
344	−0.909	409	−0.493	474	−0.106	539	−0.091
345	+0.362	410	−0.732	475	+0.451	540	+0.080
346	+0.346	411	−0.103	476	+0.372	541	+0.320
347	−0.026	412	+0.409	477	+0.209	542	−0.285
348	+0.030	413	+0.428	478	−0.026	543	+0.702
349	−0.722	414	−0.401	479	−0.407	544	−0.647
350	+0.708	415	−0.153	480	−0.164	545	−0.168
351	−0.671	416	+0.752	481	+0.233	546	+0.033
352	+0.431	417	−0.478	482	−1.122	547	+0.080
353	+0.605	418	+0.280	483	+0.495	548	+0.109
354	−0.352	419	+1.886	484	−0.201	549	+0.007
355	+0.202	420	−1.130	485	+0.793	550	−0.368
356	+0.112	421	+0.421	486	−0.043	551	+0.411
357	−0.217	422	+0.818	487	+0.309	552	−0.887
358	−0.097	423	−0.406	488	−0.616	553	+0.128
359	+0.204	424	−1.500	489	−1.150	554	−0.299
360	+0.451	425	+0.605	490	+0.117	555	+0.658
361	+0.057	426	−0.344	491	+0.242	556	−0.390
362	−0.295	427	−0.481	492	+0.315	557	+0.031
363	−0.686	428	+0.219	493	+0.783	558	−0.058
364	+0.269	429	+0.042	494	−0.233	559	+0.035
365	+0.074	430	−0.068	495	+0.233	560	+0.275
366	−0.809	431	+0.008	496	+0.054	561	+0.157
367	+0.515	432	−0.247	497	−0.004	562	+0.410
368	+0.512	433	+0.255	498	+0.151	563	+0.150
369	+0.111	434	+0.103	499	−0.140	564	−0.260
370	−0.403	435	+1.038	500	+0.459	565	+0.256
371	−0.924	436	+0.292	501	+0.379	566	−0.116
372	+0.953	437	+0.513	502	−0.119	567	−0.029
373	−0.290	438	−0.147	503	−0.300	568	+0.226
374	+0.271	439	−1.394	504	+0.133	569	−0.761
375	−0.010	440	−0.404	505	−0.552	570	−0.471
376	+0.223	441	+0.081	506	−0.856	571	+0.261
377	−0.286	442	−0.165	507	−0.156	572	+0.745
378	+0.177	443	−0.112	508	+0.106	573	−0.251
379	+0.170	444	−0.149	509	−0.300	574	+0.304
380	−0.334	445	+0.348	510	+1.135	575	−0.982
381	+0.276	446	+0.005	511	−0.080	576	+0.003
382	+0.152	447	+0.567	512	+0.151	577	−0.156
383	−1.053	448	−0.032	513	+0.338	578	+0.418
384	−0.163	449	+0.451	514	−0.271	579	+0.665
385	+0.767	450	−1.055	515	−0.007	580	+0.563
386	+0.021	451	−0.271	516	+0.799	581	+0.986
387	−0.253	452	+0.007	517	+0.478	582	−0.393
388	+1.091	453	+0.269	518	+0.261	583	−0.749
389	−0.370	454	+0.380	519	−0.614	584	−0.726
390	+0.151	455	+0.334	520	−0.312	585	−0.180
391	−0.928	456	−0.164	521	−0.405	586	+0.498
392	+0.809	457	+0.383	522	−0.235	587	+0.294
393	+0.000	458	−0.033	523	+0.029	588	+0.679
394	+1.011	459	−0.032	524	−0.727	589	−0.973
395	−1.304	460	+0.415	525	+0.294	590	−0.251

[1] Numbers 330 to 339 omitted.

Table of corrections to observed directions—Continued.

Number of direction.	Correction to direction.	Number of direction.	Correction to direction.	Number of direction.	Correction to direction.	Number of direction.	Correction to direction.
591	−0.654	611	−0.205	631	−0.254	651	−0.134
592	+0.904	612	+0.715	632	+0.730	652	+1.319
593	+0.204	613	−0.719	633	+0.134	653	−0.031
594	−0.893	614	+0.119	634	+0.159	654	−0.625
595	−0.196	615	−0.005	635	+0.187	655	−0.690
596	+0.124	616	+0.824	636	+0.375	656	−0.404
597	−0.034	617	+0.587	637	−0.855	657	+0.393
598	−0.788	618	+0.094	638	+0.195	658	+0.395
599	+1.582	619	−1.619	639	+0.346	659	−0.030
600	+0.118	620	−0.094	640	+0.749	660	−0.324
601	+0.440	621	+0.200	641	+0.518	661	+0.027
602	+0.306	622	−0.616	642	+0.560	662	−0.209
603	+0.066	623	+0.811	643	−0.205	663	+0.209
604	+0.141	624	+0.298	644	+1.002	664	−0.134
605	−1.071	625	+0.428	645	−0.018	665	+0.134
606	−0.166	626	−0.652	646	−0.703		
607	−0.123	627	+0.225	647	−0.191		
608	+0.080	628	−0.273	648	+0.623		
609	+0.209	629	+0.524	649	−1.061		
610	+0.209	630	−0.727	650	+0.572		

The largest correction to any direction is for direction No. 419 at station Nine which amounts to +1″.886.

CORRECTIONS TO ANGLES AND CLOSURES OF TRIANGLES.

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

Table of triangles.

Station.	Correction to angle from figure adjustment.	Error of closure of triangle.	Corrected spherical angle.	Spherical excess.	Station.	Correction to angle from figure adjustment.	Error of closure of triangle.	Corrected spherical angle.	Spherical excess.
	″	″	° ′ ″	″		″	″	° ′ ″	″
Handy	+0.45	+1.04	62 55 57.40	0.32	Hickley	−.17	−0.28	34 50 39.56	0.44
Donna	+1.26		81 12 14.62		San Juan	−.06		80 02 56.13	
Rio	−.67		35 51 48.30		Handy	−.05		65 00 24.75	
San Juan	−1.36	−1.01	12 34 51.21	.08	McAllen	−.63	−.94	26 34 47.11	.33
Donna	+.61		161 04 00.37		San Juan	+.45		117 18 35.23	
Rio	−.26		0 21 08.50		Handy	−.76		36 06 37.99	
San Juan	−.41	−1.87	58 48 15.43	.16	McAllen	+.19	+.76	86 33 04.02	.36
Donna	−.65		79 51 45.75		San Juan	+.51		37 15 39.10	
Handy	−.81		41 19 58.98		Hickley	+.06		56 11 17.24	
San Juan	+.95	+.18	46 13 24.22	.40	McAllen	+.82	+1.42	59 58 16.91	.47
Rio	−.41		29 30 39.80		Handy	+.71		28 53 46.76	
Handy	−.36		104 15 56.38		Hickley	−.11		91 07 56.80	

Table of triangles—Continued.

Station.	Correction to angle from figure adjustment.	Error of closure of triangle.	Corrected spherical angle.	Spherical excess.	Station.	Correction to angle from figure adjustment.	Error of closure of triangle.	Corrected spherical angle.	Spherical excess.
	"	"	° ′ ″	"		"	"	° ′ ″	"
Mamie	+ .37	+1.10	43 43 46.26	0.32	Monument	− .02	−1.05	61 38 08.70	0.17
McAllen	+ .69		61 47 39.99		Pancho	− .33		28 28 02.89	
Hickley	+ .04		71 28 34.07		Garcia	− .70		89 53 48.58	
Mission	+ .36	+ .45	32 56 34.21	.32	Grande	− .17	− .31	78 09 39.96	.14
McAllen	+ .42		104 16 52.62		Corpus	+ .32		46 17 59.45	
Hickley	− .33		42 46 33.49		Monument	− .46		55 32 20.73	
Mission	+ .15	− .08	77 41 50.51	.29	Hebron	−1.08	−1.70	37 26 29.47	.29
McAllen	− .27		39 29 12.63		Corpus	− .37		93 48 42.20	
Mamie	− .56		02 48 57.15		Monument	− .25		48 44 48.62	
Mission	− .21	− .03	44 45 16.30	.29	Hebron	− .44	−1.35	42 56 20.04	.18
Hickley	+ .37		28 42 00.58		Corpus	− .69		47 30 42.75	
Mamie	− .19		106 32 43.41		Grande	− .22		89 32 57.39	
Pedro	+ .35	+1.01	37 55 55.58	.25	Hebron	+ .04	+ .04	5 29 50.57	.03
Mission	+ .61		47 47 09.53		Monument	− .21		6 47 32.11	
Mamie	+ .05		94 16 55.14		Grande	− .39		167 42 37.35	
Palo	− .34	− .23	37 27 25.78	.28	Ringgold	+ .16	− .25	69 29 07.39	.14
Mission	+ .37		87 54 50.31		Hebron	− .49		47 22 41.36	
Mamie	− .26		54 37 44.19		Grande	+ .08		63 08 11.39	
Palo	+ .03	− .64	84 30 45.55	.29	Ringgold	− .43	+ .48	95 19 28.03	.27
Mission	− .24		40 07 40.78		Hebron	+ .15		52 52 31.93	
Pedro	− .43		55 21 33.96		Monument	+ .76		31 48 00.31	
Palo	+ .37	+ .60	47 03 19.77	.26	Ringgold	− .59	+ .69	25 50 20.64	.10
Mamie	+ .31		39 39 10.95		Grande	+ .31		129 09 11.26	
Pedro	+ .08		93 17 29.54		Monument	+ .97		25 00 28.20	
Fordyce	.00	− .15	48 00 09.94	.26	Garcena	− .07	− .11	67 18 20.12	.09
Palo	+ .34		61 27 31.87		Heoron	+ .28		83 16 45.84	
Pedro	− .49		70 32 18.45		Ringgold	− .32		29 24 54.13	
Eltoro	− .34	− .34	36 27 36.09	.27	Gorgoro	− .38	−1.33	0 02 23.71	.03
Palo	− .08		99 37 24.97		Garcena	− .80		102 14 04.80	
Pedro	+ .08		43 54 59.21		Hebron	− .15		11 43 31.46	
Eltoro	− .56	−1.74	77 47 14.02	.21	Gorgoro	−1.12	−1.33	43 44 30.95	.20
Palo	− .42		38 09 53.10		Garcena	− .73		94 55 44.74	
Fordyce	− .76		64 02 53.09		Ringgold	+ .52		41 19 44.51	
Eltoro	− .22	−1.55	41 19 37.93	.20	Gorgoro	− .74	− .11	37 42 07.24	.26
Pedro	− .57		26 37 10.24		Hebron	+ .43		71 33 14.38	
Fordyce	− .76		112 03 03.03		Ringgold	+ .20		70 44 38.64	
Pancho	− .73	− .70	20 23 46.00	.26	Roma	+ .23	+2.20	57 18 28.41	.12
Eltoro	+ .17		116 31 06.01		Garcena	+ .73		32 48 10.64	
Fordyce	− .14		43 05 08.19		Gorgoro	+1.24		89 53 21.07	
Garcia	+ .24	− .19	70 52 25.28	.38	Chinges	+ .72	+3.31	40 52 19.43	.18
Pancho	− .11		64 28 16.51		Garcena	+1.54		98 43 24.99	
Eltoro	− .32		44 39 18.59		Gorgoro	+1.05		40 24 15.76	
Garcia	− .24	+ .77	102 12 38.21	.39	Chinges	+ .54	+1.53	65 00 20.74	.20
Pancho	+ .62		44 04 30.45		Garcena	+ .81		65 55 14.35	
Fordyce	+ .39		33 42 51.73		Roma	+ .18		49 04 25.11	
Garcia	− .48	+ .26	31 20 12.93	.27	Chinges	− .18	+ .42	24 08 01.31	.14
Eltoro	+ .49		71 51 47.42		Gorgoro	+ .19		49 29 05.31	
Fordyce	+ .25		76 47 59.92		Roma	+ .41		106 22 53.52	
Corpus	−1.02	−1.89	63 35 02.69	.21	Banchez	+ .46	+1.03	58 02 08.03	.04
Pancho	− .66		77 40 41.95		Chinges	+ .17		114 39 55.25	
Garcia	− .21		88 38 15.57		Roma	+ .40		7 17 56.76	
Monument	− .61	−1.09	37 47 05.97	.19	Margo	− .35	− .43	9 12 02.95	.03
Corpus	− .75		92 54 15.16		Banchez	− .01		116 23 06.39	
Pancho	− .33		49 18 39.06		Chinges	− .07		54 24 50.69	
Monument	− .63	− .85	99 25 14.67	.15	Margo	− .30	−1.06	77 39 13.76	.19
Corpus	+ .27		29 19 12.47		Banchez	− .47		58 20 58.36	
Garcia	− .49		51 15 83.01		Roma	− .20		43 59 48.07	

Table of triangles—Continued.

Station.	Correction to angle from figure adjustment.	Error of closure of triangle.	Corrected spherical angle.	Spherical excess.	Station.	Correction to angle from figure adjustment.	Error of closure of triangle.	Corrected spherical angle.	Spherical excess.
	"	"	° ′ ″	"		"	"	° ′ ″	"
Margo	+ .05	+0.40	68 27 10.81	0.20	Humaran	+ .14	+2.02	43 37 24.39	0.25
Chinges	+ .24		60 15 04.56		Roleta	+ .91		40 39 17.08	
Roma	+ .11		51 17 44.83		Rafael	+ .97		95 43 18.78	
Labra	+ .22	+1.00	37 13 38.42	.26	Moleno	+ .83	− .42	45 32 14.28	.29
Margo	+ .38		100 05 45.25		Humaran	− .56		64 25 13.97	
Roma	+ .40		42 40 36.59		Rafael	− .69		70 02 32.09	
Burros	− .31	−1.48	11 29 05.05	.08	Zapata	+1.57	+1.80	68 09 06.42	.26
Margo	− .38		158 23 57.48		Moleno	+ .49		75 53 59.20	
Roma	− .79		10 06 57.55		Humaran	− .26		35 56 54.64	
Burros	+ .24	− .96	72 53 32.65	.20	Zapata	+ .83	+ .70	111 57 11.13	.13
Margo	− .76		58 18 12.23		Moleno	− .34		30 21 44.97	
Labra	− .44		48 48 15.32		Rafael	+ .21		37 41 04.03	
Burros	+ .55	+1.52	61 24 27.60	.38	Zapata	− .74	−1.52	43 48 04.71	.16
Roma	+1.19		32 33 39.04		Humaran	− .30		28 28 19.33	
Labra	− .22		86 01 53.74		Rafael	− .48		107 43 36.12	
Flores	− .33	+ .40	88 16 20.17	.04	Urebeno	+1.19	+ .81	61 36 36.73	.13
Burros	− .96		80 54 06.56		Moleno	+ .42		74 47 06.24	
Labra	+1.69		10 49 33.31		Zapata	− .80		43 36 17.16	
Roleta	−1.19	− .95	0 03 45.22	.00	Feoro	+ .19	−1.16	35 33 21.57	.04
Burros	+ .42		0 89 14.78		Moleno	−1.03		17 32 33.09	
Flores	− .18		179 17 00.00		Urebeno	− .32		126 54 05.38	
Roleta	− .01	− .66	26 15 05.00	.49	Feoro	− .20	−1.21	41 46 10.57	.18
Burros	− .54		81 33 21.34		Moleno	− .61		92 19 39.33	
Labra	− .11		72 11 34.15		Zapata	− .40		45 54 10.28	
Roleta	+1.18	− .11	26 11 19.78	.45	Feoro	− .39	− .86	6 12 49.00	.01
Flores	+ .51		92 26 39.83		Urebeno	− .87		171 29 17.89	
Labra	−1.80		61 22 00.84		Zapata	+ .40		2 17 53.12	
Presa	−1.51	+ .10	10 37 26.99	.04	Loma	+ .75	+ .42	57 58 13.00	.08
Burros	+ .31		64 12 39.08		Moleno	− .51		76 08 26.09	
Flores	+1.30		105 09 53.97		Urebeno	+ .18		45 53 20.99	
Presa	− .67	−1.16	89 15 05.19	.44	Loma	+ .08	+ .71	83 39 39.87	.10
Burros	− .11		63 33 24.30		Moleno	+ .52		58 35 53.00	
Roleta	− .38		27 11 30.95		Feoro	+ .11		37 44 27.23	
Presa	+ .84	−2.21	78 37 38.20	.40	Loma	− .07	− .87	25 41 26.87	.06
Flores	−1.48		74 07 06.03		Urebeno	− .50		81 00 44.39	
Roleta	−1.57		27 15 16.17		Feoro	+ .30		73 17 48.80	
Ale	− .34	−1.11	119 57 26.56	.10	Ygnacio	− .98	+ .43	39 49 08.61	.18
Presa	−1.34		7 22 47.45		Loma	+ .12		54 12 26.29	
Roleta	+ .57		52 39 46.09		Feoro	+1.29		85 58 25.28	
Evanito	− .71	− .33	66 55 05.05	.30	Union	− .77	− .79	21 51 05.47	.29
Presa	− .25		22 31 29.26		Loma	+ .29		105 36 52.63	
Ale	+ .63		90 33 25.39		Feoro	− .31		52 32 02.19	
Evanito	−1.01	−2.27	75 19 00.43	.43	Union	−1.46	− .34	46 22 01.66	.37
Presa	−1.59		29 54 16.71		Loma	+ .17		51 24 26.84	
Roleta	+ .33		74 46 43.29		Ygnacio	+ .95		82 13 32.37	
Evanito	− .30	− .83	8 23 54.78	.03	Union	− .69	+ .88	24 30 56.19	.26
Ale	− .29		149 29 08.05		Feoro	+1.60		33 26 23.09	
Roleta	− .24		22 06 57.20		Ygnacio	− .03		122 02 40.98	
Rafael	+ .26	+1.12	54 59 55.55	.22	Dan	− .73	− .59	47 41 33.55	.14
Evanito	+ .52		62 41 44.32		Union	+ .28		115 24 07.74	
Roleta	+ .34		62 18 20.35		Ygnacio	− .14		16 54 18.85	
Humaran	− .20	−1.20	30 09 20.76	.13	Dolores	− .39	− .74	5 59 06.39	.08
Evanito	− .43		128 11 36.10		Dan	− .72		154 37 05.89	
Roleta	− .57		21 39 03.27		Union	+ .37		19 23 47.80	
Humaran	− .06	− .30	73 46 45.15	.16	Dolores	−1.41	− .60	36 00 24.37	.59
Evanito	− .95		65 29 51.78		Dan	+ .01		106 55 32.34	
Rafael	+ .71		40 43 23.23		Ygnacio	+ .80		37 04 03.88	

Table of triangles—Continued.

Station.	Correction to angle from figure adjustment.	Error of closure of triangle.	Corrected spherical angle.	Spherical excess.	Station.	Correction to angle from figure adjustment.	Error of closure of triangle.	Corrected spherical angle.	Spherical excess.
	"	"	° ′ ″	"		"	"	° ′ ″	"
Dolores	−1.02	−0.45	30 01 17.89	0.65	Fieldings	+.90	+1.39	46 27 33.22	0.10
Union	−.09		96 00 19.94		Orvil	+.71		57 54 21.65	
Ygnacio	+.60		53 58 22.73		Knob	−.22		75 38 05.29	
George	−.64	+.20	55 29 38.66	.56	Davis	+.67	−.82	21 24 14.42	.26
Dan	−.06		49 34 17.72		Orvil	−.32		112 22 18.32	
Dolores	+.90		74 56 04.18		Knob	−1.17		46 13 27.52	
Fort	+.34	−.49	26 27 38.23	.53	Davis	+.45	−1.05	42 08 28.14	.31
George	−.71		132 01 32.38		Orvil	−1.03		51 27 56.67	
Dan	−.12		21 30 49.92		Fieldings	−.47		83 23 35.50	
Fort	−.51	−.54	50 10 11.02	.55	Davis	−.22	+1.16	20 44 13.72	.21
George	−.07		76 31 53.72		Knob	+.95		29 24 37.77	
Dolores	+.04		53 17 55.81		Fieldings	+.43		129 51 08.72	
Fort	−.85	+.21	23 42 32.79	.58	Tordillo	−.30	−.12	44 41 25.71	.35
Dan	+.06		28 03 27.80		Davis	+.36		41 39 17.81	
Dolores	+1.00		128 13 59.99		Fieldings	−.18		93 39 16.83	
Casbeer	−1.52	−1.77	59 51 32.05	.43	Coleman	+1.49	+.65	40 08 29.27	.47
George	−.20		39 24 43.35		Davis	−.38		54 27 33.52	
Fort	+.04		80 43 45.03		Fieldings	−.46		85 23 57.68	
Taylor	−.39	−1.45	57 33 18.80	.11	Coleman	+.40	−.78	62 41 02.57	.18
Casbeer	−1.21		114 44 32.09		Davis	−.74		12 48 15.71	
George	+.15		7 42 08.26		Tordillo	−.50		104 30 41.90	
Taylor	−.42	−.43	111 52 18.82	.06	Coleman	−1.03	−1.55	22 32 33.30	.06
Casbeer	+.31		54 53 00.94		Fieldings	+.28		8 15 19.15	
Fort	−.32		13 14 40.30		Tordillo	−.80		149 12 07.61	
Taylor	−.03	−.75	64 18 59.96	.38	Tajone	+.18	−1.37	66 24 54.70	.28
George	−.44		31 42 35.09		Davis	−.18		16 46 26.20	
Fort	−.28		93 58 25.33		Coleman	−1.37		16 48 39.38	
Laredo	+.11	−.30	48 18 02.40	.24	Thomas	+.28	−2.56	12 05 09.52	.37
Taylor	−.72		18 06 46.20		Tajone	−1.08		104 19 35.81	
Fort	+.31		83 35 11.64		Davis	−1.76		63 35 15.04	
Orvil	−.59	+.39	26 31 52.87	.44	Thomas	−.17	−2.16	53 22 07.93	.81
Taylor	−.28		100 02 47.04		Tajone	−1.26		37 54 41.11	
Fort	+1.26		53 25 19.93		Coleman	−.19		88 43 11.77	
Orvil	−1.46	−.33	46 59 56.84	.47	Thomas	−.09	−.97	41 16 58.41	.72
Taylor	+.44		51 56 01.44		Davis	+1.58		33 11 11.16	
Laredo	+.09		81 04 02.19		Coleman	−1.56		105 31 51.15	
Orvil	−.87	−1.02	20 28 03.97	.27	Brewster	−.37	+.45	69 31 23.76	1.10
Fort	−.95		30 09 51.71		Tajone	+.31		43 22 01.04	
Laredo	+.80		129 22 04.59		Thomas	+.51		67 06 36.30	
Knob	+.90	−.10	61 05 17.39	.34	Willie	−.29	−.70	63 22 59.65	.98
Orvil	−.09		97 10 33.08		Brewster	+.31		82 37 10.73	
Taylor	−.91		21 44 09.27		Tajone	−.72		33 59 50.60	
Knob	+1.06	+1.33	89 10 27.36	.30	Willie	+.52	+.85	120 45 53.82	.17
Orvil	+.60		70 38 40.81		Brewster	+.68		13 05 46.97	
Fort	−.23		20 10 52.22		Thomas	−.35		46 08 19.38	
Knob	+.27	+.95	98 07 13.37	.21	Willie	+.81	+2.00	57 22 54.17	.29
Orvil	+1.37		50 10 36.84		Tajone	+1.03		9 22 10.44	
Laredo	−.69		31 42 10.00		Thomas	+.16		113 14 55.68	
Knob	+.10	+1.82	28 05 09.97	.49	Cup	+.11	−.39	61 57 34.30	.51
Taylor	+.03		78 18 38.37		Brewster	+.33		53 28 33.23	
Fort	+1.03		73 36 12.15		Willie	−.83		64 33 52.08	
Knob	−.03	+.72	37 01 55.98	.34	Galvan	+1.12	+.62	36 18 58.05	.30
Taylor	+1.35		30 11 52.17		Brewster	−.22		123 31 27.18	
Laredo	.00		112 46 12.19		Willie	−.28		20 09 35.07	
Knob	−.79	−1.40	8 56 46.01	.09	Galvan	+.78	−.04	76 23 37.47	.35
Fort	−.72		9 58 59.49		Brewster	−.55		70 02 53.95	
Laredo	+.11		161 04 14.59		Cup	−.27		33 33 28.93	

Table of triangles—Continued.

Station.	Correction to angle from figure adjustment.	Error of closure of triangle.	Corrected spherical angle.	Spherical excess.	Station.	Correction to angle from figure adjustment.	Error of closure of triangle.	Corrected spherical angle.	Spherical excess.
	"	"	° ′ ″	"		"	"	° ′ ″	"
Galvan	− .34	−1.05	40 04 39.42	0.56	Indio	− .20	+0.16	85 00 54.33	0.63
Willie	− .55		44 24 17.91		Glass	− .40		55 56 43.24	
Cup	− .16		95 31 03.23		Barr	+ .76		39 02 23.06	
Twin	+ .41	+ .05	38 23 32.69	.20	Indio	+ .13	+1.97	29 26 33.57	.47
Galvan	− .29		14 38 06.01		English	+1.10		61 31 47.33	
Cup	− .07		126 58 21.50		Barr	+ .74		89 01 39.57	
Cat	+1.36	+1.43	32 45 16.80	1.01	Farland	.00	−1.46	38 10 31.88	.40
Galvan	− .42		65 48 08.90		Glass	− .50		119 26 34.87	
Cup	+ .49		81 26 35.31		English	− .96		22 22 53.65	
Cat	+1.15	+1.26	44 27 46.46	1.11	Farland	− .40	+ .12	62 08 08.23	.58
Galvan	− .13		51 10 02.89		Glass	− .75		92 30 29.20	
Twin	+ .24		84 22 11.76		Barr	+1.27		25 21 23.15	
Cat	− .21	− .12	11 42 29.66	.30	Farland	− .92	−1.36	93 33 26.57	.22
Cup	− .56		45 31 46.19		Glass	− .35		36 33 45.90	
Twin	+ .65		122 45 44.45		Indio	− .09		49 52 47.69	
Tom	+ .94	+ .87	92 28 03.02	.59	Farland	− .40	+2.13	23 57 36.35	.61
Cat	+ .79		48 50 56.76		English	+1.28		80 41 44.00	
Twin	− .86		38 41 00.21		Barr	+1.25		75 20 39.06	
Big	− .04	+1.24	37 52 59.47	.05	Farland	− .92	−1.16	55 22 54.69	.41
Tom	+ .36		136 42 22.29		English	+ .18		19 09 57.27	
Cat	+ .92		5 24 38.29		Indio	− .42		105 27 08.45	
Big	+ .23	+ .08	130 10 20.32	.06	Farland	− .52	−1.32	31 25 18.34	.27
Tom	− .58		44 14 18.67		Barr	− .51		13 40 59.91	
Twin	+ .43		5 35 21.07		Indio	− .29		134 53 42.02	
Big	+ .27	− .29	92 17 20.85	.60	Mack	− .28	− .23	85 57 15.44	.05
Cat	− .13		43 26 18.47		Glass	− .39		11 06 04.19	
Twin	− .43		44 16 21.28		Farland	+ .44		82 56 40.42	
Carlow	+1.09	+ .51	46 45 19.66	.55	Kennedy	− .45	+1.43	46 43 57.13	.29
Cat	− .92		74 37 32.45		Glass	+ .56		84 54 35.18	
Tom	+ .34		58 37 08.44		Farland	+1.32		48 21 27.98	
Dentonio	− .23	+ .51	103 12 44.48	.24	Kennedy	− .04	+1.47	51 54 39.80	.28
Carlow	+1.01		48 35 46.87		Glass	+ .95		73 48 30.99	
Cat	− .27		28 11 28.89		Mack	+ .56		54 16 49.49	
Dentonio	+ .10	− .56	176 46 24.13	.01	Kennedy	+ .41	− .19	5 10 42.67	.04
Carlow	− .08		1 50 27.21		Farland	− .88		34 35 12.44	
Tom	− .58		1 23 08.67		Mack	+ .28		140 14 04.93	
Dentonio	+ .33	− .56	73 33 39.65	.32	Silo	− .75	− .12	50 13 56.32	.43
Cat	− .65		46 26 03.56		Kennedy	− .01		74 27 50.85	
Tom	− .24		60 00 17.11		Mack	+ .64		55 18 13.26	
Barr	+ .66	− .03	78 49 08.90	.51	Davidson	+1.34	− .41	25 18 35.32	.26
Carlow	+ .62		56 23 18.85		Kennedy	− .51		133 17 40.87	
Tom	−1.31		44 47 32.76		Mack	−1.24		21 23 44.07	
English	+1.43	+1.34	55 27 31.06	.31	Davidson	− .12	+ .31	71 52 07.34	.33
Carlow	− .10		106 07 19.89		Kennedy	− .50		58 49 50.02	
Tom	+ .01		18 25 06.36		Silo	+ .93		49 18 02.97	
English	+ .05	−1.01	98 22 07.98	.18	Davidson	−1.46	+ .60	46 33 32.02	.50
Carlow	− .72		49 44 01.04		Mack	+1.88		33 54 29.19	
Barr	− .37		31 53 51.16		Silo	+ .18		99 31 59.29	
English	−1.38	−2.41	42 54 33.92	.38	Pass	+ .52	+ .73	36 45 02.07	.58
Tom	−1.32		26 22 26.40		Davidson	+ .52		74 10 05.25	
Barr	+ .29		110 43 00.06		Silo	− .31		69 04 53.26	
Glass	+ .25	+ .55	20 56 05.67	.43	Lone	+ .95	+ .56	85 32 37.71	.40
English	+ .32		103 04 38.25		Davidson	+ .15		27 48 13.38	
Barr	− .02		49 59 16.51		Pass	− .54		66 39 09.31	
Indio	+ .33	−1.26	55 34 20.76	.59	Eagle	+1.08	+ .94	65 15 25.14	.35
Glass	− .15		82 52 48.91		Lone	−1.37		91 21 03.80	
English	− .78		41 32 50.92		Davidson	+1.23		23 23 31.41	

Table of triangles—Continued.

Station.	Correction to angle from figure adjustment.	Error of closure of triangle.	Corrected spherical angle.	Spherical excess.	Station.	Correction to angle from figure adjustment.	Error of closure of triangle.	Corrected spherical angle.	Spherical excess.
	"	"	° ′ ″	"		"	"	° ′ ″	"
Eagle	+1.30		143 01 35.02		Lake	−1.20		65 39 24.42	
Lone	−2.32	+0.59	5 48 26.09	0.02	Pen	− .25	−1.89	53 07 02.15	0.13
Pass	+1.61		31 09 58.91		Wilfp	− .44		61 13 33.56	
Eagle	−1.22		35 17 48.39		Towne	−1.32		39 18 16.20	
Davidson	− .56	− .89	78 34 47.22	.60	White	+ .02	− .89	80 04 46.81	.20
Silo	+ .89		66 07 24.99		Wilfp	+ .41		60 36 57.19	
Eagle	+ .22		77 46 09.88		Jamerson	−1.50		21 25 23.54	
Davidson	−1.08	+ .21	4 24 41.97	.07	White	+ .51	−1.52	121 50 54.33	.21
Pass	+1.07		97 49 08.22		Wilfp	− .53		36 43 42.34	
Eagle	+1.44		42 28 21.40		Jamerson	− .72		56 17 26.41	
Silo	−1.20	+1.83	2 57 28.27	.05	White	+ .49	+ .32	41 46 07.52	.23
Pass	+1.59		134 34 10.29		Towne	+ .55		81 56 26.30	
Laplace	+ .51		19 24 55.47		Jamerson	+ .78		34 52 02.87	
Eagle	−1.46	−2.07	49 38 24.14	.02	Wilfp	+ .94	+ .05	23 53 14.85	.22
Pass	−1.12		110 56 40.41		Towne	− .77		121 14 42.50	
Laplace	+ .53		76 28 32.07		Dixie	−1.29		86 10 46.97	
Eagle	− .02	− .82	92 06 45.63	.23	Jamerson	+ .87	− .06	70 47 35.90	.28
Silo	−1.33		11 24 42.53		Towne	− .54		73 01 37.41	
Laplace	+ .02		57 03 36.60		Peters	+ .42		32 43 52.33	
Pass	− .47	− .58	114 29 09.30	.16	Jamerson	+ .54	+ .46	114 54 58.92	.17
Silo	− .13		8 27 14.26		Towne	− .50		32 31 08.92	
Nine	−1.31		32 28 01.78		Peters	− .60		98 44 16.10	
Lone	+1.40	+ .54	59 59 27.99	.25	Jamerson	− .33	−1.45	44 07 23.02	.21
Eagle	+ .45		87 32 30.55		Dixie	− .52		37 08 21.09	
Nine	−1.00		19 37 43.61		Peters	−1.02		66 00 23.77	
Eagle	− .29	− .66	79 47 30.29	.18	Towne	− .01	−2.87	40 40 28.49	.32
Laplace	+ .63		80 34 46.23		Dixie	−1.81		73 19 08.06	
Paloma	+ .25		20 58 41.75		Ross	+ .21		35 13 24.07	
Lone	+1.43	+ .99	119 05 53.04	.24	Peters	+2.44	+3.34	79 47 14.53	.37
Eagle	− .69		39 55 25.45		Dixie	+ .69		64 59 21.77	
Paloma	+1.15		62 20 29.83		Brackett	+ .11		6 11 27.19	
Lone	+ .03	+1.58	59 00 25.05	.44	Peters	+ .81	+1.15	155 10 45.49	.30
Nine	+ .40		58 33 05.56		Dixie	+ .23		18 37 47.62	
Paloma	+ .90		41 21 48.08		Brackett	+ .88		30 38 53.62	
Eagle	+1.14	+1.13	47 37 05.10	.45	Peters	−1.63	−1.58	75 23 30.96	1.08
Nine	− .91		91 01 07.27		Ross	− .83		73 57 36.50	
Burr	+ .70		124 43 12.31		Brackett	+ .77		24 27 26.43	
Paloma	−1.23	+1.02	22 33 51.26	.13	Dixie	+ .46	+ .01	46 21 34.15	1.15
Nine	+1.55		32 42 50.56		Ross	− .62		109 11 00.57	
Pen	− .10		62 15 04.24		Dobkins	+1.61		26 56 56.79	
Paloma	+ .76	+ .52	43 51 05.64	.16	Brackett	− .75	+ .62	12 27 59.57	.65
Burr	− .14		73 53 50.28		Ross	− .24		140 35 04.29	
Wilfp	−1.24		42 21 33.12		Dobkins	+ .92		45 07 01.01	
Pen	+ .00	−2.13	88 44 55.40	.15	Brackett	+ .13	+1.59	43 00 53.19	2.03
Burr	− .95		48 53 31.57		Peters	+ .54		91 46 04.83	
Wilfp	+ .99		24 35 39.52		Dobkins	− .69		18 10 07.22	
Burr	+ .39	−1.04	112 29 25.84	.16	Ross	+1.07	+2.55	145 27 19.21	.30
Nine	−3.02		42 54 54.80		Peters	+2.17		16 22 33.87	
White	− .25		64 23 50.37		Hamilton	− .93		51 48 01.66	
Pen	+ .25	− .00	60 00 83.46	.13	Brackett	− .74	−1.83	50 29 49.59	2.05
Wilfp	− .66		55 35 36.30		Ross	− .16		77 42 10.80	
Lake	+ .50		68 53 46.17		Hamilton	− .19		80 48 15.94	
White	− .19	+ .81	109 12 42.54	.02	Brackett	+ .01	−1.13	38 01 50.02	2.29
Pen	+ .50		6 53 31.31		Dobkins	− .95		61 09 56.33	
Lake	− .70		129 33 10.59		Hamilton	+ .74		29 00 14.28	
White	+ .06	− .42	44 48 62.17	.02	Ross	− .08	+1.32	62 52 53.49	.89
Wilfp	+ .22		4 37 57.26		Dobkins	+ .66		88 06 53.12	

Table of triangles—Continued.

Station.	Correction to angle from figure adjustment.	Error of closure of triangle.	Corrected spherical angle.	Spherical excess.
	"	"	° ′ ″	"
Johnstone	+ .46	+2.13	154 00 47.35	0.11
Dobkins	+ .40		21 21 35.63	
Hamilton	+1.27		4 37 37.13	
Moore	+ .20	+ .20	116 54 33.17	.50
Hamilton	+ .12		32 53 26.27	
Dobkins	− .12		30 13 01.06	
Kelly	+ .43	+ .43	4 04 26.91	.05
Hamilton	+ .08		2 53 12.06	
Moore	− .08		173 02 21.08	
Kelly	− .25	−1.01	75 29 24.33	.92
Hamilton	+ .20		35 45 38.33	
Dobkins	− .96		68 44 58.26	
Kelly	− .68	−1.04	71 24 57.42	.37
Moore	− .12		70 03 05.75	
Dobkins	− .84		38 31 57.20	
Mark	+ .70	+ .95	33 09 00.34	.83
Hamilton	+ .54		86 18 23.75	
Moore	− .29		60 32 36.74	
Mark	+ .97	+1.25	50 30 02.50	1.40
Hamilton	+ .46		83 25 11.69	
Kelly	− .18		46 04 47.21	
Mark	+ .27	+ .73	17 21 02.16	.62
Moore	+ .21		112 29 44.34	
Kelly	+ .25		50 09 14.12	
Feely	+ .21	− .78	56 52 11.66	1.92
Mark	− .41		40 13 51.12	
Kelly	− .58		82 53 50.14	
McNutt	+ .18	+ .70	46 48 02.70	2.72
Mark	+1.02		79 47 59.22	
Kelly	− .50		53 24 00.71	
McNutt	+ .44	+1.26	76 01 31.63	2.08
Mark	+1.43		39 34 08.10	
Feely	− .61		64 24 22.35	
McNutt	+ .26	− .22	29 13 28.84	1.28
Kelly	− .08		29 29 58.43	
Feely	− .40		121 16 34.01	
Harrison	+ .98	− .10	57 29 24.63	2.56
Mark	− .98		75 31 46.02	
McNutt	− .10		46 58 51.91	
Jim	− .49	+ .56	48 28 30.33	2.48
Harrison	+ .62		57 41 40.70	
Mark	+ .23		73 49 51.45	
Jim	+ .32	+ .47	173 29 59.61	.01
Harrison	− .16		0 12 16.07	
McNutt	+ .31		6 17 44.33	
Jim	+ .81	− .19	125 01 29.28	.09
Mark	−1.21		1 41 54.57	
McNutt	+ .21		53 16 36.24	
Blue	+1.12	+1.75	52 59 54.54	3.45
Harrison	− .40		48 19 22.04	
Jim	+1.03		78 40 46.87	
Blue	+ .25	− .88	54 52 32.89	3.57
Harrison	− .56		48 31 38.11	
McNutt	− .57		76 35 52.57	
Blue	− .87	−3.10	1 52 38.35	.11
Jim	−1.35		107 49 13.52	
McNutt	− .88		70 18 08.24	

Station.	Correction to angle from figure adjustment.	Error of closure of triangle.	Corrected spherical angle.	Spherical excess
	"	"	° ′ ″	"
Tippetts	+ .05	+0.20	72 34 51.25	2.22
Blue	+ .69		61 42 39.32	
McNutt	− .54		45 42 31.65	
Babb	+ .77	+ .91	42 40 57.02	2.21
Blue	+ .36		109 08 13.71	
McNutt	− .22		28 10 51.48	
Babb	+ .60	+ .47	71 06 20.73	1.29
Blue	− .33		47 25 34.39	
Tippetts	+ .20		61 28 00.17	
Babb	− .17	− .24	28 25 29.71	1.30
McNutt	− .82		17 31 40.17	
Tippetts	+ .25		134 02 51.42	
Proctor	+1.02	+ .92	61 53 20.23	.95
Babb	+ .77		63 39 12.85	
Tippetts	− .87		54 27 27.87	
Ike	+ .96	+1.85	40 20 44.03	.13
Babb	+ .41		133 46 29.05	
Tippetts	+ .48		5 52 47.05	
Ike	− .09	−1.75	100 09 31.08	.10
Babb	− .36		70 07 16.20	
Proctor	−1.30		9 43 12.88	
Ike	−1.05	−2.68	59 48 47.05	.98
Tippetts	−1.35		48 34 40.82	
Proctor	− .28		71 36 33.11	
Bassett	+ .09	− .84	3 07 47.37	.62
Babb	− .60		9 32 26.24	
Ike	− .33		167 19 46.41	
Bassett	+ .33	−1.15	62 36 51.32	.66
Babb	− .96		79 39 42.44	
Proctor	− .52		37 43 26.90	
Bassett	+ .24	+1.44	59 29 03.95	.48
Ike	+ .42		92 30 42.51	
Proctor	+ .78		28 00 14.02	
Hoddy	− .41	−2.07	56 05 16.50	.49
Bassett	− .68		103 34 52.54	
Proctor	− .98		20 19 51.45	
Peggy	+ .73	+ .27	12 29 04.53	.51
Hoddy	+ .10		126 44 59.46	
Bassett	− .56		40 45 56.52	
Peggy	+1.21	+2.23	51 34 35.97	1.67
Hoddy	+ .51		70 39 42.96	
Proctor	+ .51		57 45 42.74	
Peggy	+ .48	− .11	39 05 31.44	1.65
Bassett	− .12		62 48 56.02	
Proctor	− .47		78 05 34.19	
Hen	+ .55	+ .56	63 01 42.21	1.44
Hoddy	− .28		44 47 23.54	
Peggy	+ .29		72 10 55.69	
Eldridge	+ .57	+ .91	52 16 01.62	.94
Hen	+ .25		106 56 25.81	
Hoody	+ .09		20 47 33.51	
Eldridge	+1.25	− .04	99 19 19.71	.51
Hen	− .30		43 54 43.60	
Peggy	− .99		36 45 57.20	
Eldridge	+ .68	− .39	47 03 18.09	1.01
Hoddy	− .37		23 59 50.03	
Peggy	− .70		108 56 52.89	

Table of triangles—Continued.

Station.	Correction to angle from figure adjustment.	Error of closure of triangle.	Corrected spherical angle.	Spherical excess.
	"	"	° ′ ″	"
Dryden east base	−1.26	−0.26	109 42 42.77	0.15
Eldridge	+.02		36 54 49.61	
Hen	+.98		33 22 27.77	
Dryden west base	−.40	−1.23	64 38 15.62	.13
Hen	+.82		45 55 49.01	
Dryden east base	−1.65		69 25 55.50	
Dryden west base	+1.16	+.64	145 23 33.48	.06
Hen	−.16		12 33 21.24	
Eldridge	−.36		22 03 05.34	
Dryden west base	+1.56	+1.61	80 45 17.86	.08
Dryden east base	+.39		40 16 47.27	
Eldridge	−.34		58 57 54.95	
Road	−1.21	−2.11	31 15 06.69	.39
Hen	+.41		31 00 25.77	
Eldridge	−1.31		117 44 27.93	
Sanderson	−1.10	−2.17	27 43 38.40	.82
Hen	+.66		92 11 43.41	
Eldridge	−1.73		60 04 39.01	
Sanderson	−.40	−.08	55 09 18.22	1.22
Hen	+.25		61 11 17.04	
Road	+.07		63 39 25.36	
Sanderson	+.70	−.02	27 25 39.82	.79
Eldridge	+.42		57 39 48.02	
Road	−1.14		91 54 32.05	
New	+.05	−.01	55 58 55.25	1.37
Sanderson	+.31		63 37 47.81	
Road	−.37		60 23 18.31	
Dry	−1.41	−1.51	29 11 53.06	2.47
Sanderson	+.16		94 52 13.55	
Road	−.23		55 55 55.86	
Dry			31 10 22.52	1.35
Sanderson	−.15		31 14 25.74	
New	−.38		114 35 13.09	
Dry			4 58 29.46	.25
Road	−.14		4 27 22.45	
New	−.33		170 34 08.34	
Brown	−.49	−.74	2 57 32.52	.14
Sanderson	−.79		1 10 38.10	
Dry	+.51		175 45 49.52	
Brown			20 02 39.15	2.00
Sanderson	−.01		32 31 03.84	
New	−.25		127 26 19.01	
Brown	−2.20	−2.85	21 24 01.74	3.53
Sanderson	−.60		96 08 51.65	
Road	−.05		62 27 10.14	
Brown			17 05 06.03	.51
Dry			150 03 47.96	
New	+.13		12 51 05.92	
Brown	−1.71	−.00	18 26 29.22	.92
Dry	+.93		155 02 17.42	
Road	+.18		6 31 14.28	

Station.	Correction to angle from figure adjustment.	Error of closure of triangle.	Corrected spherical angle.	Spherical excess
	"	"	° ′ ″	"
Brown			1 21 22.50	0.16
New	+.20		176 34 45.74	
Road	+.32		2 03 51.83	
Pyle	+.89	+3.43	83 24 04.82	2.18
Sanderson	+1.61		30 13 33.89	
Dry	+.93		66 22 23.47	
Pyle	+.08	+2.21	109 58 11.96	3.02
Sanderson	+2.37		34 56 55.79	
Brown	−.24		35 04 55.27	
Pyle	−.81	−1.96	26 34 07.14	.98
Dry	−.42		115 23 26.05	
Brown	−.73		38 02 27.79	
Nation	+.48	+2.72	79 22 00.90	1.93
Pyle	+1.42		49 09 52.65	
Brown	+.82		51 28 08.38	
Madera	−1.08	−2.84	55 14 47.29	1.56
Pyle	−.51		39 21 32.22	
Nation	−1.25		85 23 42.05	
Chancellor	+.03	+1.70	36 47 27.47	1.03
Madera	+.88		110 17 23.65	
Nation	+.79		32 55 00.91	
Ord	−.05	−1.02	31 50 20.55	4.86
Chancellor	+.03		59 44 05.26	
Nation	−1.00		88 25 39.05	
Ord	+.36	+1.22	28 30 28.31	3.73
Nation	+.98		73 53 28.09	
Brown	−.12		77 36 07.33	
Beard	−1.02	−3.33	69 33 45.92	6.87
Chancellor	−1.04		70 33 47.75	
Ord	−1.27		39 52 33.20	
Baldy	+.35	+.13	53 31 26.48	10.40
Beard	−.77		71 45 39.72	
Ord	+.55		54 43 01.20	
Star	−1.68	−2.36	57 47 20.09	9.63
Chancellor	+.19		58 35 30.75	
Ord	−.87		63 37 18.79	
Star	+1.63	+1.84	90 58 45.20	0.57
Ord	+.15		30 58 18.61	
Baldy	+.06		58 03 02.76	
Newman	−1.94	−2.06	83 10 10.20	5.95
Beard	+.60		38 45 45.64	
Baldy	−.72		58 04 01.05	
Newman	−.62	−1.75	60 18 02.18	3.38
Star	−.70		60 09 36.43	
Baldy	−.43		53 32 24.77	
Chispa	+.26	+1.06	39 53 50.04	5.74
Newman	−.06		57 08 38.18	
Baldy	+.86		82 57 36.62	
Krouse	+.53	+.47	35 28 50.79	4.00
Newman	−.06		110 27 52.84	
Baldy	−.00		34 03 20.37	
Krouse	−.53	+.59	52 38 57.55	7.04
Baldy	+.86		48 51 16.25	
Chispa	+.26		78 26 53.24	

ACCURACY OF OBSERVATIONS.

The maximum correction to any one angle is +2″.44 to the angle at Peters between Dixie and Ross. A table is given below showing statistics in regard to the accuracy of the precise triangulation of the arc considered in this publication. The mean error of an angle $\alpha = \sqrt{\frac{\Sigma\Delta^2}{3n}}$, in which $\Sigma\Delta^2$ is the sum of the squares of the closing errors of the triangles and n is the number of triangles.

STATISTICS SHOWING ACCURACY OF TRIANGULATION.

Total number of triangles	271
Number of triangles with plus closures	120
Number of triangles with minus closures	146
Number of concluded triangles	5
Average closure of all triangles without regard to sign	1″.02
Maximum closure of a triangle	3″.43
Mean error of an angle	±0″.72
Probable error of an observed direction	±0″.50

The average closing error of the 266 closed triangles of this arc is 1″.02; the instructions under which the work was done call for an average closure of 1″.00. The instructions say that the closing error of a triangle shall seldom exceed 3″.00; in this work there are four triangles where this limit of 3″.00 is exceeded, the maximum being 3″.43.

A comparison of the average closing errors of triangles in various arcs is given below:

	Average closing error.
	″
Ninety-eighth meridian in United States and Mexico	0.63
Texas-California arc	.90
Ninety-eighth meridian arc	.92
One hundred and fourth meridian arc	.99
Rio Grande arc	1.02
Transcontinental triangulation	1.06
Utah-Washington arc	1.12
Eastern oblique arc	1.19
California-Washington arc	1.22

COMPUTATION, ADJUSTMENT, AND ACCURACY OF THE ELEVATIONS.

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

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

$$h_2 - h_1 = s \tan \tfrac{1}{2} (\zeta_2 - \zeta_1) \text{ [A B C]}$$

in which h_2 and h_1 are elevations of the stations, ζ_2 and ζ_1 are the measured zenith distances as corrected for height of instrument and of object observed, s is the horizontal distance between the stations, and

A, B, and C are correction factors whose values are nearly unity and are as follows:

$$A = 1 + \frac{h_1}{\rho} = \text{correction for elevation of the station whose elevation is known.}$$

$$B = 1 + \frac{s}{2\rho} \tan \frac{(\zeta_2 - \zeta_1)}{2} = \text{correction for approximate difference of elevation.}$$

$$C = 1 + \frac{s^2}{12\rho^2} = \text{correction for distance.}$$

The logarithms of these corrections are given in tabular form on pages 64 and 65 of U. S. Coast and Geodetic Survey Special Publication No. 26, and also on pages 218 and 219 of Special Publication No. 28.

The elevations of the stations of the main scheme for the entire arc from the ninety-eighth meridian to the Texas-California triangulation were adjusted in two sets of equations. The first adjustment involved all stations of the main scheme from the ninety-eighth meridian triangulation to the Zapata base. The second adjustment fixed the elevations of the main scheme stations from the Zapata base to the Texas-California triangulation.

In the first adjustment the elevations of stations Rio, Donna, San Juan, Mamie, Pedro, Ringgold, Labra, Zapata, Urebeno, Feora, and Loma were held fixed with elevations as given in the table on page 31. Rio and Donna are stations of the ninety-eighth meridian triangulation [1] previously adjusted, and therefore no change was made in their elevations. The nine remaining stations are bench marks on a line of precise levels forming a part of the level net of the United States.

The probable error of an observation of unit weight derived from this adjustment is ± 1.09 meters. In other words, the reciprocal observations over a line 31.7 kilometers (19.7 miles) long, this being the length of line corresponding to unit weight, determined the difference of elevation of two points with such a degree of accuracy that it is an even chance whether the error is greater or less than 1.09 meters. The probable errors for the lines were assumed to be proportional to their lengths.

The elevation of station Pancho was assumed to be the least accurately determined of any along this part of the arc, and its probable error was computed as a limiting value and found to be ± 0.27 meter.

In the second adjustment the elevations of stations Loma, Feora, Laredo, Tajone, Laplace, Johnstone, Dryden east base, Dryden west base, Newman, Krouse, and Chispa were held fixed with the elevations as given in the table on page 31. Of these stations Newman, Krouse, and Chispa are a part of the Texas-California triangulation which has been previously adjusted, while the rest are bench marks of a line of precise levels which forms a part of the level net of the United States.

[1] See U. S. Coast and Geodetic Survey Special Publication No. 54.

The probable error of an observation of unit weight derived from this adjustment is ±1.38 meters. In other words, the reciprocal observations over a line 31.7 kilometers (19.7 miles) long, this being the length of line corresponding to unit weight, determined the difference of elevation of two points with such a degree of accuracy that it is an even chance whether the error is greater or less than 1.38 meters. The probable errors for the lines were assumed to be proportional to their lengths.

The elevation of station Blue was assumed to be the one least accurately determined, and its probable error was computed as a limiting value and found to be ±0.90 meter from the vertical angles alone, or when combined with the probable error of the elevations of stations fixed by previous vertical adjustment it is not greater than ±1.00 meter.

The datum for all the elevations is mean sea level. The stations are in three classes: First, those fixed by direct connection with precise level elevations, the elevations of which are subject to a probable error of ±0.15 meter; second, the stations in the main scheme fixed by reciprocal measures of vertical angles and subject to probable errors varying from ±0.15 meter to ±0.9 meter; and, third, the intersection stations, the elevations of which are fixed by measurement of vertical angles which are not reciprocal, the stations not being occupied, and subject to probable errors which may be as great as ±2 meters.

The table of elevations is given in Part I. (See p. 31.)

INDEX TO POSITIONS, DESCRIPTIONS, ELEVATIONS, AND SKETCHES.

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

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

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

Station.	Position.	Description.	Elevation.	Sketch.
Mexico—Continued.				
Tallest of 3 stacks, mine	Page. 22	Page.	Page.	No. 8
White house	20			6
Mine, house, small	21			7
Mission	11	35	31	5
Mission:				
First lift pump, stack	18		32	5
Second lift pump, stack	18			5
Standpipe	17			5
Third lift pump, stack	18		32	5
Moffeta section house, south gable	25			9
Moleno	12	38	31	6
Moleno, reference mark	26			
Monastery, north end, east cupola	18		32	5
Monument	11	36	31	
Monument, reference mark	27			
Monument, R. P. 4, International Boundary Survey	18		32	5
Moore	15	46	31	9
Moore, reference mark	29			
Moore, windmill near station	24			
Moore, windmill north of station	24			
Mountain Peak No. 1 (Mexico)	19			
Mountain Peak No. 2 (Mexico)	20			
Mountain Peak No. 3 (Mexico)	20			
Mountain Peak No. 4 (Mexico)	20			
Nation	16	49	31	9,10
Nation, reference mark	30			
Neely's ranch, windmill	23			8
New	16	48	31	9
New, reference mark	30			
Newman	17	50	31	10
Nine	14	44	31	8
Nine, reference mark	28			
Nine, windmill northeast of station	23			8
Nine, windmill south of station	23			8
North Eagle Pass, prominent building, latticework on roof	23			8
North wireless mast, Laredo	20		32	6
Northeast windmill, Capatosa ranch	18			5
Nuevo Laredo:				
Catholic church (see Laredo Catholic Church).				
Church	20			6
Presbyterian church	20			6
Standpipe	20		32	6
Oil derrick No. 1	19			5
Oil derrick No. 2	19			5
Ord (U. S. G. S.)	16	49	31	10
Ord (U. S. G. S. cairn)	25			
Ord (U. S. G. S.), reference mark	30			
Orvil	13	40	31	6,7
Orvil, reference mark	27			
Orvil, white windmill southwest of station	21			6
Orvil, windmill east of station	21			7
Orvil, windmill northeast of station	21			7
Palo	11	35	31	5
Palo, reference mark	25			
Paloma	14	44	31	8
Paloma, house 3 miles northwest of station, north gable	23			8
Paloma ranch, windmill	23			8
Paloma, reference mark	28			
Pancho	11	36	31	5
Pancho, reference mark	27			
Pass	14	44	31	8
Pass, reference mark	28			
Pedro	11	35	31	5
Pedro, reference mark	25			
Peggy	16	48	31	9
Peggy, reference mark	29			
Pen	14	45	31	8
Pen, reference mark	28			
Peters	15	45	31	8
Peters, reference mark	29			
Pharr:				
Elevator east of railroad station, flagpole	17			5
Post office, pagoda cupola	17			5
Standpipe, finial	17		32	5
Post office, Pharr, pagoda cupola	17			5
Precise level bench mark E 31	24			8
Presa	12	38	31	5
Presa, reference mark	26			
Presbyterian Church, Nuevo Laredo	20			6
Proctor	15	47	31	9
Proctor, reference mark	29			
Prominent building, North Eagle Pass, lattice work on roof	23			8
Pump stack, first lift, Mission	18		32	5
Pump stack, second lift, Edinburg	18			5
Pump stack, second lift, Mission	18			5
Pump stack, third lift, Mission	18		32	5
Pumping station, southernmost of two stacks	20			6
Pump station, tall metal stack	17			5
Pyle	16	49	31	9
Pyle, reference mark	30			

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

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

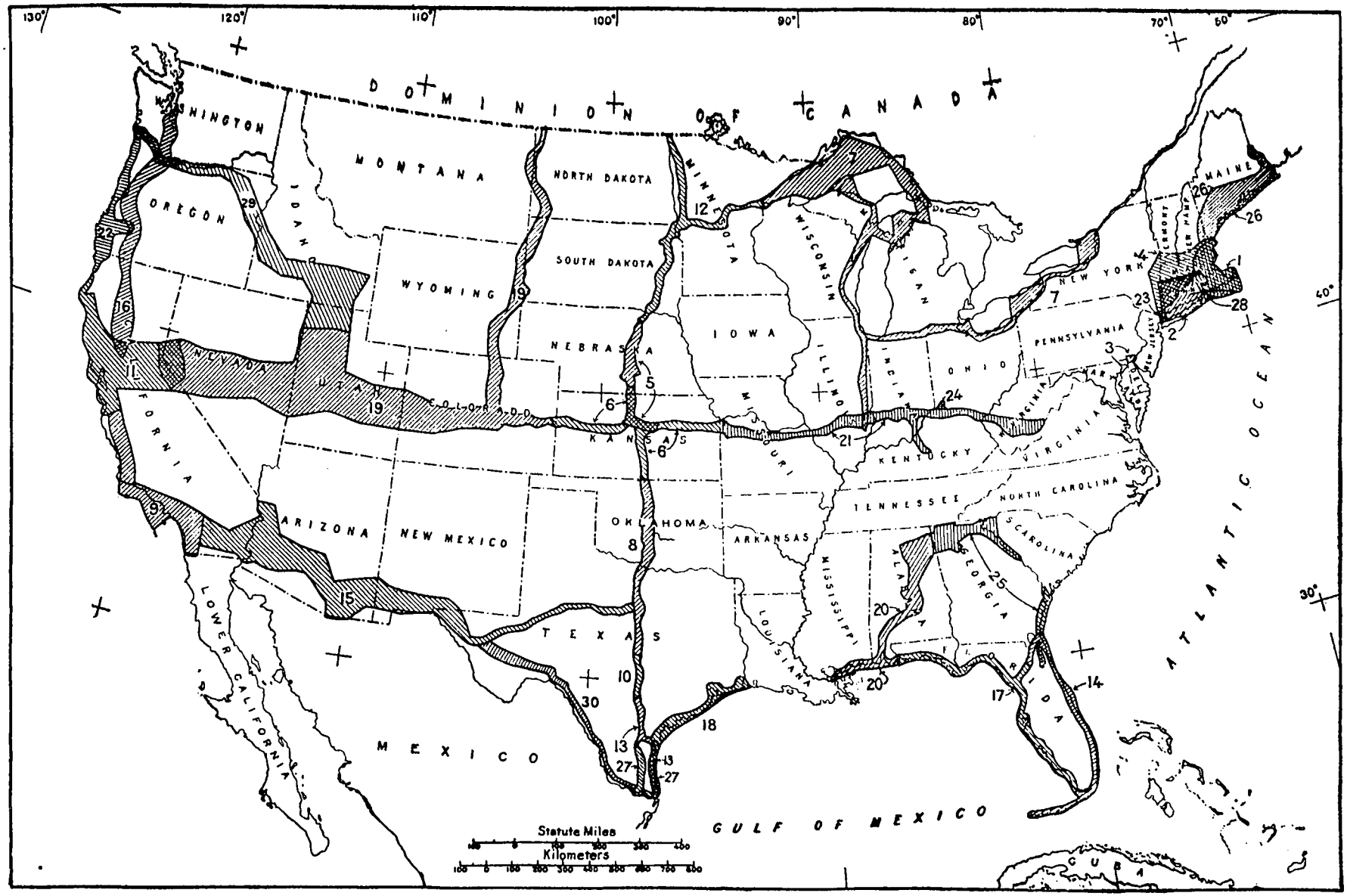

FIG. 3. -INDEX MAP SHOWING AREAS IN THE UNITED STATES COVERED BY PUBLISHED TRIANGULATION WHICH HAS BEEN RIGIDLY COMPUTED ON THE NORTH AMERICAN DATUM.

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.
9. Appendix 9, Report for 1904.
10. Appendix 5, Report for 1905.
11. Appendix 5, Report for 1910.
12. Appendix 4, Report for 1911.
13. Appendix 5, Report for 1911.
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.

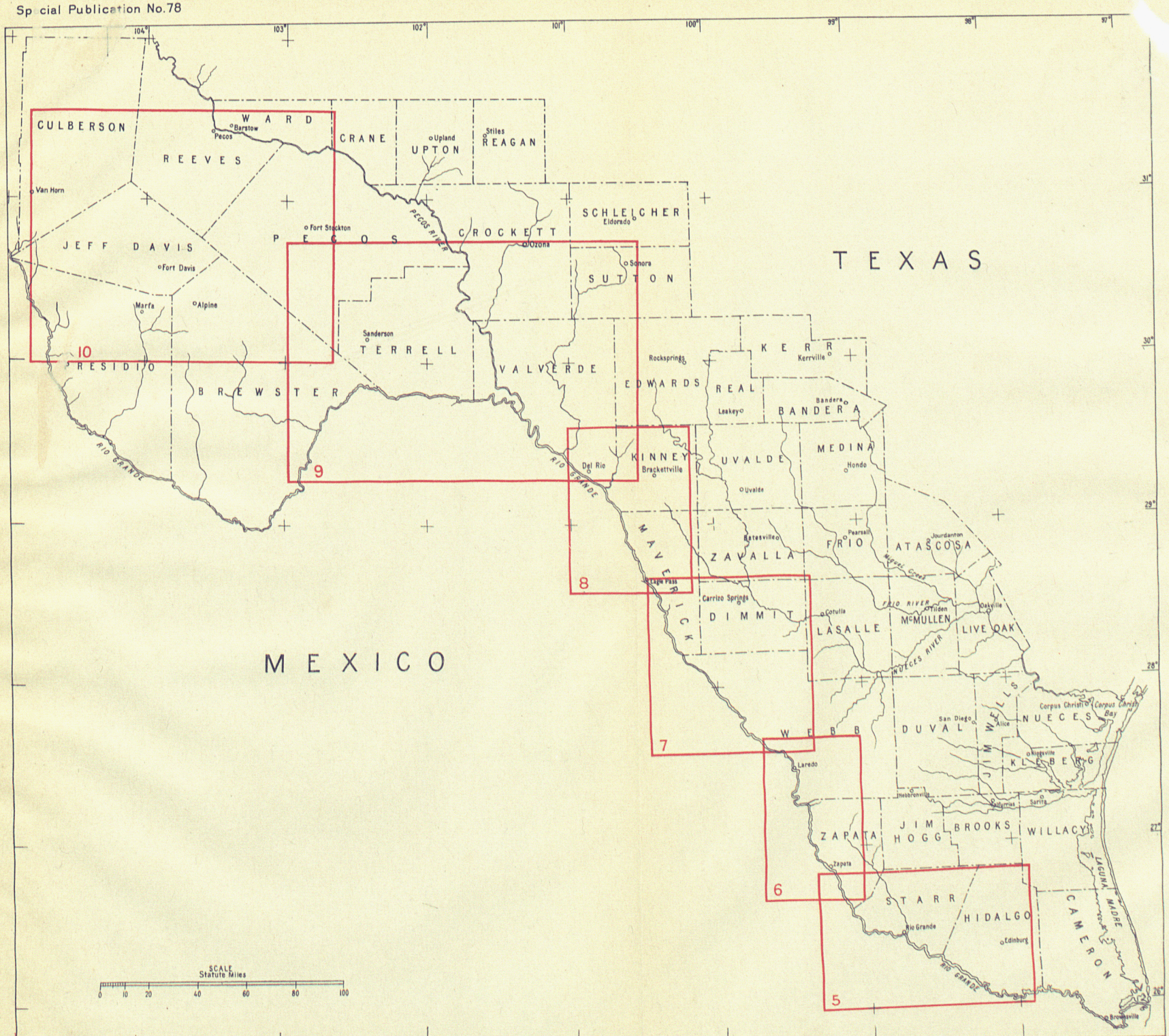

FIG. 4 — INDEX SKETCH OF THE RIO GRANDE ARC SHOWING THE BOUNDARIES OF EACH OF THE TRIANGULATION SKETCHES, FIGURES 5 TO 10

C & G.S. Print-A138

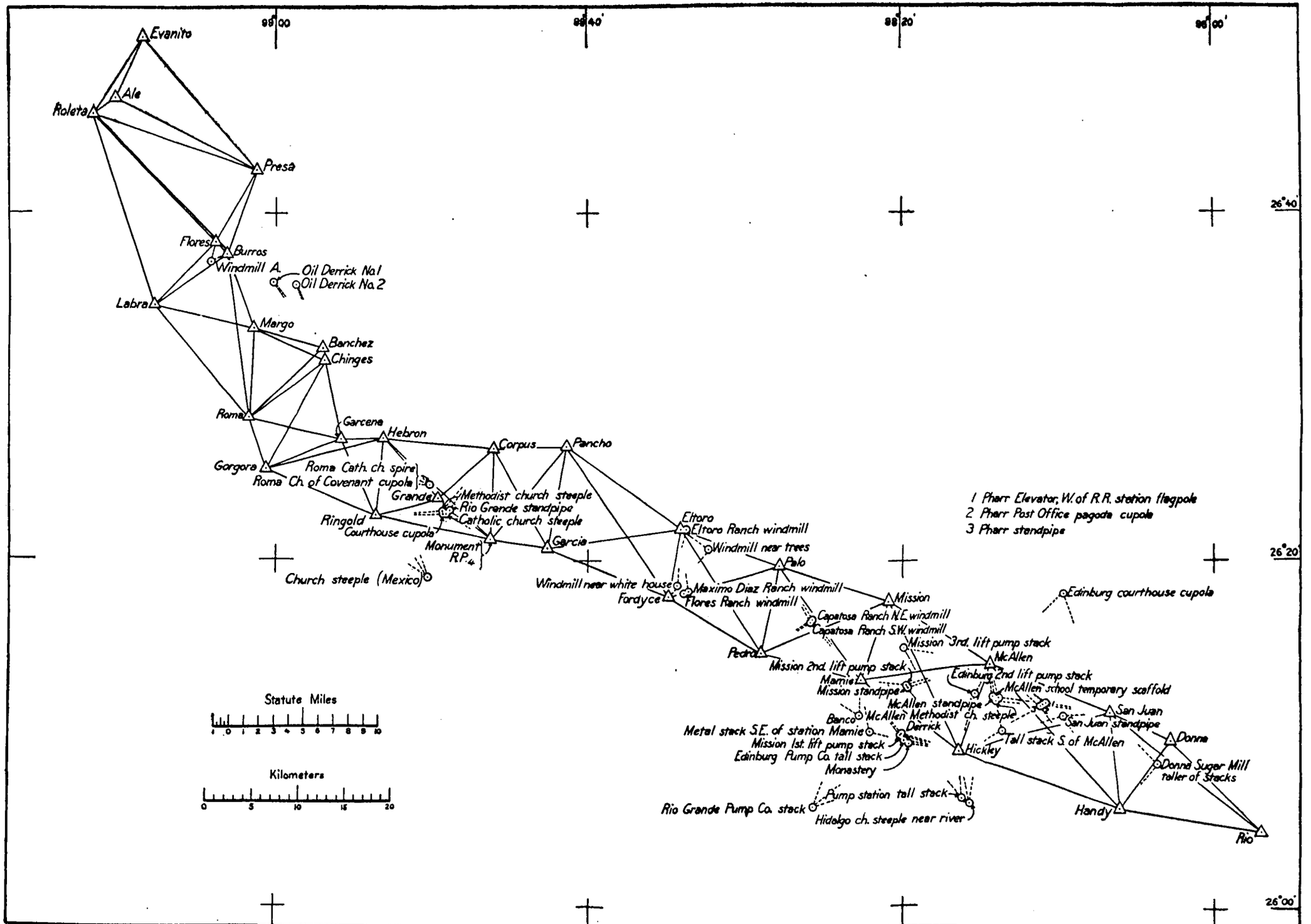

FIG. 5.—TRIANGULATION, NINETY-EIGHTH MERIDIAN ARC TO VICINITY OF ZAPATA.

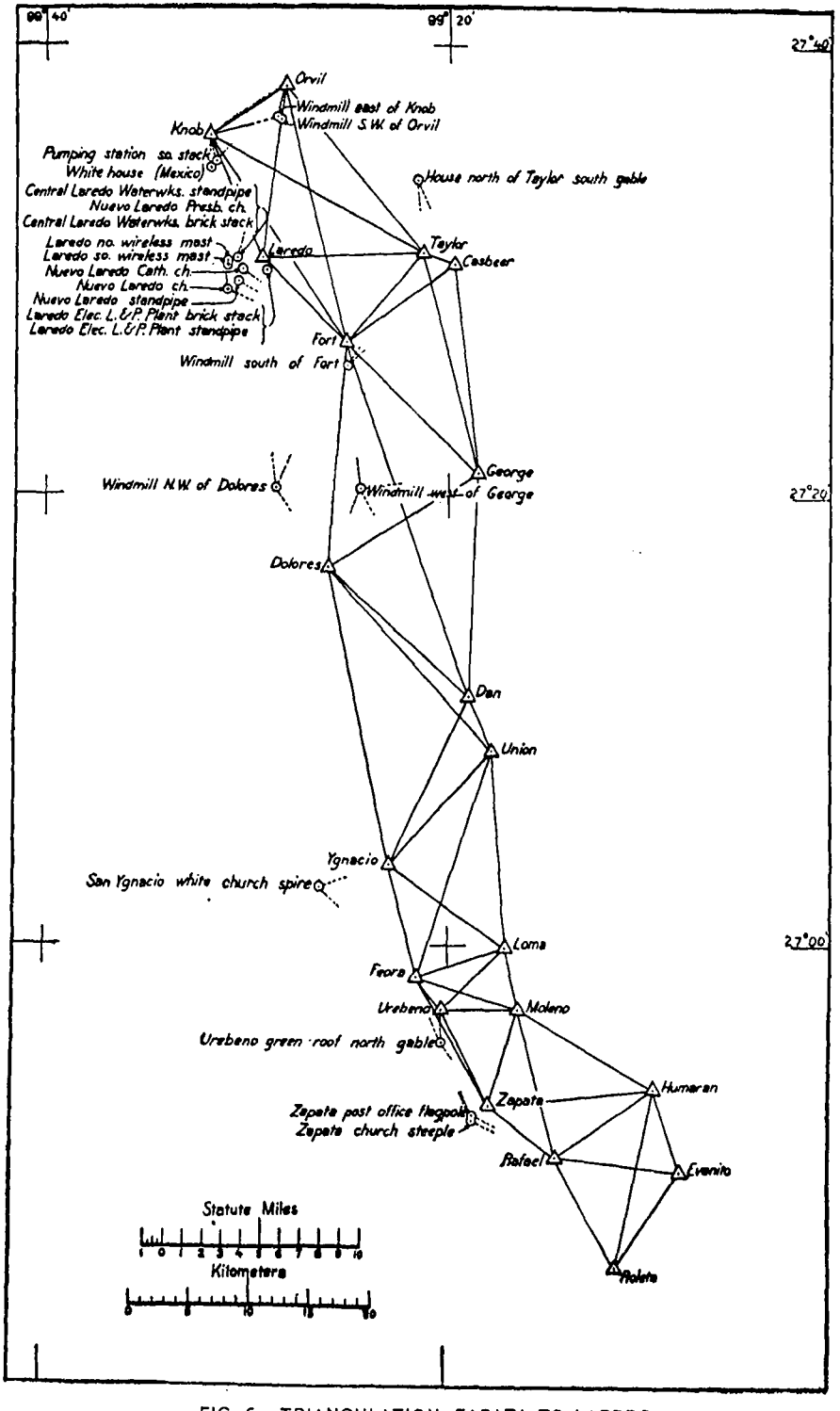

FIG. 6.—TRIANGULATION, ZAPATA TO LAREDO,

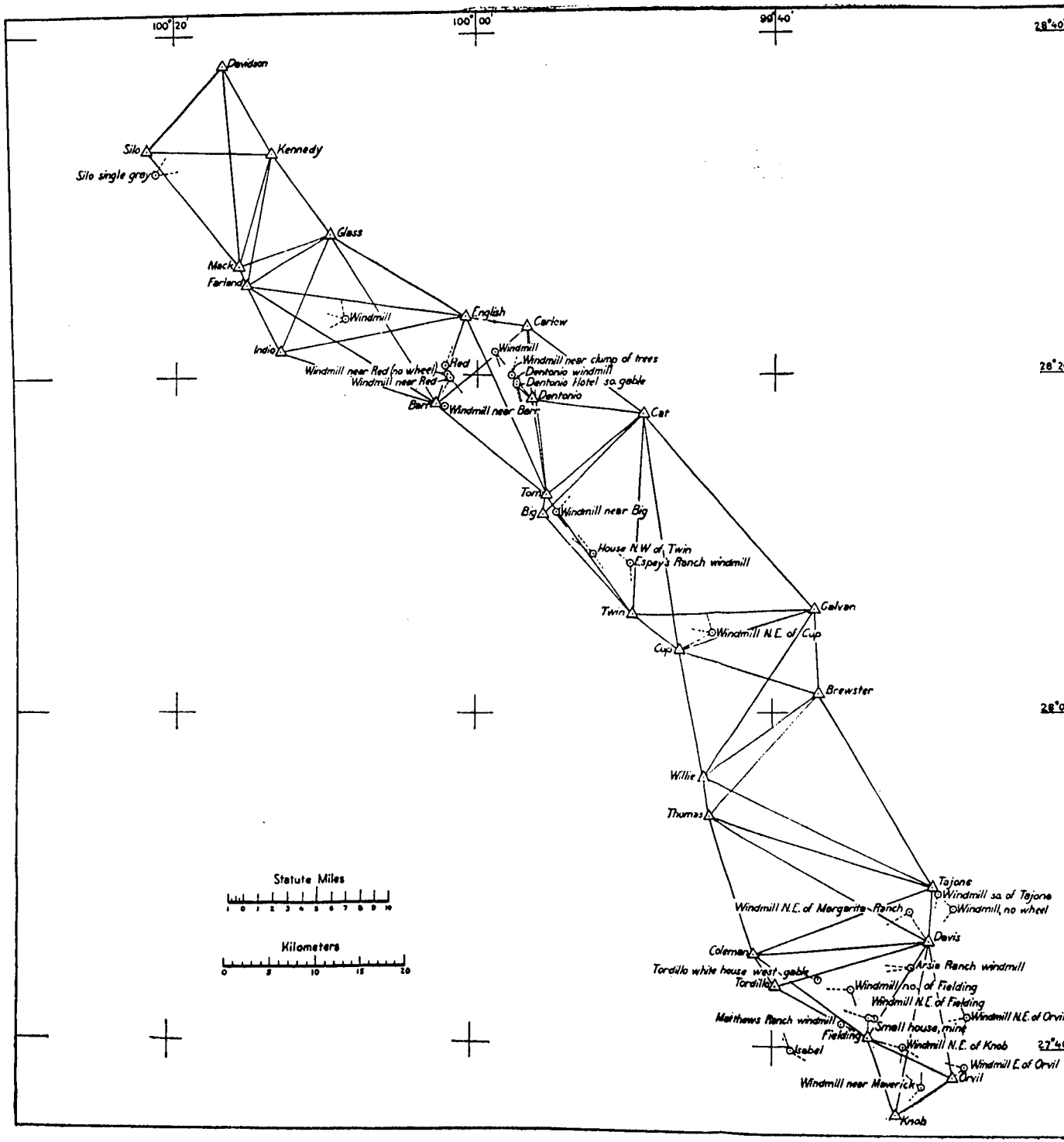

FIG. 7.—TRIANGULATION, VICINITY OF LAREDO TO VICINITY OF EAGLE PASS.

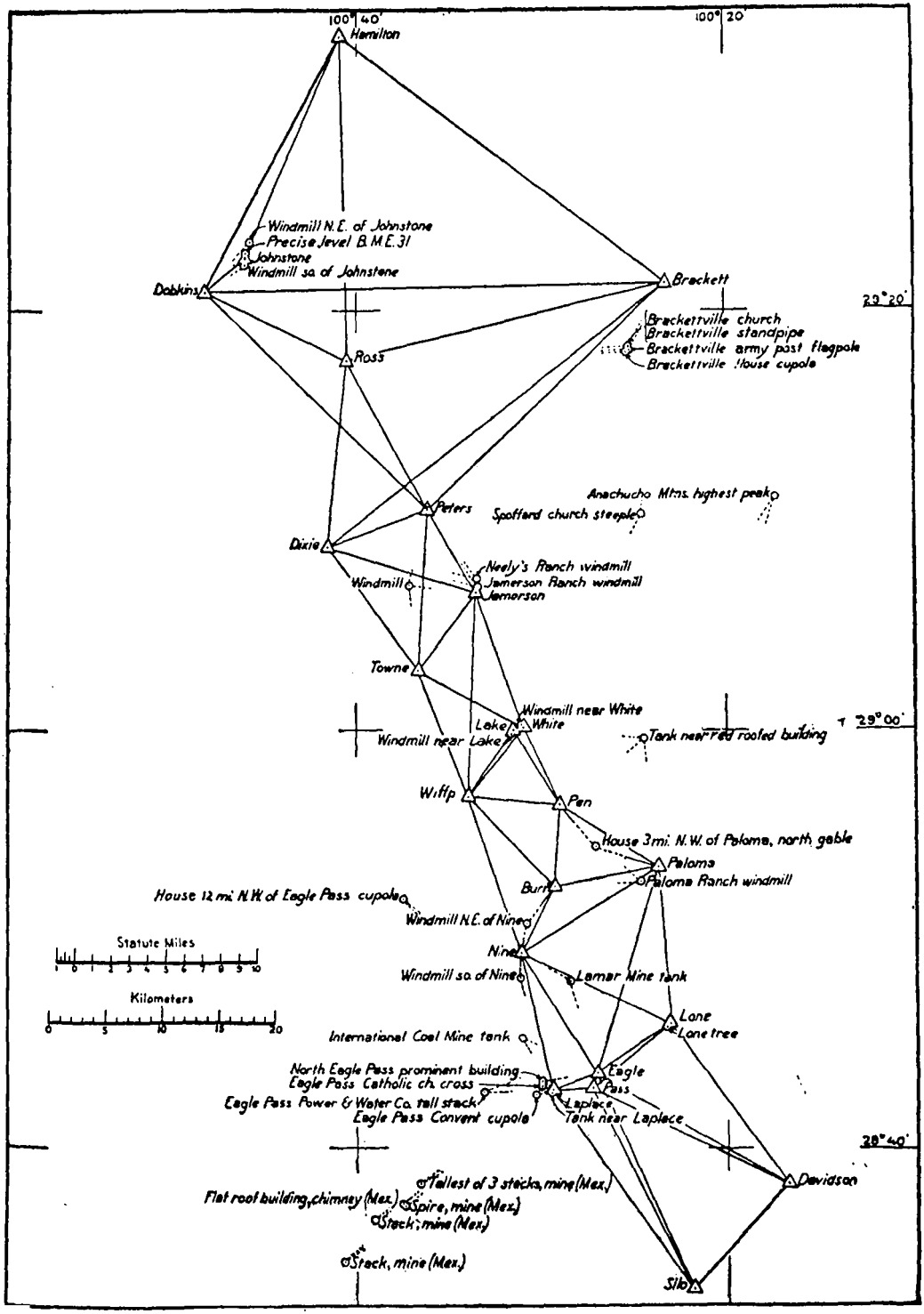

FIG. 8.—TRIANGULATION, EAGLE PASS TO DEL RIO.

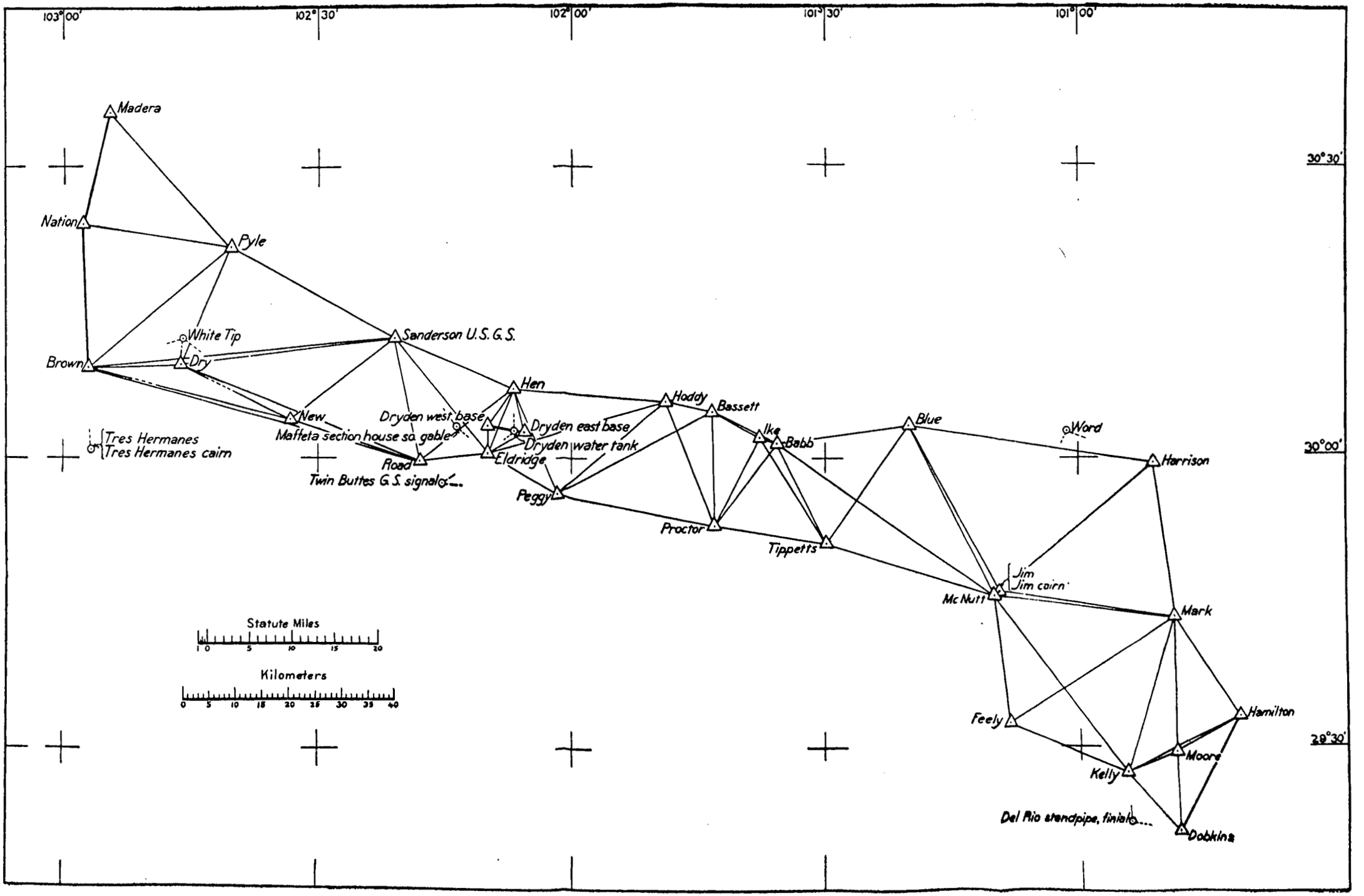

FIG. 9.—TRIANGULATION, DEL RIO TO 30 MILES WEST OF SANDERSON.

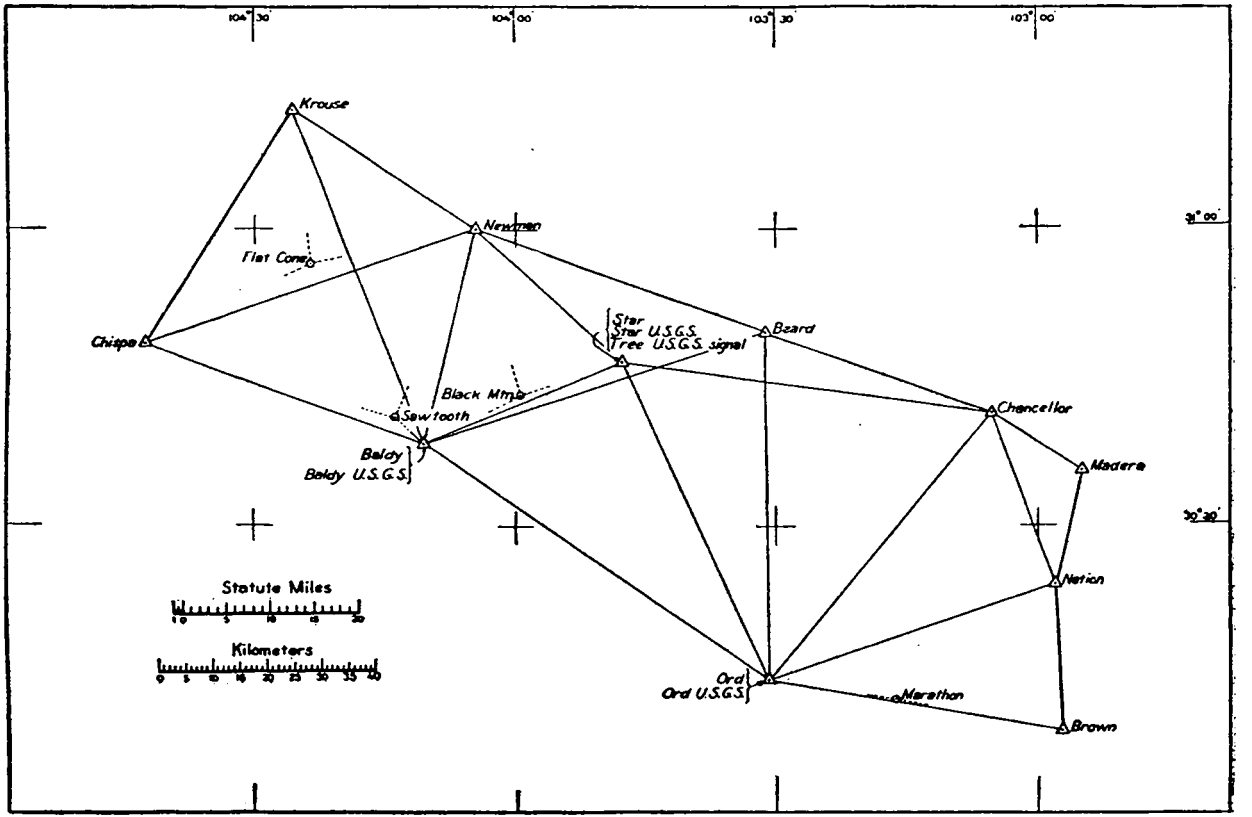

FIG. 10.—TRIANGULATION, 30 MILES WEST OF SANDERSON TO TEXAS-CALIFORNIA ARC.