Spring 5-26-1953

A Plane Coordinate System for Bernalillo County

Karl V. Morin

Morin — Plane Coordinate Grid for Bernalillo County

A PLANE COORDINATE GRID FOR BERNALILLO COUNTY

By

Karl V. Morin

A Thesis

Presented in Partial Fulfillment of

the Requirements for the Degree of

Master of Science

University of New Mexico

June 1953

This thesis, directed and approved by the candidate's committee, has been accepted by the Graduate Committee of the University of New Mexico in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

E. A. Castetter
DEAN

5/26/53
DATE

Thesis committee

Marvin C. May
CHAIRMAN

W. C. Wagner

Ray Fosse

INTRODUCTION

Plane coordinates, based on a State Coordinate System, have proven so valuable and satisfactory wherever used that it is believed desirable that the engineers in Bernalillo County have made available to them the necessary information for use of this system. Unfortunately the only published information is that furnished by the United States Coast and Geodetic Survey, which assumes a greater knowledge of geodetic surveying than the average practicing engineer or land surveyor possesses. Also, at the present time, there is no state enabling act authorizing the use of the plane coordinate system in New Mexico.

The first purpose of this thesis is to frame an enabling act that could be submitted to the state legislature for adoption. Such an act would authorize the use of the plane coordinate system, but not make it mandatory. Twenty-four states have passed laws establishing state coordinate systems.

The second purpose of this thesis is to provide practicing engineers with all the necessary information and explanitory material in one manuscript to permit them to apply the system to their work. An example is worked out in detail using local points known to local men and fully explained step by step.

In addition to the above, a method has been developed for extending triangulation control stations over moderate distances by plane coordinates without the use of involved geodetic computations.

TABLE OF CONTENTS

PART I

PROPOSED ACT FOR STATE COORDINATE SYSTEM

PART II

METHODS AND DATA FOR USING

THE NEW MEXICO COORDINATE SYSTEM

PART III

TRIANGULATION CONTROL EXTENSION

A PLANE COORDINATE GRID FOR BERNALILLO COUNTY

PART I

PROPOSED ACT FOR STATE COORDINATE SYSTEM

PROPOSED ACT FOR STATE COORDINATE SYSTEM

An Act to describe, define, and officially adopt a system of coordinates for designating the position of points on the surface of the earth within the state of New Mexico, County of Bernalillo.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF NEW MEXICO,

Section 1. The system of plane coordinates which has been established by the United States Coast and Geodetic Survey for defining and stating the positions or locations of points on the surface of the earth within the State of New Mexico is hereafter to be known and designated as the "New Mexico Coordinate System."

For the purpose of the use of this system the State is divided into Zones as shown in Figure 1.

The area now included in Bernalillo County shall constitute the Central Zone.

Section 2. As established for use in the Central Zone, the New Mexico Coordinate System shall be named, and in any land description in which it is used it shall be designated, the "New Mexico Coordinate System, Central Zone."

Section 3. The plane coordinates of a point on the earth's surface, to be used in expressing the position or location of such point in the Central Zone of this

system, shall consist of two distances, expressed in feet and decimals of a foot. One of these distances, to be known as the "x-coordinate," shall give the position in an east-and-west direction; the other, to be known as the "y-coordinate," shall give the position in a north-and-south direction. These coordinates shall be made to depend upon and conform to the coordinates, on the New Mexico Coordinate System, of the triangulation and traverse stations of the United States Coast and Geodetic Survey within the State of New Mexico, as those coordinates have been determined by the said Survey.

Section 4. (a) For purposes of more precisely defining the New Mexico Coordinate System the following definition by the United States Coast and Geodetic Survey is adopted:

The New Mexico Coordinate System, Central Zone, is a Transverse Mercator conformal projection of the Clarke spheroid of 1866, having central meridian 106° 15' west of Greenwich (See Figure 1).

The origin of coordinates is at the intersection of the meridian (106° 15') west of Greenwich and the parallel (31°) north latitude. This origin is given the coordinates: x = 500,000 feet and y = 0 feet.

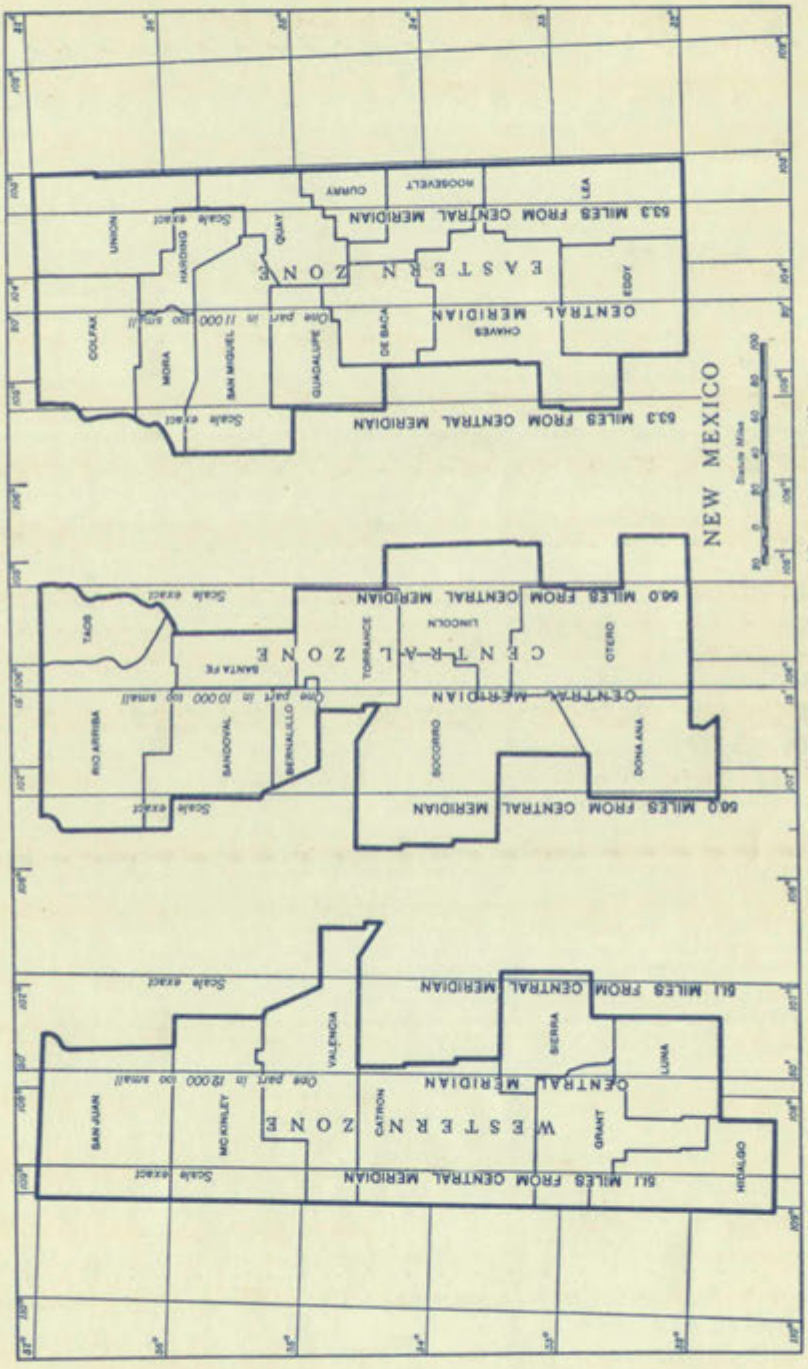


FIGURE 1—Map of New Mexico with grid system outline.

FIGURE 1.

(b) The position of New Mexico Coordinate System shall be as marked on the ground by triangulation or traverse stations established in conformity with standards adopted by the United States Coast and Geodetic Survey for first-order, second-order and third-order work, whose geodetic positions have been rigidly adjusted on the North American datum of 1927, and whose coordinates have been computed on the system herein defined. Any such station may be used for establishing a survey connection with the New Mexico Coordinate System.

Section 5. All coordinates based on the New Mexico Coordinate System, purporting to define the position of points on the earth's surface, presented to be recorded in the public land records or deed records of the County of Bernalillo, shall have been determined by methods and standards as follows:

Points established from one or more established stations by traverse shall conform to the method and accuracy as hereinafter designated:

a. All measurements shall be made with a steel or invar tape that has been compared to a standardized tape.

b. Corrections to measurements shall be made for slope, temperature and tension.

c. Corrected measurements shall be reduced to sea level and grid lengths using the factors as given in special publication No. 219, Coast and Geodetic Survey, titled Triangulation in New Mexico, 1940.

d. Average angular closure shall not exceed seven seconds per angle turned in the closed traverse.

e. The total error of closure in position after making angle adjustments shall be less than one in nine thousand.

f. Final coordinates shall be computed by reducing error of closure to zero by proportioning error in each line to total error in total length.

g. Permanent markers shall be set at each traverse angle point.

h. Records of field notes and office calculations shall be kept and submitted for inspection if requested in connection with recording of coordinates.

Section 6. Whatever coordinates based on the New Mexico Coordinate System are used to describe any tract of land which in the same document is also described by reference to any subdivision, line, or corner of the United States public land surveys, the description by coordinates shall be construed as supplemental to the basic description of such subdivision, line, or corner contained in the official plats and field notes filed of record, and in the event of any conflict the description by reference to the subdivision, line, or corner of the United States public land surveys shall prevail over the description by coordinates.

Section 7. Nothing contained in this Act shall require any purchaser or mortgagee to rely on a description,

any part of which depends exclusively upon the New Mexico Coordinate System.

Section 8. If any provision of this Act shall be declared invalid, such invalidity shall not affect any other portion of this Act which can be given effect without the invalid provision, and to this end the provisions of this Act are declared to be severable.

Section 9. This Act shall take effect . . . . . .

A PLANE COORDINATE GRID FOR BERNALILLO COUNTY

PART II

METHODS AND DATA FOR USING THE NEW MEXICO COORDINATE SYSTEM

A PLANE COORDINATE GRID FOR BERNALILLO COUNTY

INTRODUCTION

The object of this part is to present a plane coordinate system with factual data and method of use of this data in as simple a manner as practicable as set up by the U. S. Coast and Geodetic Survey for the State of New Mexico and applied to the County of Bernalillo.

WHAT IS A STATE PLANE COORDINATE SYSTEM(1)

As with any plane-rectangular coordinate system, a projection employed in establishing a State Coordinate system may be represented by two sets of parallel straight lines, intersecting at right angles. The network thus formed is termed a grid. One set of these lines is parallel to the plane of a meridian passing approximately through the center of the area shown on the grid, and the grid line corresponding to that meridian is the Axis of Y of the grid. It is also termed the central meridian of the grid. Forming right angles with the Axis of Y and to the south of the area shown on the grid is the Axis of X. The point of intersection of these axes is the origin of coordinates. The position of a point represented on the grid can be defined by stating two distances, termed coordinates. One of these distances, known as the x-coordinate, gives the position in an east-and-west direction. The other distance, known as

---

Note: (1) indicates reference number as listed on page 64.

the y-coordinate, gives the position in a north-and-south direction; this coordinate is always positive. The x-coordinates increase in size, numerically, from west to east; the y-coordinates increase in size from south to north. All x-coordinates in an area represented on a State grid are made positive by assigning the origin the coordinates: x = 0 plus a large constant. For any point, then, the x-coordinate equals the value of x adopted for the origin, plus or minus the distance (x') of the point east or west from the central meridian (Axis of Y); and the y-coordinate equals the perpendicular distance to the point from the Axis of X. The linear unit of the State coordinate systems is the foot of 12 inches defined by the equivalence: 1 international meter = 39.37 inches exactly.

The linear distance between two points on a State coordinate system as obtained by computation or scaled from the grid, is termed the grid length of the line connecting those points. The angle between a line on the grid and the Axis of Y, reckoned clockwise from the south through 360°, is the grid azimuth of the line. The computations involved in obtaining a grid length and a grid azimuth from grid coordinates are performed by means of the formulas of plane trigonometry.

MAP PROJECTIONS AND STATE GRIDS

By using a conformal map projection as the base for a State coordinate system and limiting one dimension of the area which is to be covered by a single grid, two things are accomplished: first, on a conformal map projection, angles are preserved. This means that, at a given point, the difference between geodetic and grid azimuths of very short lines is a constant, and angles on the Earth formed by such lines are truly represented on the map. For practical purposes of land surveying, this condition holds for distances up to about ten miles. For longer lines, the difference varies, and the correction to be applied to an observed (geodetic) angle to obtain a corresponding grid angle is the difference of the corrections to the azimuths of the lines, separately derived. Second, the limitation in the width of the projection or grid permits a control of deviations of grid lengths from geodetic lengths. When the width of an area covered by a single grid is 158 statute miles, the extreme difference between geodetic and grid lengths will be 1/10,000 of the length of a line, which is quite satisfactory for most land surveys.

Deviations of grid lengths from geodetic lengths will be a maximum along the margins of the longer dimension of the grid and midway between those margins. Along the margins, the grid length of a line will be greater than its

geodetic length; along the center line, the geodetic length will be the greater. Between these limits are two lines along which grid and geodetic lengths are equal: these are lines of exact scale. The quantity by which a geodetic length is multiplied to obtain the corresponding grid length is termed a scale factor. It is greater than unity in areas outside the lines of exact scale; decreases to unity along those lines; and continues to decrease to a minimum about midway between them. The magnitude of a scale factor at any point depends upon the position of the point with respect to the lines of exact scale. It is constant along a line--any line--which is parallel with the lines of exact scale. These lines of equal scale correction are grid lines on the transverse Mercator grid, being parallel with the central meridian or Axis of Y. Scale factors admit of simple tabulation. For any given survey line, the scale factor may be readily ascertained and applied to the geodetic length of the line to obtain its grid length; or in an inverse operation, employed in obtaining a geodetic from a grid length. Where the exact length of a line is desired, it is thus easily obtained. It must be remembered that a geodetic length is a distance on the spheroid (sea-level surface of the Earth), whose relationship to the corresponding ground-level distance may be expressed by very simple formulas and accurately illustrated by a geometrical figure.

geodetic length; along the center line, the geodetic length will be the greater. Between these limits are two lines along which grid and geodetic lengths are equal: these are lines of exact scale. The quantity by which a geodetic length is multiplied to obtain the corresponding grid length is termed a scale factor. It is greater than unity in areas outside the lines of exact scale; decreases to unity along those lines; and continues to decrease to a minimum about midway between them. The magnitude of a scale factor at any point depends upon the position of that point with respect to the lines of exact scale. It is constant along a line--any line--which is parallel to the lines of exact scale. These lines of equal scale correspond to grid lines on the transverse Mercator grid, being parallel to the central meridian or axis of Y. Scale factors admit of simple tabulation. For any given survey line, the scale factor may be readily ascertained and applied to the geodetic length of the line to obtain its grid length; or in an inverse operation, employed in obtaining a geodetic from a grid length. Where the exact length of a line is desired, it is thus easily obtained. It must be remembered that a geodetic length is a distance on the spheroidal (sea-level) surface of the earth, whose relationship to the corresponding ground-level distance may be expressed by very simple formulas and accurately illustrated by a geometrical figure.

On the other hand, a grid length is a distance on a plane which is mathematically related to the spheroid, so that the relationship between corresponding lengths on the two surfaces can be expressed by mathematical formulas, but is not susceptible of accurate graphical demonstration.

The projection for the State of New Mexico is called the transverse Mercator grid. Figure 1 shows this grid system.

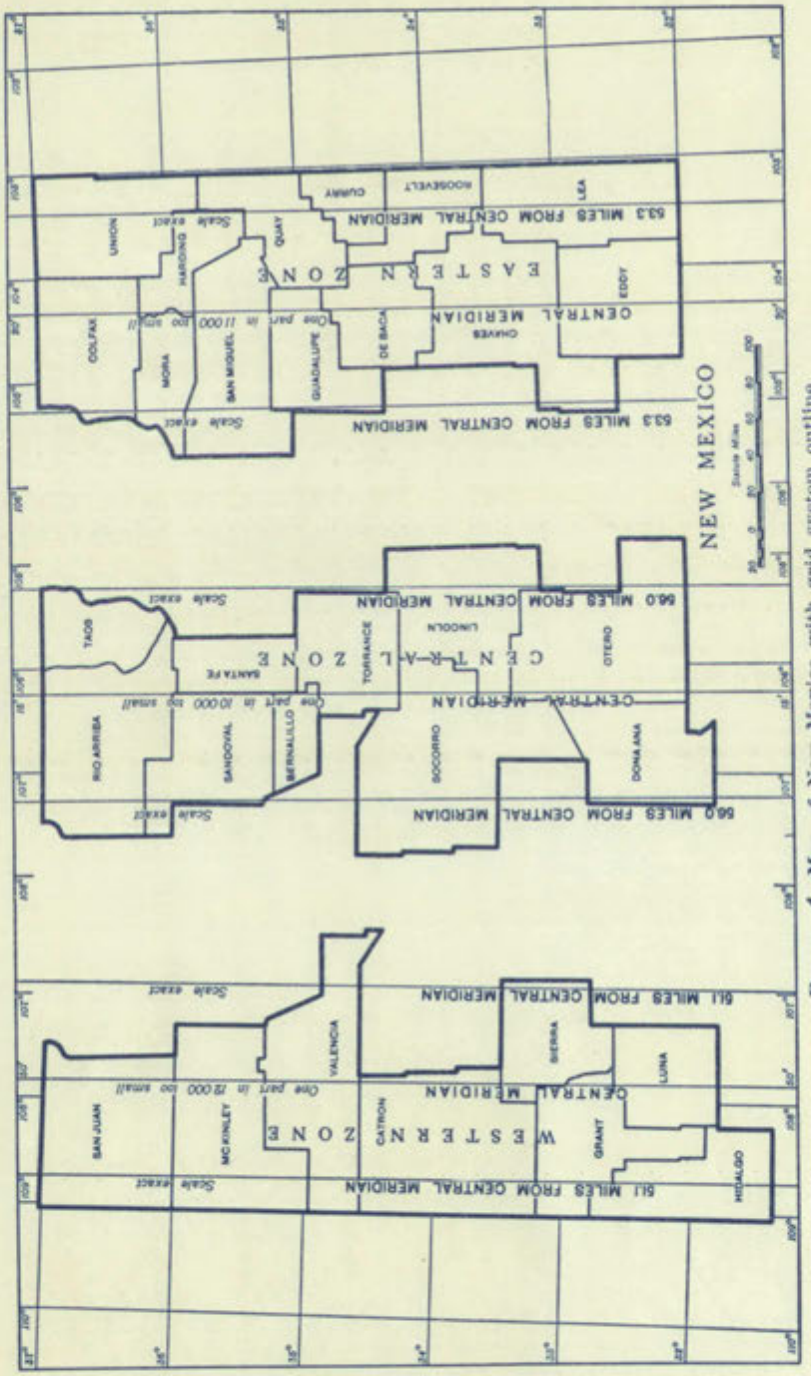


FIGURE 1—Map of New Mexico with grid system outline.

FIGURE 1

SURVEY CONTROL DATA

The relationships which make it practicable to pass with mathematical accuracy from a geodetic to a plane-coordinate system--to transform a geodetic position on the standard datum into plane-rectangular coordinates on a State system[2][3][4]--have made it practicable to utilize the precise data of the national triangulation net for the referencing and control of land surveys in many parts of the country.[5] PLATE I shows the general location of the triangulation stations in the County of Bernalillo. A surveyor planning work in a particular area may send a letter to the Director, U. S. Coast and Geodetic Survey, Washington, D. C., requesting the State coordinates and descriptions of survey stations in that locality.

Table 1 gives plane grid coordinates for triangulation stations in Bernalillo County.[6][7][8]

TABLE 1

PLANE GRID COORDINATES
FOR
TRIANGULATION STATIONS IN BERNALILLO COUNTY

Co. No.	Station	x coordinate / y coordinate Feet	Convergence Grid Az. to Az. Mark ° ' "	Elev Feet Meters	(d.) Pg. (6)
101	Sandia r. 1921 (d.m.)	440,548.84 1,531,749.81		10,682	12& 19
102	Sandia Range, Sharp Peak 1921 (d.)	446,169.20 1,499,053.75			133

Co. No. = County Number
(d.) = described
(d.m.) = described and marked

TABLE 1 (continued)

PLANE GRID COORDINATES
FOR
TRIANGULATION STATIONS IN BERNALILLO COUNTY

Co. No.	Station	x coordinate / y coordinate Feet	Convergence Grid Az. to Az. Mark °	'	"	Elev Feet / Meters	(d.) Pg. (6)
103	Corrales 1946	380,650.50	-0	13	50	5285	12
	(d.m.)	1,541,515.94	297	00	42		
104	Black 1946	372,747.03	-0	14	44	5218	12
	(d.m.)	1,526,768.82	102	24	52		
105	Tijeras 1946	423,162.77	-0	08	51	5615	15, 20&
	(d.m.)	1,471,136.05	269	03	49		
106	Radio 1946	360,885.20	-0	16	01	5087.2	14
	(d.m.)	1,479,032.08	252	36	11		
107	Isleta (U.S.G.S.) 1946	356,784.11	-0	16	25		16
	(d.m.)	1,426,449.11	318	36	13	1641.8	
108	Loudon (N. Mex.) 1946	387,016.89	-0	12	59		16,
	(d.m.)	1,454,802.93	278	02	06	1618.7	20&
109	Bernaval (N. Mex.) 1946	418,163.02	-0	09	22		16,
	(d.m.)	1,422,189.30	39	37	17	1714.8	20&
110	Hangar (d.m.)	398,966.60	-0	11	38	5341.8	20
		1,474,814.36					
201	Kirtland 1946	388,889.67	-0	12	48	5308.0	15
	(d.m.)	1,473,161.35	174	59	19		
202	Alb. Mun Airport Flagpole, 1946 (d.)	388,930.	-0	12	47		15
		1,473,037.					
203	Golf, 1946	388,489.47	-0	12	52	5143.2	13
	(d.m.)	1,488,938.68	298	48	30		
204	University(U.S.G.S)(1931)	389,470.10	-0	12	45	5162.9	13
	1946 (d.m.)	1,486,766.52	180	13	12		

(U.S.G.S.) = U. S. Geological Survey
(N. Mex.) = New Mexico Geological Survey
Alb. = Albuquerque

TABLE 1 (continued)

PLANE GRID COORDINATES
FOR
TRIANGULATION STATIONS IN BERNALILLO COUNTY

Co. No.	Station	x coordinate / y coordinate Feet	Convergence Grid Az. to Az. Mark °	'	"	Elev Feet Meters	(d.) Pg. (6)
205	Workman, 1946	426,767.70	-0	08	24	5695	16
	(d.m.)	1,442,765.96	3	04	17		
206	Workman Az. Mark	426,650.41	-0	08	25	5698	16
	1946 (d.m.)	1,440,580.13					
207	Bernaval Az. Mark	416,844.84	-0	09	31	5510	16
	1946 (d.m.)	1,420,597.09					
208	Isleta Az. Mark	362,623.98	-0	15	44	4977	17
	(U.S.G.S.) 1946 (d.m.)	1,419,824.22					
209	Libra (U.N.M.)						
	1953 (d.m.)						
301	Alameda Nativitati Ch.	390,506.	-0	12	40		
	So. spire 1946 (n.d.)	1,524,031.				1545.9	
302	Alb. Indian School	378,580.78	-0	14	01		13
	East tank, 1946 (d.)	1,495,215.83				1545.0	
303	Alb. Radio Tower on	380,762.	-0	13	45		
	City Hall, 1946 (n.d.)	1,486,802.					
304	Alb. San Felipe School	374,836.59	-0	14	26		13
	spire 1946 (d.)	1,489,789.00					
305	Alb. K.O.B. Radio	391,903.69	-0	12	31		12
	Mast, 1946 (d.)	1,529,080.02				1661.1	
306	Alb. Indian School	378,270.93	-0	14	03		12
	West tank, 1946 (d)	1,495,327.19				1545.1	
307	Alb. Nazareth Hosp.	395,216.92	-0	12	08		
	cross on cupola, 1946						
	(n.d.)	1,524,463.47				1565.8	

ch. = church
(n.d.) = not described
Hosp. = hospital

TABLE 1 (continued)

PLANE GRID COORDINATES
FOR
TRIANGULATION STATIONS IN BERNALILLO COUNTY

Co. No.	Station	x coordinate / y coordinate Feet	Convergence Grid Az. to Az. Mark ° ' "	Elev Feet Meters	(d.) Pg. (6)
308	Alb. Indian Hosp. Stack, 1946 (d.)	390,742.12 1,487,820.61	-0 12 36		14
309	Alb. K.G.G.M. Radio Mast, 1946 (d.)	370,878.63 1,483,829.57	-0 14 53	1579.3	14
310	Alb. Hilton Hotel Tower sign, 1946 (d.)	380,619.31 1,486,421.13	-0 13 46	1567.8	14
311	Alb. Veterans Hosp. tank, 1946 (d.)	400,612.15 1,474,726.84	-0 11 27	1664.8	15
312	Alb. Veterans Hosp. center, flagpole, 1946 (d.)	400,186.34 1,475,450.88	-0 11 30	1657.3	15
313	Alb. Veterans Hosp. Stack, 1946 (d.)	400,422.00 1,474,721.20	-0 11 28	1661.1	15
314	Alb. Federal Bldg. dome, 1946 (d.)	379,698.17 1,486,025.70	-0 13 52		14
315	Alb. Santa Fe R.R. Yards, stack, 1946 (d.)	380,637.70 1,482,270.87	-0 13 45		14
316	Sandia Mtns U.S.F.S. Lookout Tower, 1946 (n.d.)	439,700.95 1,534,222.51	-0 06 59	3259.7	
318	L.A. to Amarillo Airway Bn. 68, 1946 (d.)	337,243.55 1,476,123.38	-0 18 45	1769.4	14
319	Radio Mast Sly of two, 1946 (n.d.)	436,399. 1,439,194.	-0 07 18	1891.1	
320	Alb. center stack of three, 1946 (n.d.)	377,372.73 1,493,524,88	-0 14 09	1566.0	

U.S.F.S. = United States Forest Service

Note: 317 omitted.

TABLE 1 (continued)

PLANE GRID COORDINATES
FOR
TRIANGULATION STATIONS IN BERNALILLO COUNTY

Co. No.	Station	x coordinate / y coordinate Feet	Convergence Grid Az. to Az. Mark ° ' "	Elev Feet Meters	(d.) Pg. (6)
321	Alb. Cutter-Carr Airfield, windsock, 1946 (d.)	360,572. 1,486,338.	-0 16 04	1574.2	15
322	Oil derrick, 1946 (n.d.)	328,417.88 1,455,787.99	-0 19 43	1751.0	
323	L.A. to Amarillo Airway Bn. 71,1946 (n.d.)	469,640.22 1,474,506.79	-0 03 30	2389.4	
324	Radio Range Sta. center mast of five, 1946 (n.d.)	389,232.47 1,450,714.59	-0 12 43	1657.2	
325	Isleta, cross on Ch. 1946 (n.d.)	367,260. 1,422,402.	-0 15 12	1507.0	
326	U (U.N.M.) 1953 (d.m.)				
327	Elena (U.N.M.) 1953 (d.m.)				
328	Rosemoon (U.N.M.) 1953 (d.m.)				

L.A. = Los Angeles
Sta. = station
(U.N.M.) = by University of New Mexico

TABLE I (continued)

PLANE GRID COORDINATES
FOR
TRIANGULATION STATIONS IN BERNALILLO COUNTY

Co. No.	Station	Y coordinate (Feet)	X coordinate (Feet)	Convergence to Astro. Az.	Elev. Meters (δ)	Ref. Ft. (δ)
325	Alb. Cutter-Dart Airfield, Wagaroek, 1948 (d.)	360,372. 1,466,858.	-0 16 04			15
326	Gil Corral, 1948 (n.d.)	358,417.68 1,465,787.99	-0 19 43			1781.0
329	I.A. to Sandia Airway Tr. 1948 (n.d.)	466,830.83 1,475,808.78	-0 03 20			2868.4
336	Radio Range Sta. center mast of five, 1948 (n.d.)	380,252.47 1,480,714.89	-0 19 42			1857.9
339	Isleta, cross on Ch. 1948 (n.d.)	387,260. 1,456,402.	-0 15 12			1807.0
340	U 1933	(U.N.M.) (d.m.)				
342	Elena 1933	(U.N.M.) (d.m.)				
343	Rosemont 1933	(U.N.M.) (d.m.)				

I.A. = Los Angeles
Sta. = Station
(U.N.M.) = By University of New Mexico

DESCRIPTION OF STATIONS

AS SHOWN

IN TABLE 1

UNITED STATES COAST AND GEODETIC SURVEY
Descriptions of Triangulation Stations

COMER (continued)
located in the center of Santa Fe, go W on San Francisco Street 2 blocks. Here turn right onto Cerrillos Road, which is U.S. Highway 85, and go SW toward Albuquerque for 27.15 miles to an abandoned filling station on the left side of the highway. Continue on highway 85 for 0.1 mile to a bladed dirt road leading off the highway through a fence and signed "BLACK LUJAN." This road turns off the highway just before the highway reaches more abandoned buildings on the left side of the road and 1.05 miles before the highway passes the Mormon Battalion Monument. Pass through the gate and follow the bladed road for 0.4 mile to the azimuth mark on the right side of the road. Continue straight ahead on the bladed road, going for 0.45 mile to a fork. Take the right fork and follow a track road down into a wash, going for 0.05 mile to another fork. Take the left fork this time and follow the track road up the S side of the wash for 1.35 miles to a gate. Keep to the main traveled tracks up the wash and the side of the wash, for there are many other tracks leading off in all directions. Pass through this gate and, crossing the wash once, go 0.3 mile to where the road begins to cross the wash again and there is a dim track road leading from the main traveled tracks to the right. Take the right fork here and follow these dim tracks across the wash, going for 0.05 mile. Here turn right and go cross country for 0.25 mile to the end of truck travel at a small wash. From here pack WSW over minor drainage and up to the top of the ridge, going about 1/2 mile to the station.

The station is a bronze station disk stamped "COMER 1946" and capped on a 3-inch cast-iron pipe which projects about 6 inches above the surrounding surface.

Reference mark 1 is a bronze reference disk stamped "COMER NO 1 1946" and capped on a 3-inch cast-iron pipe which projects 6 inches above the surrounding surface. It is about 3 feet lower than the station and is located ENE of the station.

Reference mark 2 is a bronze reference disk stamped "COMER NO 2 1946" and capped on a 3-inch cast-iron pipe which projects 6 inches above the surrounding surface. It is about the same height as the station and is located WNW of the station.

The azimuth mark is a standard General Land Office section-corner marker stamped "T14N R6E S7 S8 S18 S17 1932." It is capped on a 1-1/2-inch pipe which projects 5 inches above the surrounding surface. It is located 1-1/2 miles NNW of the station, 15.5 feet W of a fence corner, and 9 feet W of the center of the bladed road.

OBJECT		DISTANCE		DIRECTION
PLACITAS		meters	feet	0°00'00"0
R.M. 2	WNW	6.575	21.568	113 47 23
Azimuth Mark	NNW	1-1/2 miles		155 16 22.8
R.M. 1	ENE	7.101	23.302	210 21 20

Height of light above station mark - 1.1 meters.
Height of instrument above station mark - 1.5 meters.

****

TONQUE (Sandoval County,N.Mex.,C.A.E.,1946)--This station was established in 1936 but was not occupied until 1946.

Station is located about 11 miles, airline, NE of Bernalillo, 6 miles N of Placitas, and 1 mile SE of U.S. Highway 85. It is located on the top of a hogback ridge, which is the highest ridge in the vicinity, and which is slightly wider at the station than at other points in the vicinity. Station is 175 yards E of the old graded highway and 250 yards SE of a cut where this highway crosses the station ridge.

To reach the station from the post office in Algodones, go NE on U.S. Highway 85 for 3.7 miles to a wire gate in the fence along the right side of the road. (To reach the azimuth mark continue for 1.0 miles to the azimuth mark on the right side of the road.) Turn right through the gate and go 0.7 mile to a fork. Take the left fork, a dim track road, and go E for 0.2 mile to the old graded highway. Turn left on this road and go 0.7 mile to where the highway cuts through a ridge. Pack to the top of the ridge on the right side of the road and go SE along the top for about 250 yards to the station. It is a pack of 5 minutes.

Station is marked by a bronze station disk stamped "TONQUE 1939" and set in concrete in the top of an iron pipe which projects 6 inches above the ground.

Reference mark 1 is located ENE of the station and about 1 foot lower. It is marked by a bronze reference disk stamped "TONQUE 1936 NO 1" and set in concrete in the top of an iron pipe which projects 3 inches above the ground.

Reference mark 2 is located NW of the station and about the same height. It is marked by a bronze reference disk stamped "TONQUE 1936 NO 2" and set in concrete in the top of an iron pipe which projects 1 foot above the ground.

The azimuth mark is located about 1-1/2 miles NNE of the station, about 250 feet NE of the E end of a concrete highway bridge, 70 feet SE of the center of U.S. Highway 85, 3-1/2 feet NW of the right-of-way fence along the SE side of the highway, and 3 feet W of a 4-inch square witness post. It is marked by a bronze reference-mark disk stamped "TONQUE 1936 AZIMUTH MARK" and set in the top of a square concrete post which projects 4 inches above the ground.

OBJECT		DISTANCE		DIRECTION
COMER		meters	feet	0°00'00"0
R.M. 2	NW	11.688	38.353	234 11 43
Azimuth Mark	NNW	1-1/2 miles		300 08 54.0
R.M. 1	ENE	11.513	37.775	357 47 58

****

PLACITAS (Sandoval County,N.Mex.,C.A.E.,1945)--The station is on a high hill, located by approximate airline distances 22 miles NE of Albuquerque, 10 miles E of Bernalillo, 6 miles ENE of Sandia Peak, and 2 miles E of the settlement of Placitas. It overlooks the country to the N, W, and E.

To reach the station from the courthouse in Bernalillo, go N on U.S. Highway 85 for 0.8 mile to a road right at a sign "SANDIA DRIVE." Turn right on a paved road and continue 7.0 miles to Placitas post office on the left. Continue 1.15 miles to a dirt road to the left through a wire gate. Turn left, off Sandia Drive, and go 1/2 mile to the base of one of the ridges running steeply up into the main hill. Pack E up one of the ridges to the station, about 200 yards NW of the highest point of the ridge which forms the top of the hill. The top of the hill runs NW-SE. A 40-minute pack. To reach the azimuth mark from the turn-off from Sandia Drive, continue along the drive for 0.8 mile to road marker 500 on right, about 200 yards before reaching a cattle guard and the entrance to the National Forest. From the road marker, pack up the hill about 100 yards to NNW to mark, next to a National Forest boundary fence corner.

Station, a bronze station disk stamped "PLACITAS 1945", is brazed to top of 1-1/2-inch iron pipe projecting about 4 inches above ground; about 200 yards NW of highest point of the hill.

Reference mark 1, a bronze reference disk stamped "PLACITAS NO 1 1945", is set in a drill hole in a boulder flush with the ground, and is N of station and about 1 foot lower.

Reference mark 2, a bronze reference disk stamped "PLACITAS NO 2 1945", is set in a drill hole in outcropping bedrock flush with the ground, and about 1 foot lower than the station.

Azimuth Mark, a bronze azimuth disk stamped "PLACITAS 1945", is set in a drill hole in outcropping bedrock flush with ground, and 4 feet E of National Forest boundary fence corner.

OBJECT		DISTANCE		DIRECTION
JEMEZ 1938		meters	feet	0°00'00"0
R.M. 1	N	7.629	25.030	74 00 33
Azimuth Mark	SW	1-1/2 miles		227 49 17.2
R.M. 2	WSW	4.257	13.962	335 16 29
Bernalillo, water tank				342 28 26.4

Height of instrument above station mark - 1.6 meters.

****

JEMEZ (Sandoval County,N.Mex.,C.A.E.,1945)--Established in 1938 but not occupied until 1946. On one of a low group of hills rising out of the Rio Grande (4 miles to E) and about 1/4 mile S of State Hwy. 44. A hill slightly higher is about 100 yards to NNE. Approx. (airline distances) 20 miles N of Albuquerque, 18 miles SE of San Ysidro, and 4 miles NW of Bernalillo.

To reach from junction of State Highway 44 and U.S. Highway 85 about 1 mile N of Bernalillo, go W on highway 44 for 0.65 mile to bridge across Rio Grande. Crossing the bridge, continue on highway 44 for 4.1 miles to azimuth mark on right (N) side of highway. Continue on State highway, going 0.65 mile to a road coming in on left. Turn left off the highway and, crossing a cattle guard and going on another left fork along the fence, go for 0.6 mile to a gate in the fence on the left and a corral. Turn left through the gate and then left again, and, following the track road back along the fence, go 0.3 mile to a deep track road going off to right. Turn right here and follow this track road 0.15 mile to end of truck travel and station.

Station is a bronze station disk stamped "JEMEZ 1938" and set in a concrete post which projects about 1 foot above surrounding surface, 8.8 feet N of a 4-inch square white witness post.

Reference mark 1, a bronze reference disk stamped "JEMEZ 1938 NO 1", is set in a square concrete post which projects about 1 inch above surrounding surface and is about 30 inches below station.

Reference mark 2, a bronze reference disk stamped "JEMEZ 1938 NO 2", is set in a square concrete post which projects about 4 inches above surrounding surface and is about 14 inches below statio

Reference mark 3, a bronze reference disk stamped "JEMEZ NO 3 1945", is set in a square concrete post which projects about 1 inch above the surrounding surface. It is about 3 feet below the stati

The azimuth mark is a bronze reference disk stamped "JEMEZ 1938 AZIMUTH MK" and set in a square concrete post which projects about 2 inches above the surrounding surface. It is 129 feet N of the center of State Highway 44 and about 8 feet higher. It is 2-1/2 feet S of a 4-inch square white witness post.

OBJECT		DISTANCE		DIRECTION
ROSA (U.S.G.S.)		meters	feet	0°00'00"0
R.M. 1	NE	7.120	23.364	13 10 41
R.M. 3	E	12.256	40.210	46 40 06
Azimuth Mark	E	1/2 mile		53 07 13.2
Bernalillo, water tank				87 52 32.5
R.M. 2	WSW	9.586	31.452	240 56 51

****

BERNALILLO MAG (Sandoval County,N.Mex.,C.A.E.,1946)--The station is located at the foot of sandhills about 3/4 mile SE of the Bernalillo railroad depot, about 80 yards ESE of the center of the Old Santa Fe Road, about 135 yards E of the most E irrigation ditch in vicinity, and about 150 yards ENE of a horseshoe bend in the irrigation ditch. In approximate airline distances it is located 1 mile SE of Bernalillo.

To reach the station from the Sandoval County Courthouse in Bernalillo, go S on U.S. Highway 85 for 0.2 mile to a road leaving the highway on the left and heading toward the foothills to the E. (The azimuth mark is reached from this point by turning left off the highway and going for 0.1 mile to the railroad depot. Turn left here and follow dim road down W side of railroad tracks, going for 0.2 mile to adobe house and end of truck travel. From here pack on down the W side of the track to the first signal on the W side of the track and the azimuth mark.) Continue S on U.S. Highway 85 for 0.2 mile to another road coming into the highway on the left and leading toward the foothills to the E. Turn left off the highway here and go 0.4 mile across the railroad tracks toward the foothills to a bridge across an irrigation ditch. Cross the ditch and immediately take a left fork going for 0.2 mile to the end of truck travel on the E side of the road next to the fence. Cross the fence here and pack directly toward the foothills or ESE, going about 75 yards to the station.

The station is a bronze magnetic disk unstamped and set in a concrete post which projects about 6 inches above the surrounding surface. The concrete post is square. The underground mark is a bronze station disk in concrete.

Reference mark 1 is a bronze reference disk stamped "BERNALILLO MAG NO 1 1946" and set in a square concrete post which projects about 7 inches above the surrounding surface. It is about 4 feet above the station and is located SE of the station.

Reference mark 2 is a bronze reference disk stamped "BERNALILLO MAG NO 2 1946" and set in a square concrete post which projects about 5 inches above the surrounding surface. It is about the same level as the station and is located W of the station.

The azimuth mark is a bronze azimuth disk stamped "BERNALILLO MAG 1946" and set in the concrete base of a railroad signal post on the Atchison, Topeka & Santa Fe Railway which projects 2 feet above the surrounding surface. It is located 1 mile NNW of the station, 1/4 mile N of the depot, 11 paces E of the fence, 9 paces N of the switch lever, and 7 feet W of the W rail of the railroad tracks.

The General Land Office mark is stamped "PC 287 PC 256 PC 280

(continued on page 12)

BERNALILLO MAG (continued)
T12N R4E S5 1927" and is set or capped on a 1-inch pipe which projects about 1-1/2 feet above the surrounding surface. It is located 377.9 feet WSW of the station, 45 feet WNW of telephone pole 17720, 32 feet NW of the center of the Old Santa Fe Road, and 6 inches E of the fence corner.

OBJECT		DISTANCE meters	feet	DIRECTION ° ' "
CORRALES				0°00'00"0
R.M. 2	W	18.309	60.069	80 54 20
Bernalillo, water tank				59 11 39.1
Azimuth Mark	NNW	1 mile		98 40 25.8
R.M. 1	SE	18.312	60.076	278 31 29

Height of light above station mark - 2.7 meters.
Height of instrument above station mark - 3.1 meters.

103

CORRALES (Sandoval County,N.Mex.,C.A.E.,1946)--The station is on low hills overlooking the Rio Grande valley, by approximate airline distances, 10 miles N of Albuquerque, 7 miles SW of Bernalillo, 4 miles NNW of Alameda, and 2-1/2 miles W of the settlement of Corrales.

To reach the station, turn W off U.S. Highway 85 in the town of Alameda, on a graded road about 50 yards N of the Nativitati Church. Go W on graded road 1.5 miles, cross the Rio Grande and continue on main road NW and N 2.7 miles to a cross road in a small settlement. Turn left and go W 0.55 mile to the azimuth mark on the right side of the road. Continue 0.3 mile, keep left fork 0.1 mile, then take the right fork and continue on a track road 0.9 mile to a gate. Pass through and continue 0.4 mile to where the road tops a small rise. Turn right, across country, 0.2 mile to the station on a sandy knoll.

The station mark, which is a bronze station disk stamped "CORRALES 1946", is set in a square concrete post which projects about 6 inches above the ground. It is located on a sandy knoll about 0.2 mile N of the track road. The underground mark is a bronze station disk set in concrete.

Reference mark 1, which is a bronze reference disk stamped "CORRALES NO 1 1946", is set in a square concrete post which projects about 8 inches above the ground. It is located SSE of the station on the same level.

Reference mark 2, which is a bronze reference disk stamped "CORRALES NO 2 1946", is set in a square concrete post which projects about 8 inches above the ground. It is located NNW of the station on the same level.

The azimuth mark, which is a bronze azimuth disk stamped "CORRALES 1946", is set in a square concrete post which projects about 2 inches above the ground. It is located ESE of the station, 15 feet NNE of the center of the road, 2.8 feet SSW of a fence line, and 2-1/2 feet W of a 4- by 4-inch white witness post.

All stations visible from the ground.

OBJECT		DISTANCE meters	feet	DIRECTION °'"
JEMEZ 1936				0°00'00"0
Lookout tower, Sandia Pk.				88 51 06.6
Azimuth Mark	ESE	2 miles		108 49 21.2
KOB radio tower				129 40 07.5
R.M. 1	SSE	8.937	29.318	148 33 57
R.M. 2	WSW	8.217	26.950	231 04 25

Height of instrument above station mark - 3.3 meters.

104

BLACK (Bernalillo County,N.Mex.,C.A.E.,1946)--The station is on low hills overlooking the Rio Grande Valley to the E. It is about 2 miles W of the Rio Grande and about 3-1/2 miles W of the small town of Alameda. In approximate airline distances it is located 11 miles SSW of Bernalillo, and 7 miles NNW of Albuquerque.

To reach the station from the T-intersection on U.S. Highway 85 at Alameda, which is a small town about 7 miles N of Albuquerque, go W on graveled graded road for 1.4 miles to a steel bridge over the Rio Grande. (The T-intersection is about 50 yards N of the Nativitati Church in Alameda.) Cross the Rio Grande and continue on the main graded road for 0.45 mile to a road coming in on the left. Turn left here and crossing a cattle guard, go for 0.1 mile to where the road crosses an irrigation ditch. Continue on the main traveled road for 1.85 miles to a crossroads. Turn sharp right here and follow the track road W up hill for 1.1 miles to a fork. Take the right fork and go for 0.4 mile to a windmill and tanks and the azimuth mark. Continue on the track road, passing to the right of the windmill and going for 0.2 mile. Turn sharp right here and go across country down the slight ridge for 0.5 mile to the end of truck travel and the station.

The station mark is a bronze station disk stamped "BLACK 1946" and set in a square concrete post which projects about 8 inches above the surrounding surface. It is located 10 feet E of a 4-inch square white witness post. Underground mark is a bronze station disk set in concrete.

Reference mark 1 is a bronze reference disk stamped "BLACK NO 1 1946" and set in a square concrete post which projects about 2 inches above the surrounding surface. It is about 1 foot lower than the station and is located SE of the station.

Reference mark 2 is a bronze reference disk stamped "BLACK NO 2 1946" and set in a square concrete post which projects about 2 inches above the surrounding surface. It is about 1 foot lower than the station and is located SW of the station.

The azimuth mark is a bronze azimuth disk stamped "BLACK 1946" and set in an irregular mass of concrete which once formed one of the bases for the legs of a windmill. It projects 2 inches above the surrounding surface and is located 1/2 mile WNW of the station. It is 31-1/2 feet W of the fence surrounding the well which is nearest the road and 5.8 feet ENE of the well.

OBJECT		DISTANCE meters	feet	DIRECTION °'"
CORRALES				0°00'00"0
KOB Radio tower (highest)				54 55 58.4
R.M. 1	SE	13.247	43.468	110 57 18
R.M. 2	SW	14.293	46.896	207 11 58
Azimuth Mark	WNW	1/2 mile		254 13 34.6

Height of light above station mark - 2.7 meters.
Height of instrument above station mark - 3.1 meters.

SANDIA (Bernalillo County,N.Mex.,C.L.O.,1920;1921)--Station is about 18 miles airline NE of Albuquerque, 25 miles NW of Moriarty, 13 miles W of San Pedro, and on the highest peak of the Sandia Range. This peak is near the N end of the range and is free from trees to a distance of about 100 yards down its sides on the N, E, and S, and is covered with small timber on the W.

To reach the station, take the Moriarty-Albuquerque road to Tijeras, 18 miles E of Albuquerque, then go N 7 miles to the Mexican village of San Antonito. From San Antonito several trails lead to the top and ranchers can be found to do animal packing. The vicinity of the station is locally known as "Valle Grande."

The station mark is a bronze station disk stamped "1919" but it was not occupied until 1920. It is set in rock outcrop.

The reference mark is a bronze reference disk set in rock outcrop. It is 12.71 meters (41.7 feet) from the station in azimuth 185°15'.

(C.A.E.,1945)--The station is on the highest point of the Sandia Mountains which is a range of mountains running generally NW to SE about 12 miles, airline, NE of Albuquerque. The highest point of this range is at or near its W extremity. The station is 8-1/2 miles, airline, SE of Bernalillo and 14 miles, airline, NE of Albuquerque.

To reach the station from the post office in Bernalillo, go N on U.S. Highway 85 to a paved crossroad, a distance of 1.1 miles. Here turn right or E and go 9.2 miles to the end of the pavement. Continue 4.8 miles up the mountain to a fork. Here take the left fork or the main traveled road and go 2.1 miles to a fork. Here take the left fork or the main traveled road 0.3 mile to a T-intersection and a sign reading "Sandia Crest Drive." Here take the right fork W for 0.6 mile to the Capulin Picnic Ground on the right. Continue 4.9 miles to a fork. Here is a sign reading "Sandia Crest Kiawa Point." Take the right fork and go 0.1 mile to the highest point and the station.

The station is a bronze station disk stamped "SANDIA 1919" and is set in bedrock projecting 4 inches. It is 150 feet W of a stone monument 5 feet high with a plaque reading "Sandia Crest Elev. 10,678 Cibola National Forest."

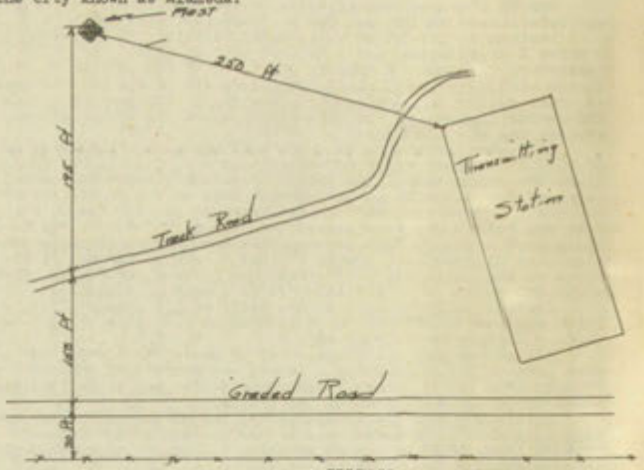
One reference mark which is not numbered is a bronze reference disk stamped "SANDIA 1919" and is set in bedrock projecting 5 inches. It is about 5 feet below the station. The mark is N of the station.

The other reference mark is a bronze reference disk stamped "SANDIA 1945 NO 2" and is set in bedrock projecting 2-1/2 feet. It is about 7 feet below the station. The mark is SE of the station.

The azimuth mark is a bronze azimuth disk stamped "SANDIA 1945" and is set flush in outcropping bedrock. It is 2 feet E of the edge of the cliff and 2 feet SE of a 2-foot cairn. The mark is 1/2 mile along the edge of the cliff SE of the station.

OBJECT		DISTANCE meters	feet	DIRECTION °'"
CORRALES				0°00'00"0
R.M. (not numbered)	N	12.695	41.653	85 59 15
Azimuth Mark	SE	1/2 mile		225 29 50.2
R.M. 2	SE	17.074	56.010	232 44 58

ALBUQUERQUE, KOB RADIO MAST (Bernalillo County,N.Mex.,C.A.E., 1946)--A tall steel-latticed frame radio mast of KOB Radio Station. Standing on the E side of North Fourth Street in the section of the city known as Alameda.



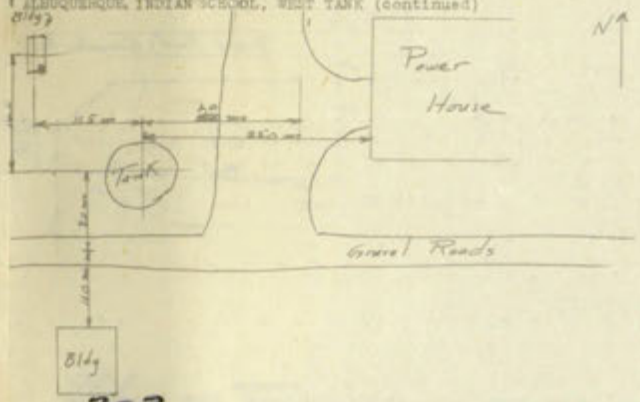
ALBUQUERQUE INDIAN SCHOOL, WEST TANK Bernalillo County, N.Mex.,C.A.E.,1946)--Tank is located 25 meters W off the powerhouse at the Indian School in the N part of Albuquerque. Separating the tank and powerhouse is an irregular gravel road and parking area. Tank is 19 meters N of an abandoned building approximately the size of a small dwelling. It is a conventional silver water tank supported by four steel legs set in concrete, with a standpipe in the center running from the ground to the tank above.

Tank is about 1/2 mile W of North Fourth Street, approximately 100 yards N of Indian School Street.

(sketch appears on page 13)

UNITED STATES COAST AND GEODETIC SURVEY
Descriptions of Triangulation Stations

ALBUQUERQUE, INDIAN SCHOOL, WEST TANK (continued)

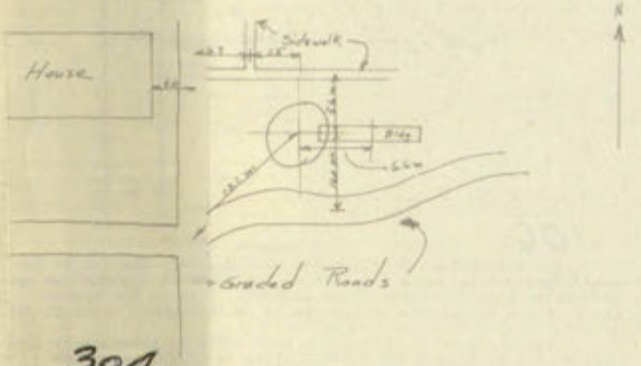


302

ALBUQUERQUE, INDIAN SCHOOL, EAST TANK (Bernalillo County, N. Mex., C.A.E., 1946)--A conventional silver tank located in the E portion of the Indian School property, in the N part of Albuquerque. It is 10 meters from the approximate center of a very irregular driveway, 8.2 meters from the center of a N-S graded street. The entire school property is at the NW corner of Albuquerque City Limits.

Tank is similar to the W tank, being supported by four steel legs embedded in concrete, with standpipe in center. There is a low rectangular building beneath and E of the tank, possibly a pump house.

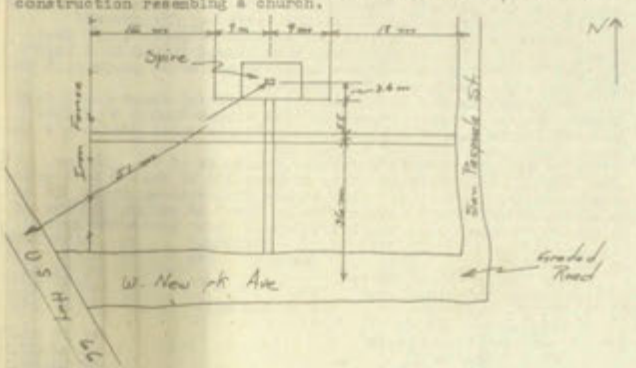
It is about 1/4 mile N of North Fourth Street, approximately 100 yards N of Indian School Street, and the more E tank of two.



304

ALBUQUERQUE, SAN FELIPE SCHOOL, SPIRE (Bernalillo County, N. Mex., C.A.E., 1946)--School is located on the corner of West New York Avenue and San Pasquale Street, NE of West Central Avenue or U.S. Highway 66. The spire is on the front of the building, facing West New York Avenue, 45 meters N of the center line of West New York Avenue, and 27 meters W of the center line of San Pasquale Street. It is 81 meters NE of the center of West Central Avenue.

A cupola-like base on top of the roof of the main structure supports the steeple. The building is of brown stone and brick construction resembling a church.



203

GOLF (Bernalill County, N. Mex., C.A.E., 1946)--Station is located about 1-1/2 miles, airline, ENE of the center of Albuquerque and is on the grounds of the University of New Mexico golf course.

To reach the station from the intersection of East Central Avenue and Cibola Avenue in Albuquerque, go N on Cibola Avenue for 0.4 mile to the end of the street. Turn right (E) and then left (N) across the through street to the entrance to the golf course grounds (a total distance of 0.1 mile). Pass through the gate, entering the golf course. Turn left along the NW side of the fence along the edge of the golf course and follow the track road nearest the fence for 0.5 mi. to the station. (The fence goes NW and then turns N.)

Station is located about 50 feet SW of the center of the green on the eleventh hole and just N of the tee on the seventeenth hole. It is about 70 paces E of the N-S fence mentioned above. It is a bronze station disk stamped "GOLF 1946" and set in a square concrete post which is 1 inch below the surface of the ground. Underground mark is a bronze station disk set in concrete 20 inches below the surface of the ground.

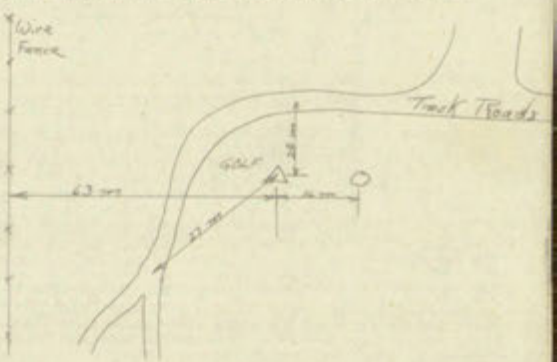
Reference mark 1 is NE of the station and about 4-1/2 feet higher. It is a bronze reference disk stamped "GOLF NO 1 1946" and set in a square concrete post which projects 3 inches above the ground.

Reference mark 2 is WNW of the station and about 1 foot lower. It is a bronze reference disk stamped "GOLF NO 2 1946" and set in a square concrete post which projects 1 inch above the ground.

The azimuth mark is located 1/4 mile ESE of the station and about 50 feet SSE of the S edge of the fairway on the twelfth hole. It is marked by a U.S. Geological Survey bench mark and triangulation station disk which is unstamped and set in a square concrete post projecting about 4 inches above the ground.

OBJECT		DISTANCE		DIRECTION
		meters	feet	0°00'00"0
RADIO				
Albuquerque, federal building, dome				1 24 32.8
Albuquerque, Hilton Hotel, sign				1 59 32.8
Albuquerque, KDGM tower				3 33 48.8
Albuquerque, San Felipe School, spire				23 18 20.8
R.M. 2	WNW	12.384	40.635	51 43 18
R.M. 1	NE	10.717	35.160	154 38 54
Azimuth Mark (U.S.G.S. mark)	ESE	1/4 mile		228 33 00.0

Height of instrument above station mark - 3.2 meters.



ALBUQUERQUE MAG. (Bernalillo County, N. Mex., C.A.E., 1946)--Station is located about 1-3/4 miles, airline, E of the center of Albuquerque and 1/8 mile S of the Albuquerque Indian Sanatorium. It is 1/8 mile N of the N boundary of the E section of the University of New Mexico Golf Course. It is 153 feet S of the center of Las Lomas Road and about 2 feet lower than the surface of this road. It is 4 feet WNW of a 4-inch square white witness post. It is a bronze magnetic disk which is unstamped and set in the top of a square concrete post projecting 1 inch above the ground.

204

UNIVERSITY (U.S.G.S.) (Bernalillo County, N. Mex., C.A.E., 1946)--Station is located about 1-5/8 miles, airline, E of the center of Albuquerque on a vacant lot which is just W of one section of the University of New Mexico Golf Course, and S of another section of this same course.

To reach the station from the intersection of East Central Avenue and Villagra Avenue, go N on Villagra Avenue for 0.3 mile. Turn right and go 0.15 mile to station on the left (N).

Station is located 155 feet W of Cibola Avenue, 59 feet N of Roma Avenue, and 9 feet WSW of a 4-inch square white witness post. It is marked by a U.S. Geological Survey bench mark and triangulation station disk stamped "R 1931" and set in the top of a square concrete post which projects 2 inches above the ground.

The first reference mark is located S of the station and about the same level. It is 24-1/2 feet N of Roma Avenue. It is marked by a U.S. Geological Survey reference disk which is unstamped and set in the top of a concrete post that is flush with the ground.

The second reference mark is located W of the station and about the same level. It is marked by a U.S. Geological Survey reference disk which is unstamped and set in the top of a square concrete post that projects 1 inch above the ground.

Reference mark 3 is located E of the station and about the same level. It is a bronze reference disk stamped "UNIVERSITY USG NO 3 1946" and set in the top of a square concrete post which projects 5 inches above the ground.

The azimuth mark is located about 1/2 mile N of the station and about 50 feet SSW of the S edge of the fairway on the twelfth hole of the University of New Mexico Golf Course. It is marked by a U.S. Geological Survey bench mark and triangulation station disk which is unstamped and set in the top of a square concrete post projecting 4 inches above the ground.

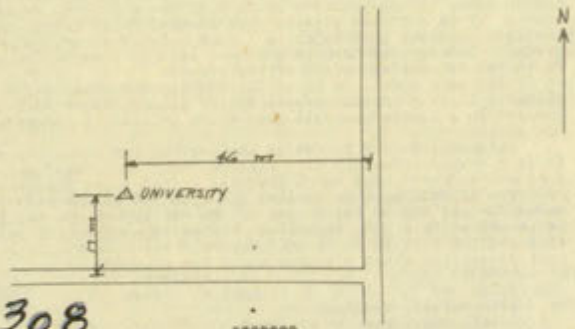
OBJECT		DISTANCE		DIRECTION
		meters	feet	0°00'00"0
GOLF				
Azimuth Mark	N	1/2 mile		24 31 02.1
R.M. 3	E	17.222	56.498	111 30 49
R.M. (U.S.G.S.)	S	10.564	34.661	200 53 56
R.M. (U.S.G.S.)	W	10.791	35.403	290 50 01

Height of instrument above station mark - 3.2 meters.

(sketch appears on page 14)

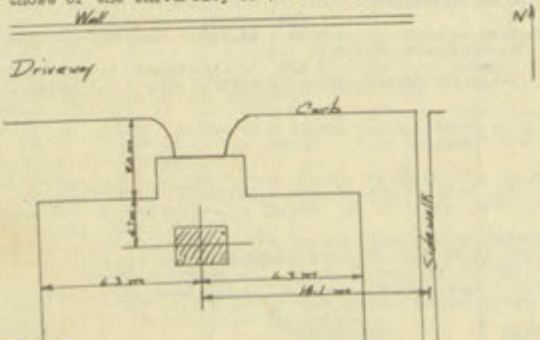
14 (d)

UNIVERSITY (U.S.G.S.)(continued)



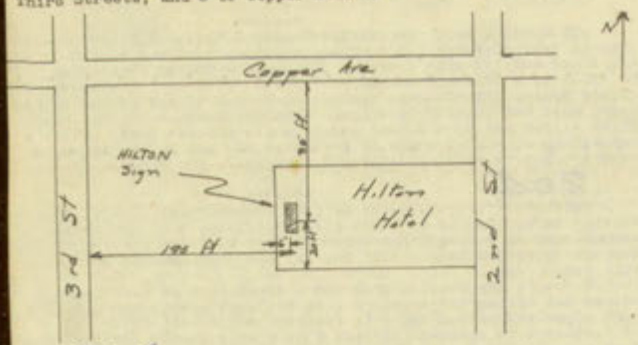
308

ALBUQUERQUE, INDIAN HOSPITAL, STACK (Bernalillo County,N.Mex., C.A.E.,1946)--The prominent yellow brick rectangular stack arising from the Indian Hospital and Sanatorium, the grounds of which adjoin those of the University of New Mexico on the NE.



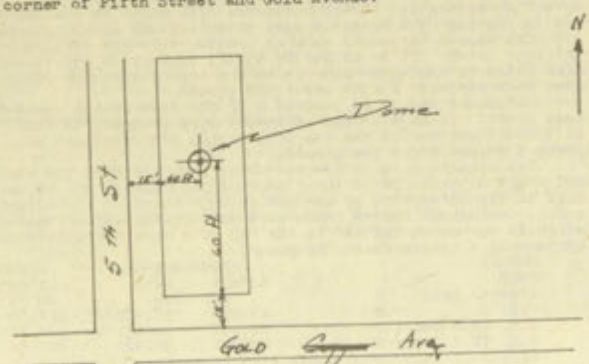
310

ALBUQUERQUE, HILTON HOTEL, TOWER SIGN (Bernalillo County,N. Mex.,C.A.E.,1946)--The center of the prominent sign with the name "HILTON", lighted at night in large letters in a vertical row atop the Hilton Hotel, in downtown Albuquerque, between Second and Third Streets, and S of Copper Avenue.



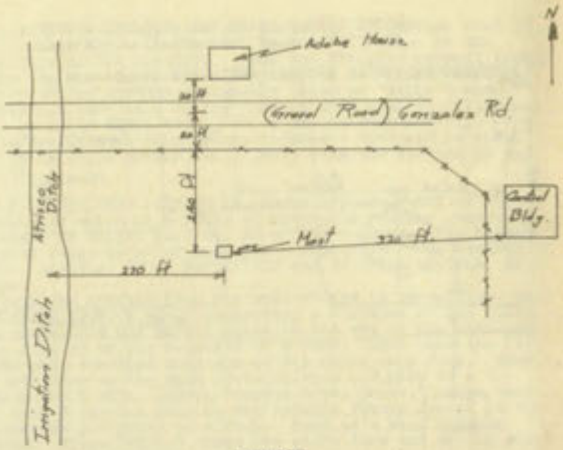
314

ALBUQUERQUE, FEDERAL BUILDING, DOME (Bernalillo County,N.Mex., C.A.E.,1946)--Gold leaf dome with finial atop the Federal Courthouse Building, in the center of Albuquerque business district, at the corner of Fifth Street and Gold Avenue.

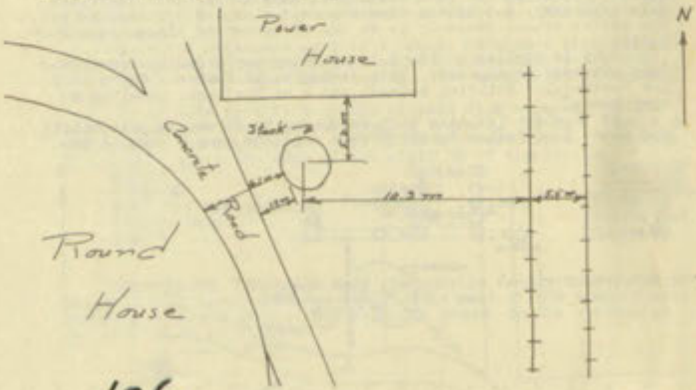


309

ALBUQUERQUE, KOGM RADIO MAST (Bernalillo County,N.Mex., C.A.E.,1946)--A tall, latticed steel mast for Radio Station KOGM, set in an area bordered on the W by Atrisco Ditch (an irrigation ditch) and on the N by Gonzales Road. It is W of the Rio Grande River, about 1/2 mile S of U.S. Highway 66.



ALBUQUERQUE, SANTA FE RAILROAD YARDS, STACK (Bernalillo County,N.Mex.,C.A.E.,1946)--A large, dirty brick stack in the Santa Fe railroad yards near the S city limits, about 75 yards E of South First Street. It is 6.1 meters NE of the nearest edge of the roundhouse, just S of the powerhouse.



106

RADIO (Bernalillo County,N.Mex.,C.A.E.,1946)--Station is located about 4 miles, airline, WNW of the center of Albuquerque and 2-1/2 miles S of the Cutter-Carr airport. It is on the higher land W of the Rio Grande valley and is on the highest point in the vicinity.

To reach the station from the post office in Albuquerque, go S and W on U.S. Highway 85 for 1.6 miles to a fork. Continue straight ahead on State Highway 135 (U.S. Highway 85 turns left or S) for 2.0 miles to a fork. Take the left fork (State Highway 135 takes the right fork) and go 0.1 mile to the azimuth mark on the right (N). Continue for 0.8 mile to a road turning off to the left (S). Turn left on this road and go S 200 feet and then turn left (E) for 40 feet to the station.

Station is located 207 feet S of an E-W graded road, 40 feet E of a track road, and 38 feet S of a 4-inch square white witness post. It is marked by a bronze station disk stamped "RADIO 1946" and set in the top of a square concrete post which projects 8 inches above the ground. Underground mark is a bronze station disk set in concrete 26 inches below the surface of the ground.

Reference mark 1 is E of the station and about 1-1/2 feet lower. It is a bronze reference disk stamped "RADIO NO 1 1946" and set in the top of a square concrete post which projects 3 inches above the surface of the ground.

Reference mark 2 is SSW of the station and about 1-1/2 feet lower. It is a bronze reference disk stamped "RADIO NO 2 1946" and set in the top of a square concrete post which projects 4 inches above the surface of the ground.

The azimuth mark is located 0.8 mile ENE of the station, 113 feet SSW of the center of State Highway 135, 48 feet N of a graded road, and 5 feet W of a 4-inch square white witness post. It is a bronze azimuth disk stamped "RADIO 1946" and set in the top of a square concrete post which projects 2 inches above the ground.

OBJECT	DISTANCE meters	DISTANCE feet	DIRECTION
			0°00'00"0
BLACK			38 24 46.6
San Felipe School spire*			55 39 11.1
Federal Building, dome*			58 38 56.0
Azimuth Mark ENE	0.8 mile		
Albuquerque Indian Sanatorium, chimney*			59 38 38.2
			66 44 02.1
Brick smokestack*			82 13 53.1
Veterans' hospital tank*			83 43 07
R.M. 1 E	20.686	67.870	343 35 26.6
R.M. 2 SSW	29.364	96.340	

*These cuts are located in the vicinity of Albuquerque.

Height of instrument above station mark - 5.9 meters.

318

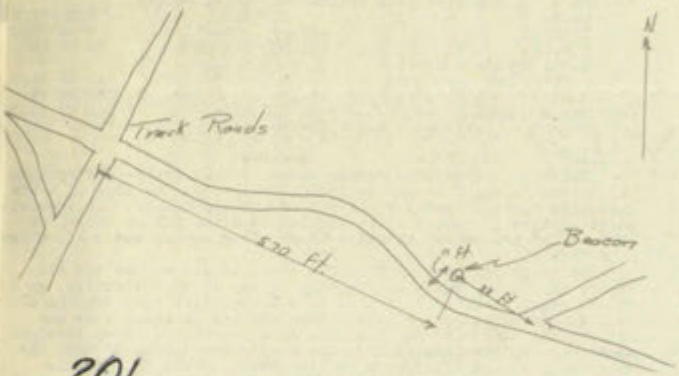
ALBUQUERQUE, AIRWAY BEACON 68 (Bernalillo County,N.Mex., C.A.E.,1946)--A standard beacon approximately 50 feet high, painted red and white, and set in concrete foundations. It is 0.4 mile S of U.S. Highway 66 and about 8 miles W of the city of Albuquerque.

To reach from Albuquerque, go W on U.S. Highway 66 for 8.5 miles from the intersection of highway 66 and U.S. Highway 85. Turn left on track road and go S 0.4 mile to beacon on left.

(sketch appears on page 15)

UNITED STATES COAST AND GEODETIC SURVEY
Descriptions of Triangulation Stations

ALBUQUERQUE, AIRWAY BEACON 68 (continued)



201

KIRTLAND (Bernalillo County,N.Mex.,C.A.E.,1946)--The station is in the center of the N of two triangles which form the highway intersection in front of the Albuquerque Municipal Airport.

Station mark is a bronze station disk stamped "KIRTLAND 1946" and set in a square concrete post flush with the ground. It is located 130.8 feet NNW of the steel flagpole in the S one of two triangles, 43.0 feet SW of the NE edge of the triangle, 29.5 feet E of the W edge, and 36.0 feet N of the S edge. It is 8.5 feet W of a 4- by 4-inch white witness post. Underground mark is a bronze station disk in concrete.

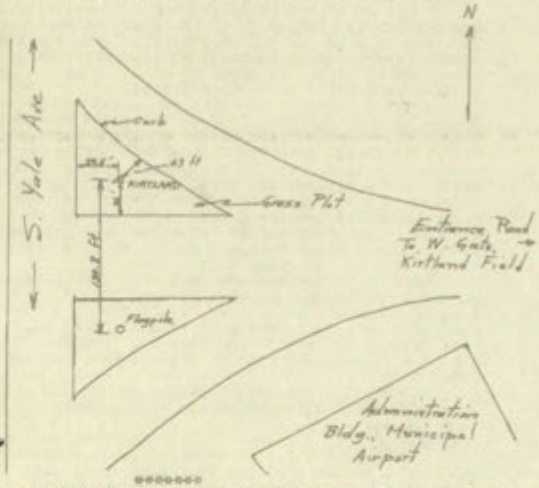
Reference mark 1, which is a bronze reference disk stamped "KIRTLAND NO 1 1946", is set in a square concrete post flush with the ground. It is located NNW of the station and about 2 feet lower than the station.

Reference mark 2, a bronze reference disk stamped "KIRTLAND NO 2 1946", is set in a drill hole in the concrete gutter along the W side of the highway, flush with the surface, and WSW of the station. It is about 2 feet lower than the station.

The azimuth mark, a bronze azimuth disk stamped "KIRTLAND 1946", is set in the 2-foot square concrete foundation for the SW leg of the S of the two radio towers of the Albuquerque Airways Radio. It is N of the station, on the W side of the highway leading to the center of the city.

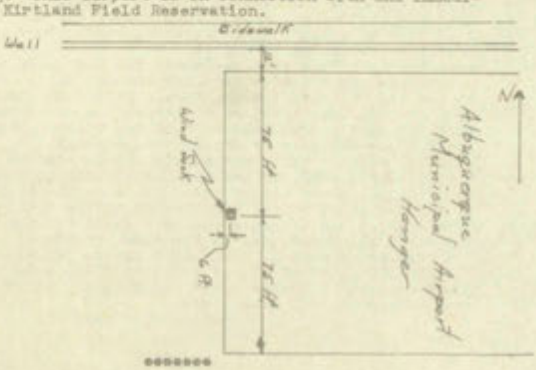
OBJECT	DISTANCE meters	DISTANCE feet	DIRECTION 0°00'00"0
RADIO Albuquerque, large smokestack			35 59 15.5
R.M. 1 NNW	25.282	82.937	64 09 26
Azimuth Mark N	1 mile		73 08 56.0
KOB radio tower			81 14 37.4
R.M. 2 WSW	23.059	75.652	322 52 15

Height of instrument above station mark - 1.7 meters.



317

ALBUQUERQUE, MUNICIPAL AIRPORT, WIND SOCK (Bernalillo County, N.Mex.,C.A.E.,1946)--The wind sock is located on top of a pole situated on the apex of the municipal hangar roof, at the W end of the building. This airport is in connection with and immediately W of the Kirtland Field Reservation.

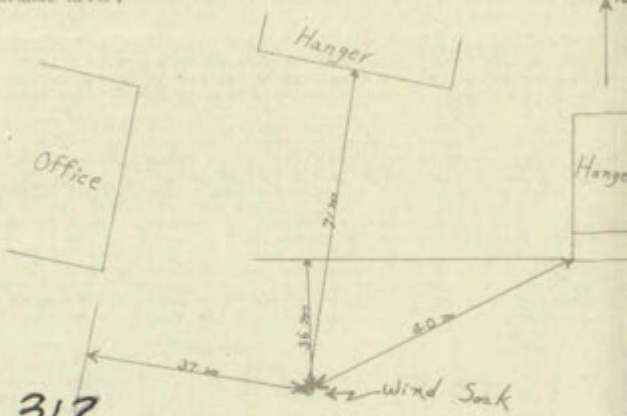


No. 900 60 1

Chama to Belen, New Mexico

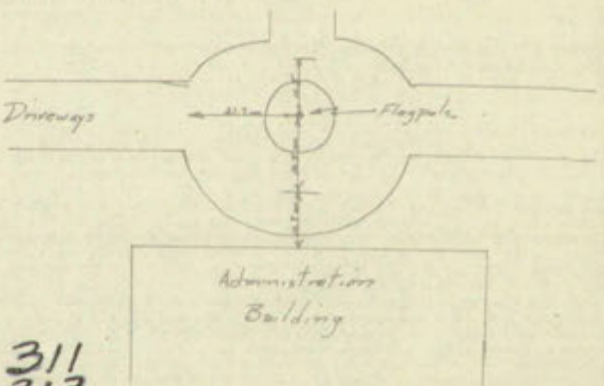
321

ALBUQUERQUE, CUTTER CAR AIRFIELD, WIND SOCK (Bernalillo County,N.Mex.,C.A.E.,1946)--This is the wind sock atop a tall wooden pole arising above the trees at the entrance to the ground of the Cutter-Carr Flying Field, formerly the Albuquerque Municipal Airport. It is about 1/2 mile N of Route 66, W of the Rio Grande River.



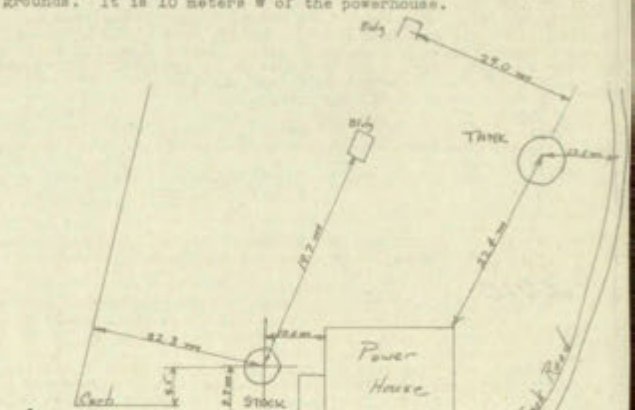
312

ALBUQUERQUE, VETERANS CENTER, FLAGPOLE (Bernalillo County, N.Mex.,C.A.E.,1946)--The tall flagpole in the center of a landscaped circle standing in front of the Administration Building of the Veterans Center in East Albuquerque, immediately E of the Kirtland Field Reservation.



311
313

ALBUQUERQUE, VETERANS HOSPITAL, TANK AND STACK (Bernalillo County,N.Mex.,C.A.E.,1946)--The tank is the large silver-colored water tank in the rear of the grounds of the Veterans Center in East Albuquerque, immediately E of the Kirtland Field Reservation. The stack is equally prominent and in the same vicinity on the grounds. It is 10 meters W of the powerhouse.



105

TIJERAS (Bernalillo County,N.Mex.,C.A.E.,1946)--The station is located on the flat mesa land which slopes from the mountains E of Albuquerque to the Rio Grande. It is about 2 miles W of the base of the mountains, 1-1/2 miles S of U.S. Highway 66, and 4 miles ESE of Sandia Base. In approximate airline distance it is located 7 miles ESE of Albuquerque.

To reach the station from the underpass on U.S. Highway 66 near the center of Albuquerque, go E on highway 66 for 6.25 miles to a road coming into the highway from the right or S. Turn right off the highway, as per sign "SADDLE HORSES FOR RENT FOUR HILL RANCH", and follow the bladed dirt road for 0.25 mile to a wire gate with arch and sign "CANDELARIA 4 HILL RANCH." Pass through this gate and follow the main traveled road for 0.2 mile to a stream bed which is in Tijeras Arroyo. Cross this stream bed and go 0.2 mile to a fork. Take the left fork, going 0.1 mile to a white wooden gate, and then, passing through this gate, go 0.3 mile

(continued on page 16)

TIJERAS (continued)
to a cattle guard. Cross the cattle guard and continue on the dirt road for 0.3 mile to where a ranch house is on the left. Continue straight ahead on the main traveled road, passing in front of the ranch yard, for 0.25 mile to the azimuth mark on the left or S side of the road. Continue down the road in a W direction, going 0.15 mile to another cattle guard. Pass over this cattle guard and keep straight ahead at T-intersection just after the cattle guard, going 0.55 mile to the end of truck travel and the station on the right or N side of the road.

The station mark is a bronze station disk stamped "TIJERAS 1946" and set in a square concrete post which projects 1 inch above the surrounding surface. It is located 50 feet N of the center of the road. Underground mark is a bronze station disk in concrete.

Reference mark 1 is a bronze reference disk stamped "TIJERAS NO 1 1946" and set in a square concrete post which projects 1 inch above the surrounding surface. It is about 1 foot above the station and is located ENE of the station.

Reference mark 2 is a bronze reference disk stamped "TIJERAS NO 2 1946" and set in a square concrete post which projects 5 inches above the surrounding surface. It is about 1 foot above the station and is located SSE of the station.

The azimuth mark is a bronze azimuth disk stamped "TIJERAS 1946" and set in a square concrete post which projects 1-1/2 inches above the surrounding surface. It is located 0.7 mile E of the station, about 1/4 mile SW of the ranch house mentioned in the description, 28 feet S of the center of the road, and 13.8 feet N of the fence.

OBJECT		DISTANCE meters	DISTANCE feet	DIRECTION 0°00'00"0
RADIO				
Veterans Hospital, water tank				1 49 18.5
R.M. 1	ENE	31.351	102.858	152 40 57
Azimuth Mark E		0.7 mile		171 50 15.9
R.M. 2	SSE	23.601	77.423	255 09 23

Height of light above station mark - 5.9 meters.
Height of instrument above station mark - 6.3 meters.

108

LOUDON (Bernalillo County, N.Mex., C.A.E., 1946)--The station is on nearly level, sandy pasture land, by approximate airline distances 4 miles S of the Albuquerque Municipal Airport, 3/4 mile NNW of a Radio Range station; and 10 yards E of the edge of the flat land where it breaks off into the Rio Grande valley.

To reach from the Municipal Airport in Albuquerque, go S on the macadam road which presently changes to graded dirt road for 1.3 miles, cross cattle guard, continue 0.05 mile to where the main road turns left. Turn left and follow the main graded road 2.45 miles to a cattle guard and a left fork through a gate. Keep straight, over the cattle guard, 0.3 mile to another left fork. Keep straight ahead, through a gate and SW for 0.95 mile, then turn right on a track road along a power line. Go 0.65 mile to a small white building on the right, then make a left U-turn returning along a track road along another power line 0.25 mile to the azimuth mark on the right. Continue 0.35 mile to a cross track. Turn right, away from the power line, 0.05 mile to a gate. Go through gate and continue N 0.35 mile, thence turn right and go across country N 0.25 mile to the station.

The station, which is a bronze station disk stamped "LOUDON 1946", is set in a square concrete post projecting about 6 inches above the ground. It is located 7.0 feet WNW of a 4- by 4-inch white witness post. Underground mark is a bronze station disk in concrete.

Reference mark 1, which is a bronze reference disk stamped "LOUDON NO 1 1946", is set in a square concrete post which projects about 6 inches above the ground. It is located ESE of the station on about the same level.

Reference mark 2, which is a bronze reference disk stamped "LOUDON NO 2 1946", is set in a square concrete post which projects about 4 inches above the ground. It is located SSW of the station on about the same level.

The azimuth mark, which is a bronze azimuth disk stamped "LOUDON 1946", is set in a square concrete post which projects about 2 inches above the ground. It is located E of the station, 11 feet W of the track road, 6.2 feet NW of power-line pole, and 4.0 feet N of a 4- by 4-inch white witness post.

All stations visible from the ground.

OBJECT		DISTANCE meters	DISTANCE feet	DIRECTION 0°00'00"0
RADIO				
Veterans Hospital, water tower				81 28 20.5
Azimuth Mark E		0.5 mile		145 11 56.1
R.M. 1	ESE	11.390	37.370	151 09 44
Radio Range station, center tower SSE				198 42 32.9
R.M. 2	SSW	13.393	43.940	243 15 32

Height of instrument above station mark - 3.1 meters.

206

WORKMAN (Bernalillo County, N.Mex., C.A.E., 1946)--The station is located about 10 miles SE of Albuquerque, on the grounds of the Naval Ordnance Depot. Station is about 1/4 mile SW of Ordnance Depot mess hall and flagpole.

To reach the station from the N gate of Kirtland Field, go E on road along N side of airfield for 1.0 mile to the Veterans Hospital. Here continue E on bladed road along adobe fence wall for 1.5 miles to a crossroad. Turn right, S, and keep on main traveled road for 1.0 mile to a fork. Take the left fork and continue on the main traveled road for 1.4 miles to a gate and sign reading "Government Restricted Area." Here stay on the main traveled road for 2.9 miles to a fork. Take the right fork for 0.2 mile to gate and guardhouse on the right. Pass through the gate and continue for 1.7 miles to a 5-road intersection and station on the right.

Station mark is a bronze station disk stamped "WORKMAN 1946" and set in a 12-inch square concrete post which projects 2 inches above the ground. It is 141 feet SW of road intersection. Underground mark is a bronze station disk in concrete.

Reference mark 1 is a bronze reference disk stamped "WORKMAN NO 1 1946" and set in a 10-inch square concrete post which projects about 6 inches above the ground. It is S of the station and at about the same level.

Reference mark 2 is a bronze reference disk stamped "WORKMAN NO 2 1946" and set in a 10-inch square concrete post which projects about 4 inches above the ground. It is W of the station and

207

at about the same level.

Azimuth mark is a bronze azimuth disk stamped "WORKMAN 1946" and set in a 10-inch square concrete post which projects about 5 inches. It is about 1/3 mile S of the station and about 50 yards W of road which passes just behind the firing range.

OBJECT		DISTANCE meters	DISTANCE feet	DIRECTION 0°00'00"0
BERNAVAL				0°00'00"0
R.M. 2	W	15.030	49.309	64 27 36
Naval Ordnance Depot, flagpole				210 15 34.4
R.M. 1	S	14.194	46.568	333 35 43
Azimuth Mark S		1/3 mile		340 22 41.34

Height of instrument above station mark - 1.64 meters.

109

BERNAVAL (Bernalillo County, N.Mex., C.A.E., 1946)--The station is located in the W breaks of the foothills, on the edge of a low mesa-like foothill lying 9 miles E of the Rio Grande. In approximated airline distances it is located 23 miles NNE of Belen, 14 miles NE of Los Lunas, 13 miles SE of Albuquerque, and 9-1/2 miles E of Isleta.

To reach the station from the steel bridge across the Rio Grande at Isleta, which is the only bridge in that vicinity, go E on the paved road for 0.15 mile to a bladed dirt road turning off at a slight angle to the left. Turn off the pavement here and follow this dirt road for 0.1 mile to a crossroad. Keep straight ahead here and, keeping on the main road which climbs up onto the mesa, go for 1.85 miles to a cattle guard. Cross this cattle guard and go for 2.2 miles to a fork. Take the right fork, or the road straight ahead, and go 2.1 miles to another cattle guard. Cross this cattle guard and go 0.45 mile to another fork. Take the right fork here and go 1.7 miles to a gate. Pass through this gate and go 0.05 mile to a fork. The right fork here goes to BERNAVAL AZIMUTH MARK and LOLITO. Take the left fork and go 0.5 mile to the top of the low mesa. Here turn left or N and go cross country for 0.1 mile to the end of truck travel and the station.

The station mark is a bronze station disk stamped "BERNAVAL 1946" and set in a square concrete post which projects about 3 inches above the surrounding surface. It is located about 50 yards E of the edge of the low mesa foothill and 7.7 feet S of a 4-inch square white witness post. Underground mark is a bronze station disk set in concrete.

Reference mark 1 is a bronze reference disk stamped "BERNAVAL NO 1 1946" and set in a square concrete post which projects 2 inches above the surrounding surface. It is about 1 foot lower than the station and is located SW of the station.

Reference mark 2 is a bronze reference disk stamped "BERNAVAL NO 2 1946" and set in a square concrete post which projects about 6 inches above the surrounding surface. It is about on the same level as the station and is located NW of the station.

The azimuth mark is station BERNAVAL AZIMUTH MARK.

OBJECT		DISTANCE meters	DISTANCE feet	DIRECTION 0°00'00"0
ISLETA (U.S.G.S.)				0°00'00"0
R.M. 2	NW	18.512	60.739	36 04 57
Radio Directional Mast, center of 5				40 37 35.4
R.M. 1	SW	19.683	64.371	300 33 25
BERNAVAL AZIMUTH MARK				305 49 05.41

Height of light above station mark - 4.3 meters.
Height of instrument above station mark - 4.7 meters.

208

BERNAVAL AZIMUTH MARK (Valencia County, N.Mex., C.A.E., 1946)--The station is located in the W breaks of the foothills just over the edge of a low mesa-like foothill lying 9 miles E of the Rio Grande River. In approximate airline distances, it is located 23 miles NNE of Belen, 14 miles NE of Los Lunas, 13 miles SE of Albuquerque, and 9-1/2 miles E of Isleta.

To reach the station from the steel bridge across the Rio Grande River at Isleta, go E on the paved road for 0.15 mile to a bladed dirt road turning off at a slight angle to the left. Turn off the pavement here and follow this dirt road for 0.1 mile to a crossroad. Keep straight ahead here and, keeping on the main road which climbs up onto the mesa, go for 1.85 miles to a cattle guard. Continue for 2.2 miles to a fork. Take the right fork and go 2.1 miles to another cattle guard. Continue and go 0.45 mile to a fork. Take the right fork and go 1.7 miles to a gate and fork just beyond. Here take the right fork and go 0.1 mile to the witness post and the station on the right of the road.

Station is the azimuth mark for triangulation station BERNAVAL and is a bronze azimuth disk stamped "BERNAVAL 1946." It is set in a square concrete post flush, 9-1/2 feet S of the witness post, 32 feet SE of a 3-inch iron post stamped "B/V" which marks the county line between Bernalillo and Valencia counties, 25 feet SSW of the center of the bladed road to the station, and 130 feet NE of a fence line.

Height of light above station mark - 1.0 meter.
Height of instrument above station mark - 1.6 meters.

107

ISLETA (U.S.G.S.) (Bernalillo County, N.Mex., C.A.E., 1946)--The station is on the S of the two bumps which form the top of a large black hill, about 2 miles WNW of Indian pueblo village of Isleta, and 12 miles S of Albuquerque on U.S. Highway 85. It is the only hill in the vicinity and overlooks the country in all directions.

To reach from the point on U.S. Highway 85 opposite the Isleta railroad station, go S on the highway 0.1 mile to a bladed road right through a gate. Turn right, off the highway, and go SW 0.05 mile to a right fork - a track road. Turn right on this track road for 1.05 miles to a gate. Pass through and continue 0.15 mile, keep the left fork straight ahead for 0.45 mile, then turn right on a very dim track road toward the station hill. Continue 0.4 mile to the end of truck travel, thence pack N up the hill to the station (a 15-minute pack) or if desired, a truck can be driven up onto the more gradual slopes W of the station, and thence up the rocky slope entirely to the top and station.

The station mark, which is a bronze station disk stamped "ISLETA USGS 1946", is set in a drill hole in a boulder projecting about 1 inch above the ground. It is on the highest part of the S of the two bumps which form the top of the hill. The U.S.G.S. station mark, a dim triangle cut in a small boulder, was removed and the new station mark set in the same location.

Reference mark 1, which is a bronze reference disk stamped "ISLETA USGS 1946 NO 1", is set in a drill hole in a boulder which projects about 2 inches above the ground. It is located WNW of the station and about 1 foot lower.

(continued on page 17)

UNITED STATES COAST AND GEODETIC SURVEY
Descriptions of Triangulation Stations

ISLETA (U.S.G.S.)(continued)

Reference mark 2, which is a bronze reference disk stamped "ISLETA USGS 1946 NO 2", is set in a drill hole in a boulder which projects about 2 inches above the ground. It is located N of the station and on about the same level.

The U.S.G.S. reference mark is a dim cross cut in a boulder and located N of the station.

The azimuth mark, which is a bronze azimuth disk stamped "ISLETA USGS 1946", is set in a square concrete post projecting about 4 inches above the ground. It is located SE of the station, 77 paces W of U.S. Highway 85, 86 feet SW of the power-line pole at the bend of the line, and 8 feet W of a 4-inch square white witness post.

To reach the azimuth mark from the point where you leave highway to go to station, continue S on U.S. Highway 85 for 0.6 mile. Turn right off highway, through gate, and along bladed road for 0.1 mile, thence right across country 0.05 mile to the mark.

The azimuth mark was occupied as a triangulation station.

OBJECT		DISTANCE		DIRECTION
RADIO		meters	feet	0°00'00"0
R.M. 2	N	5.327	17.480	1 59 51
U.S.G.S. R.M.	N	4.616	15.14	9 13 08
Radio Range Station, center tower				48 45 04.1
Azimuth Mark	SE	2 miles		134 08 40.61
R.M. 1	WNW	12.831	42.097	274 31 11

Height of instrument above station mark - 1.8 meters.

208

ooooooo

ISLETA (U.S.G.S.) AZIMUTH MARK (Bernalillo County,N.Mex., C.A.E.,1946)--The station is located on the top of a low rise about 1 mile W of the Rio Grande and 1 mile SW of the Isleta Indian Pueblo.

To reach the station from the abandoned filling station on U.S. Highway 85, which is about 200 yards W of the Atchison, Topeka & Santa Fe railroad station at Isleta and is next to the historic marker signed "ISLETA INDIAN PUEBLO", go S on highway 85 for 0.65 mile to a track road coming into the highway through a gap in the fence on the right or W side of the highway. This track road turns off just before the highway starts to go over an overpass over the railroad tracks. Turn right here and follow the track road toward old earth diggings for 0.1 mile. Here turn right again and go cross country toward the bend in the power line for 0.05 mile to the white witness post and the station.

Station mark, a bronze azimuth disk stamped "ISLETA USGS 1946" is set in a square concrete post which projects about 4 inches above the surrounding surface. It is located 2 miles SSE of station ISLETA (U.S.G.S.), about 1/4 mile N of the overpass on U.S. Highway 85, 77 paces W of highway 85, 86 feet SW of the power-line pole at the bend of the line, and 8 feet W of a 4-inch square white witness post.

OBJECT	DIRECTION
ISLETA (U.S.G.S.)	0°00'00"0
Isleta Church, cross	102 19 13.3
TOME (U.S.G.S.)	280 13 16.63
Water Tank, Los Lunas	233 51 21.2

Height of light above station mark - 1.2 meters.
Height of instrument above station mark - 1.6 meters.

ooooooo

LUNAGALLUP (Valencia County,N.Mex.,C.A.E.,1946)--This station was established in 1938 but was not occupied until 1946.

The station is 1 mile, airline, NW of Los Lunas and 11 miles, airline, N of Belen. It is near State Highway 6 on land sloping gently down toward the Rio Grande River to the E and sloping gently upward toward the Los Lunas hills to the W.

To reach from the junction of U.S. Highway 85 and State Highway 6, go NW for 0.9 mile to the witness post and the station on the right or N.

The station is a bronze station disk stamped "LUNAGALLUP 1938" and is set in a square concrete post projecting 5 inches. It is 8 feet ESE of the witness post, 87 feet N of the center of highway 6, and 72-1/2 feet WNW of pole 4 which is located at a bend in the telephone line.

Reference mark 1 is a bronze reference disk stamped "LUNAGALLUP NO 1" and is set in a square concrete post projecting 2 inches. It is about 18 inches below the station, 4-1/2 feet ENE of pole 3, and 35 feet N of the center of State Highway 6. The mark is SW of the station.

Reference mark 2 is a bronze reference disk stamped "LUNAGALLUP NO 2" and is set in a square concrete post projecting 3 inches. It is about 14 inches below the station. The mark is NW of the station.

The azimuth mark is a bronze reference disk stamped "LUNAGALLUP AZIMUTH 1938" and is set in a square concrete post flush. It is 4 feet NW of the witness post. The mark is 27 feet NW of a bridge and 33 feet NE of the center of State Highway 6. It is 0.4 mile SE along the highway from the station.

OBJECT		DISTANCE		DIRECTION
ISLETA (U.S.G.S.)		meters	feet	0°00'00"0
Beacon				81 57 49.0
Los Lunas Water Tank				117 35 06.0
Azimuth Mark	SE	0.4 mile		119 03 16.3
R.M. 1	SW	17.508	57.448	212 51 52
R.M. 2	NW	13.068	42.886	317 03 42

ooooooo

TOME (U.S.G.S.)(Valencia County,N.Mex.,C.A.E.,1946)--This station was established in 1938 but was not occupied until 1946. It is on top of a large, black, rocky hill, by approximate airline distances located 8 miles NNE of Belen, 4 miles SSE of Los Lunas, and 2 miles E of the Rio Grande. It is the only hill in the vicinity and overlooks the nearby country in all directions.

To reach from the main corner in Los Lunas (intersection of U.S. Highway 85 and State Highway 6), go E on the macadam road for 1.6 miles crossing the Rio Grande to a graded road to the right. Turn right and follow the main graded road S and E 0.7 mile to a cross road at a store and filling station on the right. Turn right and follow the main road S 2.0 miles to a road left, E, between two fence lines. (The azimuth mark is near a fence corner on the E side of the road 0.25 mile before reaching this point.) Go E in the lane for 0.5 mile to a fork at the foot of the station hill. Turn right around the bottom of the hill 0.4 mile, take the left fork and continue 0.5 mile to the SE side of the hill. Pack NW up the hill to the top and station - a 10-minute pack.

The station mark, which was a bronze U.S.G.S. disk, has been removed, but the stem is still firmly cemented into the drill hole in outcropping bedrock, located 32 feet W of the highest point of the hill.

Reference mark 1, which is a bronze reference disk stamped "TOME U.S.G.S. NO 1 1938", is set in a drill hole in outcropping bedrock which projects about 1-1/2 feet above the ground. It is located SW of the station and about 2 feet lower.

Reference mark 2, which is a bronze reference disk stamped "TOME U.S.G.S. No 2", is set in a drill hole in outcropping bedrock which projects about 2 feet above the ground. It is located N of the station and about 2 feet lower.

The azimuth mark, which is a bronze azimuth or reference disk (the designation of the mark is covered in the cement) stamped "TOME U.S.G.S. AZIMUTH MARK", is set in a square concrete post which projects about 1 inch above the ground. It is located WNW of the station, 57 feet E of the main road S, 36 feet S of a side road, and 3.2 feet S of a 4- by 4-inch white witness post.

OBJECT		DISTANCE		DIRECTION
LUNAGALLUP		meters	feet	0°00'00"0
Los Lunas, Water tank				5 33 24.9
R.M. 2	N	7.551	24.709	25 34 09
Airway Beacon				64 31 54.2
R.M. 1	SW	8.919	29.262	254 35 48
Azimuth Mark	WNW	1 mile		329 46 34.4

ooooooo

LOLITO (Valencia County,N.Mex.,C.A.E.,1946)--The station is located on the sloping mesa about 10 miles E of the Rio Grande and about 5 miles W of the base of the Manzano Range at Lolito Spring. In approximate airline distances it is 20 miles SSE of Albuquerque, 17 miles NE of Belen, 12 miles SE of Isleta, and 12 miles E of Los Lunas.

To reach the station from the steel bridge across the Rio Grande at Isleta, which is the only bridge in that vicinity, go E on the paved road for 0.15 mile to a bladed dirt road turning off at a slight angle to the left. Turn off the pavement here and follow this dirt road for 0.1 mile to a crossroad. Keep straight ahead here and keeping on the main road which climbs up onto the mesa, go for 1.85 miles to a cattle guard. Cross this cattle guard and go for 2.2 miles to a fork. Take the right fork, or the road straight ahead, and go 2.1 miles to another cattle guard. Cross this cattle guard and go 0.45 mile to another fork. Take the right fork here and go 1.7 miles to a gate. Pass through this gate and go 0.05 mile to a fork. The left fork here goes to station BERNAVAL. Take the right fork and go 0.45 mile to station BERNAVAL AZIMUTH MARK on the right side of the road. Continue on the bladed dirt road for 1.5 miles to where the road crosses a wash. Cross this wash and continue on the bladed road for 0.15 mile to a fork. Take the right fork here and go 0.9 mile to a track road turning off to the right when the bladed road turns left. Leave the bladed road here and follow this track road in a S direction 0.95 mile to a gate. Pass through this gate and continue on the track road S for 1.2 miles to another gate. Pass through this gate and go 0.8 mile to a crossroad. Keep straight ahead on the track road and go 0.95 mile to a deep ditch across road. Drive around this ditch and continue S on the track road for 0.4 mile to another gate. Pass through this gate and follow the track road 0.85 mile to another gate. Pass through this gate and turn sharp left following the fence line across country for 0.25 mile to a fence corner. Turn left here at the fence corner and go NE for 0.05 mile to the end of truck travel and the station.

The station mark is a bronze station disk stamped "LOLITO 1946" and set in a square concrete post which projects 3 inches above the surrounding surface. It is located 0.3 mile SW of a fence corner, 0.2 mile SSE of the fence corner at the azimuth mark, 0.05 mile NE of another fence corner, and 10.0 feet E of a 4-inch square white witness post. Underground mk. - bronze disk in concrete.

Reference mark 1 is a bronze reference disk stamped "LOLITO NO 1 1946" and set in a square concrete post which projects 3 inches above the surrounding surface. It is about the same level as the station and is located E of the station.

Reference mark 2 is a bronze reference disk stamped "LOLITO NO 2 1946" and set in a square concrete post which projects 1-1/2 inches above the surrounding surface. It is about the same level as the station and is located S of the station.

The azimuth mark is a bronze azimuth disk stamped "LOLITO 1946" and set in a square concrete post which projects 3 inches above the surrounding surface. It is located 0.2 mile NNW of the station and 20.2 feet SE of the apex of the fence corner. To reach the azimuth mark from the station, drive cross country in a NNW direction 0.2 mile to the fence corner and the azimuth mark.

OBJECT		DISTANCE		DIRECTION
BERNAVAL		meters	feet	0°00'00"0
R.M. 1	E	11.576	37.974	75 52 19
R.M. 2	S	9.842	32.288	167 47 16
Beacon				274 01 33.7
Azimuth Mark	NNW	0.2 mile		337 53 41.1

Height of light above station mark - 3.1 meters.
Height of instrument above station mark - 3.5 meters.

ooooooo

CHAVES (Valencia County,N.Mex.,C.A.E.,1946)--Station is located about 13 miles, airline, ESE of Belen and 13 miles SE of Los Lunas. It is on a low ridge running W from the Manzano Mountains and overlooks all the country to the W.

To reach the station from the junction of U.S. Highway 85 and State Highway 6 in Belen, go E on highway 6 for 2.6 miles to the E end of the bridge over the Rio Grande. Turn right across a cattle guard and then left onto a track road leading E along the S side of an E-W fence. Follow this road for 8.0 miles to a house, corral, tank, and windmill. Pass to the S (right) of the corral and then turn left through a wire gate about 100 yards E of the windmill. Go NE on the track road for 1.7 miles to a crossroad. Continue straight ahead for 0.3 mile to a fence and gate. Do not pass through this gate, but turn left along the fence and follow it to the second gate for 0.15 mile. (The second gate is at a fence corner.) Turn right through this gate and go E along the N side of the fence for 0.5 mile to a track road leading N. Turn left (N) on this road and follow it for 0.6 mile. At this point the azimuth mark is to the W along the fence. Continue for 0.2 mile to an E-W

(continued on page 18)

CHAVES (continued)
fence. Here turn right (E) and go cross country for 0.8 mile along the S side of the fence and up the ridge to the station.

Station is located about 70 paces S of the E-W fence mentioned above and 10 feet N of a 4-inch square white witness post. It is a bronze station disk stamped "CHAVES 1946" and is set in the top of a square concrete post which projects 6 inches above the ground. Underground mark is a bronze station disk set in concrete 24 inches below the surface of the ground.

Reference mark 1 is located NNE of the station and slightly lower. It is a bronze reference disk stamped "CHAVES NO 1 1946" and set in the top of a square concrete post which projects 1 inch above the ground.

Reference mark 2 is located W of the station and about 1-1/2 feet lower. It is marked by a bronze reference disk stamped "CHAVES NO 2 1946" and set in the top of a square concrete post which projects 2 inches above the ground.

The azimuth mark is located 1 mile WSW of the station, 4 feet SSE of a 4-inch square white witness post, and 3 feet E of a N-S fence. It is marked by a bronze azimuth disk stamped "CHAVES 1946" and set in the top of a square concrete post which projects 1 inch above the ground.

OBJECT		DISTANCE meters	DISTANCE feet	DIRECTION 0°00'00"0
MANZANO				
Becker, coal elevator				54 35 36.6
Beacon no. 20				100 14 39.7
Azimuth Mark WSW		1 mile		117 51 22.7
Belen, water tower				118 52 22.0
R.M. 2	W	15.117	49.606	137 27 30
Los Lunas, water tower				165 41 17.6
Beacon no. 21				182 26 38.6
R.M. 1	NNE	21.660	71.070	257 59 09

Height of instrument above station mark - 3.2 meters.

oooooo

BELEN (Valencia County,N.Mex.,C.A.E.,1946)--The station is located in a field which is used as a dump and between two irrigation ditches about 1/2 mile WSW of the town of Belen.

To reach the station from the main corner of Belen at the Becker-Dalies Company which is just W of the First National Bank, go S on U.S. Highway 85 for 0.35 mile to a road coming into the highway from the right. (Continue down or S on highway 85 for 0.05 mile to the azimuth mark on the left side of the highway.) Turn right here and go W on the bladed dirt road for 0.35 mile to an irrigation ditch and crossroad. Keep straight ahead here and go 0.15 mile. Turn right here and go 0.05 mile to the end of truck travel and the station.

The station mark is a bronze station disk stamped "BELEN 1946" and is set in a square concrete post which projects 3 inches above the surrounding surface. It is located 148 feet N of the bladed dirt road and 12 feet NE of a 4-inch square white witness post. Underground mark is a bronze station disk in concrete.

Reference mark 1 is a bronze reference disk stamped "BELEN NO 1 1946" and set in a square concrete post which projects 2 inches above the surrounding surface. It is about on the same level as the station and is located E of the station.

Reference mark 2 is a bronze reference disk stamped "BELEN NO 2 1946" and set in a square concrete post which is flush with the surrounding surface. It is about 8 inches above the station and is located SSW of the station.

The azimuth mark is a bronze azimuth disk stamped "BELEN 1946" and set in a square concrete post which projects 3 inches above the surrounding surface. It is located 1/2 mile E of the station, 9 paces E of the center line of U.S. Highway 85, 6 paces S of a power-line pole, and 3 feet S of a 4-inch square white witness post.

OBJECT		DISTANCE meters	DISTANCE feet	DIRECTION 0°00'00"0
TOME (U.S.,G.S.)				
Water Tank, Belen				32 24 59.2
Azimuth Mark E		1/2 mile		58 50 56.7
R.M. 1	E	9,921	32.549	63 11 28
R.M. 2	SSE	9.616	31.546	161 54 11

Height of light above station mark - 1.2 meters.
Height of instrument above station mark - 1.6 meters.

oooooo

BELENBECK (Valencia County,N.Mex.,C.A.E.,1946)--The station is on sandy pasture land on a slight rise on the NE side of the Belen-Becker road, about 4 miles, airline, SE of Belen.

To reach the station from the main corner in Belen at the Becker-Dalies Company and just W of the First National Bank, go E on the street on the right of the bank to the railroad depot, jog left, then right across the tracks to a right turn about 0.05 mile beyond the crossing, a total distance of 0.8 mile from the Becker-Dalies Company. Turn right 0.15 mile, then turn left across a small concrete bridge, thence E 1.75 miles to the E end of the bridge across the Rio Grande. Turn right, cross a cattle guard, thence keep the main road which is the center one of three forks, and continue 2.6 miles to an airway beacon on the left, and the station 666.1 feet NNE of the beacon.

The station mark, which is a bronze station disk stamped "BELENBECK 1946", is set in a square concrete post projecting about 4 inches above the ground. It is located 66 feet NE of the center of an old track road. Underground mark is a bronze station disk in concrete.

Reference mark 1, which is a bronze reference disk stamped "BELENBECK NO 1 1946", is set in a square concrete post projecting slightly above the ground. It is located E of the station on about the same level.

Reference mark 2, which is a bronze reference disk stamped "BELENBECK NO 2 1946", is set in a square concrete post projecting about 1 inch above the ground. It is located NNW of the station on about the same level.

The azimuth mark, which is a bronze azimuth disk stamped "BELENBECK 1946", is set in a square concrete post projecting about 4 inches above the ground. It is located under the center of the airway beacon and SSW of the station.

OBJECT		DISTANCE meters	DISTANCE feet	DIRECTION 0°00'00"0
MANZANO				
Azimuth Mark SSW			666.1	110 01 13.0
Belen, water tank				205 15 38.5
R.M. 2	NNW	15.234	49.982	240 11 56
R.M. 1	E	12.213	40.069	345

Height of instrument above station mark - 5.7 meters.

oooooo

AIRWAY BEACON NO. 20 (Valencia County,N.Mex.,C.A.E.,1946)--This airway beacon is on the NE side of the Becker-Belen road, 5.2 miles by road from the Becker-Dalies Company in Belen.

It is 54 feet high to the center of the lamp, has a 2-foot lamp flashing clear, and with red course lights sending the letter "N." It is 133 feet NE of the center of the graded road and 666.1 feet SSW of triangulation station BELENBECK. The azimuth mark for this station is centered underneath the beacon. It is set in a square concrete post projecting about 4 inches above the ground.

oooooo

BOSQUE (Socorro County,N.Mex.,C.A.E.,1946)--Station is located at Bosque, a small settlement about 7 miles S of Belen, on U.S. Highway 85. It is located on the Atchison, Topeka & Santa Fe Railway right-of-way and is E of the highway and N of the main crossroad in Bosque.

To reach the station from Belen, go S on U.S. Highway 85 for 7 miles to Bosque (this point is a few feet S of the church on the W side of the highway), and about 60 feet N of the main crossroad in the village. Cross the E fence along the highway, the station being between this fence and the railroad track.

Station mark is a bronze station disk set in a 12-inch square concrete post projecting about 3 inches and stamped "BOSQUE 1946." It is 62.8 feet N of the crossroad, 47.2 feet E of the center of U.S. Highway 85, 33.9 feet W of the W rail of the Atchison, Topeka & Santa Fe Railway track, 45.5 feet SSW of the railroad sign "BOSQUE", 21.2 feet N of the E-W fence, 13.2 feet E of the N-S fence, and 13 feet ENE of a white witness post. Underground mark is a bronze station disk in concrete.

Reference mark 1 is a bronze reference disk set in a 12-inch-square concrete post projecting about 3 inches and stamped "BOSQUE NO 1 1946." It is N of the station, about level with it, and 3.4 feet E of the N-S fence.

Reference mark 2 is a bronze reference disk set in a 12-inch-square concrete post projecting about 3 inches and stamped "BOSQUE NO 2 1946." It is W of the station, about level with it, 71.7 feet N of the center of U.S. Highway 85, and 3 feet N of the E-W fence.

Azimuth mark is a brass disk set in the top of a 3-inch iron pipe projecting about 6 inches and stamped "MIDDLE RIO GRANDE CONSERVANCY DIST. BM ELEVATION ABOVE SEA 477011 (there is no decimal point) 1-15-1932." It is 0.4 mile S of the station, 45 feet W of the W rail of the Atchison, Topeka & Santa Fe Railway track, 56 feet E of the center of U.S. Highway 85, 2.4 feet N of a white witness post, 1.7 feet E of the fence, and due W of a steel railroad marker numbered "940."

OBJECT		DISTANCE meters	DISTANCE feet	DIRECTION 0°00'00"0
BELENBECK				
Windmill	SE			92 50 21.9
Azimuth Mark S		0.4 mile		143 08 26.8
R.M. 2	W	36.250	118.932	237 04 40
R.M. 1	N	20.309	66.610	314 13 15

oooooo

TURN (Valencia County,N.Mex.,C.A.E.,1946)--The station is on sandy pasture land on NE side of deepest railroad cut in the vicinity, about 2 miles E of Turn Post Office, and 7 miles SSE of Belen.

To reach from the main corner in Belen at Becker-Dalies Company and just W of the First National Bank, go E on the street on the right of the bank to the railroad depot, jog left, then right across the tracks to a right turn about 0.05 mile beyond the crossing, a total distance of 0.8 mile from the Becker-Dalies Company. Turn right 0.15 mile, then turn left across a small concrete bridge, thence E 1.75 miles to the E end of the bridge over the Rio Grande. Turn right, cross a cattle guard, thence take the right one of three forks, the center one being the main road, and follow down along the E side of the river 3.5 miles to a fence corner on the right, a dim road fork on the left at the end of a broken down fence, and 0.3 mile before reaching a railroad crossing. Turn left on the track road along the inside of the fence line 1.35 miles to the azimuth mark in a railroad signal on the right, 73 feet W of a transformer on a power line. Continue on the track road 0.8 mile to the station on the left on a small rise.

The station mark, which is a bronze station disk stamped "TURN 1946", is set in a square concrete post projecting about 6 inches above the ground. It is located 180.5 feet NE of the edge of the railroad cut and 78.5 feet NE of the closest railroad right-of-way fence line. Underground mark is a bronze station disk in concrete.

Reference mark 1, which is a bronze reference disk stamped "TURN NO 1 1946", is set in a square concrete post projecting about 1 foot above the ground. It is located N of the station on about the same level.

Reference mark 2, which is a bronze reference disk stamped "TURN NO 2 1946", is set in a square concrete post projecting about 5 inches above the ground. It is located E of the station on about the same level.

The azimuth mark, which is a bronze azimuth disk stamped "TURN 1946", is set in the concrete base of a railroad signal tower, 12 feet NE of the NE rail of the tracks, and 73 feet W of a transformer on power line on NE side of the track. It is NNW of the station.

OBJECT		DISTANCE meters	DISTANCE feet	DIRECTION 0°00'00"0
BELENBECK				
R.M. 1	N	19.364	63.500	6 50 30
R.M. 2	E	17.938	58.849	93 49 46
Azimuth Mark NNW		0.8 mile		294 44 01.5
Belen, water tank				319 56 54.0

Height of instrument above station mark - 2.0 meters.

oooooo

MANZANO (Torrance County,N.Mex.,C.I.C.,1920;1935)--The station is 20 miles E 8° S of Belen, 13 miles WNW of Mountainair, in the NW 1/4 sec. 6, T. 4 N., R. 5 E., on the highest and most conspicuous peak at the S end of the Manzano Mountain Range. The peak is bald on the SE side of the top and has small timber on the other sides.

The station mark is a bronze station disk set in rock. It is stamped "1919" but it was not occupied until 1920.

Reference marks are bronze reference disks set in rock. Reference mark 1 is 10.01 meters (32.8 feet) from the station in azimuth 70°03' and reference mark 2 is 16.20 meters (53.1 feet) from the station in azimuth 169°21'.

(continued on page 19)

UNITED STATES COAST AND GEODETIC SURVEY
Descriptions of Triangulation Stations

MANZANO (continued)

(C.A.E.,1946)--The station is located on the top of Manzano Peak which is the highest peak in the Manzano Range and the most S of the several higher peaks. In approximate airline distances it is located 19 miles ESE of Belen, 12 miles N of Scholle, 12 miles WNW of Mountainair, and 7 miles SW of Manzano.

The route to station as described below was traveled in the middle of winter and the great amount of snow made it almost impossible to locate every fork and cross road. If this route is to be used in the summer, it would be advisable to stop at the Mountainair Ranger Station and obtain information and a map of this route to station.

To reach the station from the Mountainair Post Office, go N on the main street for 0.2 mile to a sign on the right saying "MOUNTAINAIR RANGER STATION." Turn right here and go for 0.05 mile to a left fork, again signed "MOUNTAINAIR RANGER STATION." Take this left fork and go for 0.75 mile to a right fork. The road straight ahead at this point goes to the Mountainair Ranger Station. Take the right fork and go 0.95 mile to a left fork signed "THUNDERBIRD RANCH", thence take left fork 1.0 mile, thence right fork 0.9 mile, thence left fork again for 3.85 miles to the boundary of the Cibola National Forest, keeping straight ahead at all crossroads. During the winter the route from here on is impassable to trucks. However, a vehicle like a tractor or "Weasl" can be driven on to the normal end of truck travel. Cross over the cattle guard marking the boundary of the National Forest and follow the track road for about 1.6 miles to a gate. Pass through this gate and go about 0.65 mile to where the road turns left and crosses some minor drainage. Follow the road for about 0.15 mile to a main fork and Forest Service signs. Take the right fork as per sign "KAYSER MILL ROAD" and go for about 2.0 miles to the end of truck travel at a Forest Service sign "KAYSER MILL TRAIL" and a Forest Service bulletin board. (The mileage from the Forest Service boundary is approximate in a sense, for it was taken from the speedometer on a "Weasl" which was not tested for accuracy in snow.) From the end of truck travel follow the blazed Kayser Mill Trail up a canyon and onto a ridge at a small saddle. From here pack S along the crest of the main ridge about 3/4 mile to the station.

The station mark is a bronze station disk stamped "MANZANO 1919 1934" and set in a slight depression in a boulder which is on the approximately highest point of the peak.

Reference mark 1 is a bronze reference disk stamped "MANZANO 1921 NO 1 1934" and set in a boulder which projects about 6 inches above the surrounding surface. It is about 3 feet lower than the station and is located WSW of the station.

Reference mark 2 was not recovered due to the unusual depth of the snow at its location.

The azimuth mark for this station is station BLUE.

OBJECT	DISTANCE		DIRECTION
	meters	feet	0°00'00"0
BLUE			
R.M. 1 WSW	9.804	32.157	45 49 00
Silver Water Tank, Belen			80 09 42.6
Water Tank, Los Lunas			106 08 09.2

****

BLUE (Socorro County,N.Mex.,C.A.E.,1946)--The station is 16 miles E of Bernardo by airline, 19-1/2 miles SE of Belen by airline, and is located in the "Y" formed by the intersection of U.S. Highway 60 and State Highway 6.

To reach from Bernardo about 17 miles S of Belen, go E on U.S. Highway 60 for 16.2 miles to its intersection with State Highway 6. The station is here N of highway 60 and W of the intersection.

The station mark is a bronze station disk stamped "BLUE 1946" and is set in a square concrete post projecting 2 inches. It is 12 feet ESE of the witness post which is near a fence corner, 94 feet N of the center of U.S. Highway 60, 105 feet SW of the center of State Highway 6, and 460 feet WNW of the intersection of the above two roads. Underground mark is a bronze station disk in concrete.

Reference mark 1 is a bronze reference disk stamped "BLUE NO 1 1946" and is set in a square concrete post projecting 2 inches. It is about 16 inches below the station and 64 feet N of the center of U.S. Highway 60. The mark is SW of the station.

Reference mark 2 is a bronze reference disk stamped "BLUE NO 2 1946" and is set in a square concrete post nearly flush with ground. It is about 6 inches below the station and 83 feet SW of the center of State Highway 6. The mark is NW of the station.

The azimuth mark is a bronze azimuth disk stamped "BLUE 1946" and is set in a square concrete post projecting 4 inches. It is 10 feet NE of the witness post which is in the right-of-way fence along the SW side of State Highway 6 and 89 feet SW of the center line of highway 6. The mark is 0.6 mile NW of the station along highway 6.

OBJECT	DISTANCE		DIRECTION
BELEN NORTH BASE 1920	meters	feet	0°00'00"0
Atchison, Topeka & Santa Fe railroad water tank			22 32 41.1
Azimuth Mark NW	0.6 mile		31 11 23.4
R.M. 2 NW	14.675	48.145	38 54 37
R.M. 1 SW	13.893	45.590	293 24 58

Height of light above station mark - 1.0 meter.
Height of instrument above station mark - 1.6 meters.

****

BELEN NORTH BASE (Socorro County,N.Mex.,C.L.G.,1920;1935)--The station is 12.5 miles airline SSE of Belen, in the NW 1/4 sec. 13, T. 3 N., R. 2 E., 20 meters (66 feet) W of the old Ocean-to-Ocean Highway, 1.2 miles by road S of a small bridge over a dry stream, and on the crest of the first ridge S of the bridge.

To reach the station, go E on U.S. Highway 60 from its intersection with U.S. Highway 85 for a distance of 9.3 miles to a cross road, thence N on the graveled road 4.2 miles to the station.

The station mark is stamped "1919" but it was not occupied until 1920. The station was recovered in 1921, 1934, and 1935. In 1934 the station was reponted to be 4 meters (13 feet) W of the W edge of the gravel road which used to be the Ocean-to-Ocean Highway. The station, underground, and reference marks are bronze disks set in concrete.

Reference mark 1 is 23.318 meters (76.50 feet) from the station in azimuth 166°36' and reference mark 2 is 22.924 meters (75.21 feet) from the station in azimuth 248°19'.

(C.A.E.,1946)--Station was recovered and all marks were found in good condition. An azimuth mark was established as noted below. The measured distances to the reference marks do not agree with the published distances. The new distances were checked.

Station is located about 13 miles, airline, SSE of Belen, 5 miles WSW of the railroad settlement of Becker, and 4 miles N of U.S. Highway 60.

To reach the station from the junction of U.S. Highways 60 and 85, go E on highway 60 for 8.9 miles to a crossroad which is about 1 mile NNE of a conspicuous hill (Turututu Hill). Turn left on this track road, passing over a cattle guard. Go N for 3.5 miles to the azimuth mark on the left (W). Continue 0.55 mile to the station on the left.

Station is located 29 feet W of a track road and 20.5 feet N of a 4-inch square witness post. It is marked by a bronze station disk stamped "N BASE 1919" and set in a square concrete post which projects 4 inches above the ground.

Reference mark 1 is located N of the station and about 1-1/2 feet lower. It is 30 feet W of the center of the track road. It is marked by a bronze reference disk stamped "N BASE NO 1 1919" and set in the top of a round concrete post which projects 4 inches above the ground.

Reference mark 2 is located ENE of the station and about 1-1/2 feet lower. It is 44 feet E of the center of the track road. It is marked by a bronze reference disk stamped "N BASE NO 2 1919" and set in the top of a round concrete post which projects 8 inches above the ground.

The azimuth mark is located 0.55 mile SSE of the station, 24 feet W of the center of a track road, and 4.3 feet N of a 4-inch square witness post. It is marked by a bronze azimuth disk stamped "N BASE 1946" and set in the top of a square concrete post which projects 2 inches above the ground.

OBJECT	DISTANCE		DIRECTION
TURN	meters	feet	0°00'00"0
R.M. 2 ENE	23.332	76.558	69 01 53
Becker, coal elevator	5 miles		87 01 39.0
Azimuth Mark SSE	0.55 mile		175 03 39.7
Beacon no. 19			217 56 52.1
Windmill	1 mile		288 28 50.6
R.M. 1 N	23.223	76.200	354 36 55

****

No. 900 Supplement

UNITED STATES COAST AND GEODETIC SURVEY
Descriptions of Triangulation Stations

Chama to Belen, New Mexico

The following recovery notes have been received since this pamphlet was lithographed.

CITOVAL (Rio Arriba County, New Mexico.,C.A.E.,1945;F.R.G.,19
(Previous description is on page 3)--The station mark and all reference marks were found in good condition. The description by C.A in 1945 was found to be complete and adequate except for the last distance in the "to reach" which should be 3.1 miles instead of th 2.9 miles as given.

The distances to the reference marks were measured as follows Reference mark No.1, 20.053 meters (65.79 feet). Reference mark No.2, 16.883 meters (55.39 feet).

****

The following stations in Bernalillo County, New Mexico, esta lished by C.A.Egner in 1946 were recovered in good condition and their descriptions found to be adequate by R. E. Rawson in 1947:

ALBUQUERQUE, INDIAN SCHOOL WEST TANK (Previous description page
ALBUQUERQUE, INDIAN SCHOOL EAST TANK (Previous description page
ALBUQUERQUE, FEDERAL BUILDING DOME (Previous description page
ALBUQUERQUE, INDIAN HOSPITAL STACK (Previous description page
ALBUQUERQUE, VETERANS HOSPITAL, STACK (Previous description page
ALBUQUERQUE, VETERANS HOSPITAL, TANK (Previous description page
KIRTLAND (Previous description page

****

101

SANDIA (Bernalillo County,N.Mex.,C.L.G.,1920;D.H.K.,1948)(Pre vious description is on page 12)--Station recovered as described and all marks found in good condition. Station was observed on but not occupied in 1948.

Station is on the highest point of the Sandia Mountains which is a range of mountains running generally NW to SE about 12 miles (air line) NE of Albuquerque. The highest point of this range is at or near its W extremity. Station is 8-1/2 miles (air line) NE of Bernalillo and 14 miles (air line) NE of Albuquerque.

To reach the station from the post office in Bernalillo, go N on U.S. Highway 85 to a paved cross road, a distance of 1.1 miles. Here turn right or E and go 9.2 miles to the end of the pavement. Continue 4.8 miles up the mountain to a fork. Here tak the left fork or the main traveled road and go 2.1 miles to a fork Here take the left fork or the main traveled road 0.3 mile to a T-intersection and a sign reading "Sandia Crest Drive." Here take the right fork W for 0.6 mile to the Capulin Picnic Grounds on the right. Continue 4.9 miles to a fork. Here is a sign reading "Sandia Crest Kiawa Point." Take the right fork and go 0.1 mile to the highest point and the station.

Station mark is a bronze station disk stamped "SANDIA 1919" and is set in bedrock projecting 4 inches. It is 150 feet W of a stone monument 5 feet high with a plaque reading "Sandia Crest Elev. 10,678 Cibola National Forest."

One reference mark which is not numbered is a bronze reference disk stamped "SANDIA 1919." It is set in bedrock projecting 5 inches. It is N of and about 5 feet below the station.

The other reference mark is a bronze reference disk stamped "SANDIA 1945 NO 2." It is set in bedrock projecting 2-1/2 feet.
(continued on page 20)

(4)

20

SANDIA (continued)
It is SE of and about 7 feet below the station.

Azimuth mark is a bronze azimuth disk stamped "SANDIA 1945" and is set flush in outcropping bedrock. It is 2 feet E of the edge of the cliff and 2 feet SE of a 2-foot cairn. The mark is 1/2 mile along the edge of the cliff, SE of the station.

OBJECT		DISTANCE meters	DISTANCE feet	DIRECTION
*CORRALES				0°00'00"0
R.M. (not numbered)	N	12.695	41.653	85 59 15
Azimuth mark	SE	1/2 mile		225 29 50.2
R.M. 2	SE	17.074	56.010	232 44 58

*All of the above are 1945 observations as the station was not occupied in 1948.

105

****

TIJERAS (Bernalillo County, N.Mex., C.A.E., 1946; D.M.K., 1948) (Previous description is on page 15)--Station and all marks recovered as described and in good condition, with the exception of the difference in distance to R.M. 1 and the difference in angle between R.M. 1 and R.M. 2. The correct distances are listed below.

Station is located on flat mesa land about 7 miles (air line) ESE of Albuquerque, 4 miles ESE of Sandia Base, 2 miles W of base of mountains, 1-1/2 miles S of U.S. Highway 66, 50 feet N of center line of graded road, and 15 feet W of a white wooden witness post.

Surface and underground marks are bronze station disks set in concrete. Surface disk is stamped "TIJERAS 1946," projects 1"

Reference mark 1 is approximately 75 feet N of the center line of graded road and 12 inches higher than station. It is a bronze reference disk set in concrete. It projects 1 inch and is stamped "TIJERAS NO 1 1946."

Reference mark 2 is approximately 25 feet S of the center line of graded road and 12 inches higher than station. It is a bronze reference disk set in concrete. It projects 6 inches and is stamped "TIJERAS NO 2 1946."

Azimuth mark is located about 28 feet S of the center line of road leading to station, 14 feet N of a fence, and 3 feet N of a white witness post. It is a bronze azimuth disk set in concrete, projects 2 inches, and is stamped "TIJERAS 1946."

To reach from the underpass on U.S. Highway 66 near center of Albuquerque, go E on U.S. Highway 66 for 8.75 miles to a road right at sign "Saddle Horses for Rent Four Hill Ranch," turn right and follow bladed dirt road for 0.25 mile to gate with arch and sign "Candelaria & Hill Ranch," pass through gate and follow road for 0.2 mile to dry stream bed (Tijeras Arroyo). Continue on road for 0.2 mile to forks, take left fork and go 0.1 mile to a white wooden gate, pass through gate and continue for 0.5 mile to cattle guard, cross cattle guard and continue for 0.3 mile to ranch house on left. Continue on main road for 0.25 mile to azimuth mark on left as described above. Continue straight ahead for 0.15 mile to cattle guard, cross cattle guard and continue for 0.55 mile to station on right as described above. A drive station.

OBJECT		DISTANCE meters	DIRECTION
BERNAVAL			0°00'00"0
R.M. 1	ENE	31.337	244 04 41
Az.Mk.	E	approx. 0.7 mile (air line)	263 13 54.8
R.M. 2	SSE	23.589	346 33 43

Observations made from a 6.0-meter tripod.

109

****

BERNAVAL (Bernalillo County, N.Mex., C.A.E., 1946; D.M.K., 1948) (Previous description is on page 16)--Station and reference marks were found in good condition as described, with the exception of an angular difference between R.M.s 1 and 2 of approximately 4 minutes was noted and checked in 1948. Also the direction to BERNAVAL AZIMUTH MARK from station BERNAVAL 1946 is in error approximately 10 minutes on the 1946 description. Our 1948 direction checks the direction as shown on the list of geographic positions. The correct data listed below.

Station is located in the W breaks of the foothills, on the edge of a low mesa-like foothill lying 9 miles E of the Rio Grande, about 23 miles (air line) NNE of Belen, about 14 miles NE of Los Lunas, about 13 miles (air line) SE of Albuquerque, and about 9.5 miles (air line) E of Isleta. It is approximately 100 yards W of the highest point, about 85 paces ENE of a small juniper bush at point where mesa breaks off to the SW.

Station mark is a bronze station disk set in concrete. It projects 3 inches and is stamped "BERNAVAL 1946."

Reference mark 1 is approximately 1 foot lower than the station. It is a bronze reference disk set in concrete, projects 4 inches, and is stamped "BERNAVAL NO 1 1946."

Reference mark 2 is approximately at the same elevation as the station. It is a bronze reference disk set in concrete, projects 6 inches, and is stamped "BERNAVAL NO 2 1946."

Azimuth mark is located along a gravel road SW of station, 8 paces S of and approximately the same elevation as the center line of gravel road, and 35 feet SE of B-V county line marker. It is a bronze azimuth disk set in concrete, projects 2 inches, and is stamped "BERNAVAL 1946."

To reach station from the steel bridge across the Rio Grande at Isleta, which is the only bridge in the vicinity, go E on the paved road for 0.15 mile to a bladed dirt road turning off at a slight angle to the left. Leave pavement and follow this dirt road for 0.1 mile to a cross road, continue straight ahead on the main road which leads to the top of mesa for 2.05 miles to a cattle guard, cross cattle guard and continue for 3.1 miles to a fork. Take the right fork straight ahead and go 1.4 miles to cattle guard, cross cattle guard and continue for 0.45 mile to fork. Take right fork and continue 1.8 miles to a cattle guard, cross cattle guard and go 0.05 mile to fork. At this point the azimuth mark is reached by taking the right fork for 0.4 mile to azimuth mark on right as described above. From the previous fork to reach station, continue straight ahead for 0.5 mile to top of mesa, turn left (N) and follow track road for 0.5 mile to station as described above. A drive station.

OBJECT		DISTANCE meters	DIRECTION
LOUDON			0°00'00"0
R.M. 1	SSW	19.614	258 14 18
Az.Mk. (BERNAVAL AZIMUTH MARK)	SW	approx. 0.5 mile (air line)	263 18 11.0
R.M. 2	NW	18.503	353 41 52

Observations made from a 5.9-meter tripod.

****

LOUDON (Bernalillo County, N.Mex., C.A.E., 1946; D.M.K., 1948) (Previous description is on page 16)--Station recovered as described and all marks found in good condition.

Station is located about 4 miles (air line) S of the Albuquerque Municipal Airport and about 0.75 mile NNW of a radio range station, on the flat, sandy pasture land.

Station mark is a bronze station disk set in concrete, projects 6 inches, and is stamped "LOUDON 1946." It is set 30 feet E of the edge of flat at which point it breaks off toward the Rio Grande River and 7 feet NNW of a white witness post.

Reference mark 1 is a bronze reference disk set in concrete, projects 6 inches, and is stamped "LOUDON NO 1 1946." It is at the same elevation as the station mark.

Reference mark 2 is a bronze reference disk set in concrete, projects 6 inches, and is stamped "LOUDON NO 2 1946." It is at the same elevation as the station mark.

Azimuth mark is a bronze azimuth disk set in concrete, projects 4 inches, and is stamped "LOUDON 1946." It is set 11 feet W of a track road, 6 feet NW of a telephone pole, and 4 feet N of a white witness post.

To reach the station from the Albuquerque Municipal Airport, go S 1.35 miles, turn left, follow main road 2.45 miles to a cattle guard, pass over cattle guard, continue 0.3 mile to a road left, continue straight ahead, pass through gate and go 0.95 mile to a road right at a power line, turn right, go 0.7 mile to a road left along telephone line, just after passing a small white building turn left, go 0.25 mile to azimuth mark on right, continue 0.35 mile to a cross road, turn right, go 0.05 mile to a gate, pass through gate, go 0.35 mile, then turn right and go N across country 0.25 mile to station. A drive station.

OBJECT		DISTANCE meters	DIRECTION
TIJERAS			0°00'00"0
Azimuth Mark	E	0.5 mile	32 21 09.5
R.M. 1	E	11.362	38 19 10
R.M. 2	S	13.397	190 26 41

Height of instrument above station mark - 3.5 meters.

NOTE--A difference of 2 minutes in angle between R.M. 1 and R.M. 2 was noted and checked in 1948.

110

****

HANGER (Bernalillo County, N.Mex., D.M.K., 1948)--Station is located in Kirkland Field, Albuquerque, about 0.5 mile (air line) E of the most E hangars, 0.5 mile (air line) N of E end of E-W runway, 200 feet ENE of two small buildings 6 feet square, and 200 feet S of adobe ruins.

Surface and underground marks are bronze station disks set in concrete. Surface mark is set flush with the ground and stamped "HANGER 1948."

Reference mark 1 is a bronze reference disk set in concrete, set flush with the ground, and stamped "HANGER NO 1 1948." It is at approximately the same elevation as the station.

Reference mark 2 is a bronze reference disk set in concrete, set flush with the ground, and stamped "HANGER NO 2 1948." It is at approximately the same elevation as the station.

Azimuth mark is located 15 paces E of center line of road, 1 foot W of N-S fence, 3 feet N of white witness post. It is a bronze azimuth disk set in concrete, projects 6 inches, and is stamped "HANGER 1948." To reach azimuth mark from station, go SE across country for 0.15 mile to gravel road, turn S and follow gravel road 0.4 mile to azimuth on left.

To reach the station from the intersection of U.S. Highway 66 and Broadway in Albuquerque, go S on Broadway for 1.65 miles to road left, turn left (E) and follow paved road for 1.35 miles to T-road, turn right (S) for 0.6 mile to road left, turn left (E) for 0.3 mile to W gate of Kirkland Field. From here go 1.25 miles E and N around the end of runway to N gate, turn right (S) for 0.25 mile to T-road and tennis court on left, turn left (E) for 0.45 mile to hangar and detour sign. Turn left and keep right fork for 0.15 mile to fork, take left fork for 0.15 mile to fork, take left fork (main traveled road) for 0.35 mile to cross road, turn right (S) across country for 0.15 mile to station. A drive station.

OBJECT		DISTANCE meters	DIRECTION
TIJERAS			0°00'00"0
Az. Mk.	SSE	approx. 0.5 mile (air line)	70 39 23.6
R.M. 2	S	27.222	83 21 17
R.M. 1	E	25.998	352 02 42

Height of instrument above station mark - 1.9 meters.

****

SANTA FE WEST BASE (Santa Fe County, New Mexico; C.A.E., 1945; H.J.B., 1948) (Previous description on page 8)--Recovered in excellent condition. Reference marks and azimuth mark in excellent condition. Distances were checked.

Description is poor. A completely new description follows:

The station is located at the Santa Fe Municipal Airport, which is about 8 miles, airline, WSW of the City of Santa Fe. The station is 0.5 miles W. of the airport offices, approximately 0.5 miles NNW from the intersection of all runways.

The station is a bronze station disk stamped "SANTA FE WEST BASE 1945" and set in a round concrete post flush with the ground. It is located 373.2 ft. SSE from the N'ly center line end of the NNW-SSE runway (end of runway painted "17"); 107.7 ft. ENE from the E'ly edge of the runway; and 132.5 ft. SW from the edge of a taxiway. Subsurface mark is disk also set in concrete.

Reference mark 1 is a bronze reference disk stamped "SANTA FE WEST BASE NO 1 1945" and set in a round concrete post flush with the ground. It is located N. of the station on about the same level.

Reference mark 2 is a bronze reference disk stamped "SANTA FE WEST BASE NO 2 1945" and set flush in the top of the concrete foundation of the second light SSE from the runway end. It is located W. of the station.

Azimuth mark is a bronze azimuth disk stamped "SANTA FE WEST BASE 1945" and set in a round concrete post projecting about 2 inches above the ground. It is located SE of the station, under the center of the airport beacon, approximately 300 feet NE of the airport buildings.

****

JEMEZ (Sandoval County, New Mexico; C.A.E., 1945; G.W.R., 1949) (Previous description on page 11)--Station recovered in good condition except that someone has dug a hole approximately 12 feet deep about 5 feet NE of the azimuth mark. As this fills in there will be some danger of the azimuth mark shifting its position. Descriptions were found to be adequate.

****

feet in diameter and which was built by the U. S. Geological Survey, is 16.2 meters (53 feet) from the station in azimuth 38°. Elevation: 3,460.5 meters (11,353 feet).

Green (Apache County, Ariz., C. L. Garner, 1920; 1936).—The station is about 17 miles air line west of Springerville, in the Apache National Forest, on top of Greens Peak, and on the highest ground in the vicinity. Greens Peak is the highest of several grassy peaks in the vicinity. In 1920 the station was reported to be 8 meters (26 feet) northwest of a lookout tower. In 1936 the station was reported to be under the center of Green Peak lookout tower. A new station *Green, eccentric* was established 7.113 meters (23.34 feet) from the station in azimuth 342°34'18". The station mark is stamped "1919", but it was not occupied until 1920. The station and the reference mark are standard disks set in rock according to notes 2 and 12a. The reference mark is 27.005 meters (88.60 feet) from the station in azimuth 342°59'. Elevation: 3,088.5 meters (10,133 feet).

Supplementary points

Tucumcari (Quay County, E. O. Heaton, 1921).—The station is on Tucumcari Mountain, which is about 4 miles southeast of the town of Tucumcari. No report has been made on how the station was marked. Elevation: 1,516.1 meters (4,974 feet).

Plane coordinates: (E), x=689,901.40 feet; y=1,504,808.05 feet.

Tucumcari, city water tank (Quay County, E. O. Heaton, 1921; 1935).—This is the large municipal water tank for the town of Tucumcari. Elevation: 1,284.2 meters (4,213 feet).

Plane coordinates: (E), x=679,727.68 feet; y=1,520,838.97 feet.

Small butte northwest of station Hill (San Miguel County, E. O. Heaton, 1921).—This is a small, isolated butte lying about 15 miles northwest of triangulation station *Hill*.

Plane coordinates: (E), x=410,000.35 feet; y=1,548,881.96 feet.

Lone butte southeast of station Tompson (San Miguel County, E. O. Heaton, 1921).—As seen from triangulation stations *Tompson* and *Aguilar*, this is a small, lone butte lying about 5 miles northward of a large mesa, about 30 miles from station *Tompson*, and about 10 degrees south of the line from *Tompson* to *Aguilar*.

Plane coordinates: (E), x=203,776.69 feet; y=1,583,881.06 feet.

Moriarity (Torrance County, E. O. Heaton, 1921).—The station is about 2 miles south of the town of Moriarity, on the right-of-way at a deep cut, east of the railroad and west of the highway. No report has been made on the marking of the station.

Plane coordinates: (C), x=539,948.51 feet; y=1,440,061.44 feet.

102 **Sandia Range, sharp peak** (Bernalillo County, E. O. Heaton, 1921).—This is a sharp point in the southern part of the Sandia Mountains about 6 miles south of triangulation station *Sandia*.

Plane coordinates: (C), x=446,169.20 feet; y=1,490,053.75 feet.

Bosque Peak (Torrance County, E. O. Heaton, 1921).—This is a well-defined peak which terminates a long, flat mountain on its northern end. It is the first point south of Tetillas Peak, which is a sharp, prominent peak, bare at the top, from the south appears to be composed of alternate layers of red and white rock, and which is the most northern high point of the Manzano Mountains.

Plane coordinates:[1] (C), x=444,202 feet; y=1,371,950 feet. (W), x=919,715 feet; y=1,374,841 feet.

Osha Peak, cairn (Torrance County, E. O. Heaton, 1921).—This is a cairn erected as a triangulation station by the U. S. Army Engineers in 1876. The peak is located in about the central part of the Cerro de Manzano Range and is about 5 miles north and one mile east of triangulation station *Manzano*. The peak has a bald, rounded top, and is timbered on all sides below the top.

Plane coordinates: (C), x=443,404.41 feet; y=1,323,230.32 feet. (W), x=919,684.09 feet; y=1,326,104.38 feet.

Becker, coal elevator (Socorro County, E. O. Heaton, 1921).—Plane coordinates: (C), x=390,397.39 feet; y=1,272,072.44 feet. (W), x=867,475.92 feet; y=1,274,111.88 feet.

Hill between Belen base stations (Socorro County, E. O. Heaton, 1921).—This is a small, isolated, rounded hill about midway between triangulation sta-

[1] No check on this position.

For notes in regard to marking of stations see p. 90.

USE OF SURVEY CONTROL DATA

The advantages derived from referencing a land survey to a system of national survey stations extending throughout the country are readily apparent. Should the monuments which mark the land corners be destroyed, the ground positions occupied by those monuments before they were destroyed may be readily and accurately determined by new surveys, originating at stations of the national survey.

GROUND LENGTHS REDUCED TO SEA LEVEL

Since the geodetic data determined by the national survey control--the latitude and longitudes of points, and the lengths and azimuths of lines--are sea-level data, it follows that surveys which are to be adjusted to stations of the national survey must first be reduced to a sea-level base. Table 2 gives values of sea-level factor for various elevations.

SEA-LEVEL LENGTHS REDUCED TO GRID LENGTHS

As the state coordinate systems are developed directly from geodetic values, the use of those systems requires the reduction of sea-level values to grid values. Table 3 gives values for reducing sea-level lengths to grid lengths. Plate I gives a graphical correction factor scale in terms of "feet per thousand correction" for any location in the county of Bernalillo.

TABLE 2

FACTORS FOR REDUCTION TO SEA LEVEL

Elevation Feet	Sea Level* Factor
1000	0.999952
2000	0.999904
3000	0.999857
4000	0.999809
5000	0.999761
6000	0.999737
7000	0.999665
8000	0.999617
9000	0.999570
10000	0.999522

Example: What is the sea level length of a line measured 3300 feet at an average ground elevation of 5500 feet.

By interpolation in above table, sea level factor equals 0.999749.

Therefore sea level length = 3300 x 0.999749 = 3299.172'.

*Based on formula $S - C = S\left(1 - \frac{h}{20,906,000}\right)$

where S = length measured in feet
C = correction in feet
h = elevation (average) of line measured in feet
20,906,000 = mean radius of earth in feet (37° Lat.)

TABLE 2

FACTORS FOR REDUCTION TO SEA LEVEL

Elevation Feet	Sea Level Factor
1000	
2000	
3000	
4000	
5000	
6000	
7000	
8000	
9000	
10000	

TABLE 3

REDUCTION OF SEA-LEVEL LENGTHS TO GRID LENGTHS

NEW MEXICO COORDINATE SYSTEM, CENTRAL ZONE

x Coordinate Feet	Scale in units of seventh place of logarithms	Scale expressed as a ratio	x Coordinate Feet	Scale in units of seventh place of logarithms	Scale expressed as a ratio
500,000	-434.3	0.9999000	340,000	-307.0	0.9999293
490,000	-433.8	001	330,000	-290.6	331
480,000	-432.3	005	320,000	-273.2	371
470,000	-429.8	010	310,000	-254.8	413
460,000	-426.4	018	300,000	-235.4	458
450,000	-421.9	029			
			290,000	-215.0	0.9999505
440,000	-416.4	0.9999041	280,000	-193.7	554
430,000	-410.0	056	270,000	-171.3	606
420,000	-402.5	073	260,000	-147.9	659
410,000	-394.0	093	250,000	-123.6	715
400,000	-384.6	114			
			240,000	- 98.2	0.9999774
390,000	-374.1	0.9999139	230,000	- 71.9	834
380,000	-362.7	165			
370,000	-350.3	193			
360,000	-336.8	224			
350,000	-322.4	258			

Example: Reduce a 5000 foot sea-level length to grid length where average x coordinate of line is 330,000.

5000 x 0.9999331 = 4999.666'

TABLE 3

REDUCTION OF SEA-LEVEL LENGTHS TO GRID LENGTHS

NEW MEXICO COORDINATE SYSTEM, CENTRAL ZONE

x coordinate value	Scale in units of 1 part in	Scale expressed as a ratio	x coordinate value	Scale in units of 1 part in
Feet			Feet	
500,000	-471.3	0.9999000	340,000	-307.0
490,000	-472.8	001	330,000	-308.6
480,000	-474.3	002	320,000	-310.2
470,000	-475.8	003	310,000	-311.8
460,000	-477.4	004	300,000	-313.4
450,000	-478.9	005		
		006	290,000	-315.0
440,000	-480.4	0.9999007	280,000	-316.7
430,000	-482.0	008	270,000	-318.3
420,000	-483.5	009	260,000	-319.9
410,000	-485.0	010	250,000	-321.5
400,000	-486.6	011		
		012	240,000	-323.2
390,000	-488.1	0.9999013	230,000	-324.8
380,000	-489.7	014		
370,000	-491.3	015		
360,000	-492.8	016		
350,000	-494.4	017		

Example: Reduce a 5000 foot sea-level length to grid length where average x coordinate of line is 350,000.

5000 x 0.9999017 = 4999.915

A LAND SURVEY BASED ON THE NEW MEXICO COORDINATE SYSTEM, CENTRAL ZONE

There follows an exemplification of a land survey computed on the State Coordinate System for the purpose of obtaining grid coordinates of the boundary points.

We will now consider the problem of relating the traverse survey, as shown in Figure 2, to the New Mexico coordinate system, utilizing for the purpose the field notes of a hypothetical survey, such field notes being the horizontal measured lengths corrected for slope, tension and temperature as compared to a standardized tape and measured direction of boundary lines to give a angular closure of not over seven seconds per angle turned.

CONNECTION TO STATE SYSTEM

In the example given the control station "Radio" was recovered with its azimuth station. An azimuth check was obtained by calculating the azimuth, Radio-Federal Dome. Radio is shown as 106 and Federal Dome as 314 on Plate 1. Coordinates for these two points as well as azimuth to Azimuth Mark was obtained from Table 1.

The steps taken in computing the grid coordinates of the points A - B - C - D - E - F as shown on Figure 2 follow:

1. Computation of Azimuth Radio-Federal Dome.
2. Calculation of combined factor to reduce measured

NEW MEXICO COORDINATE SYSTEM, CENTRAL ZONE

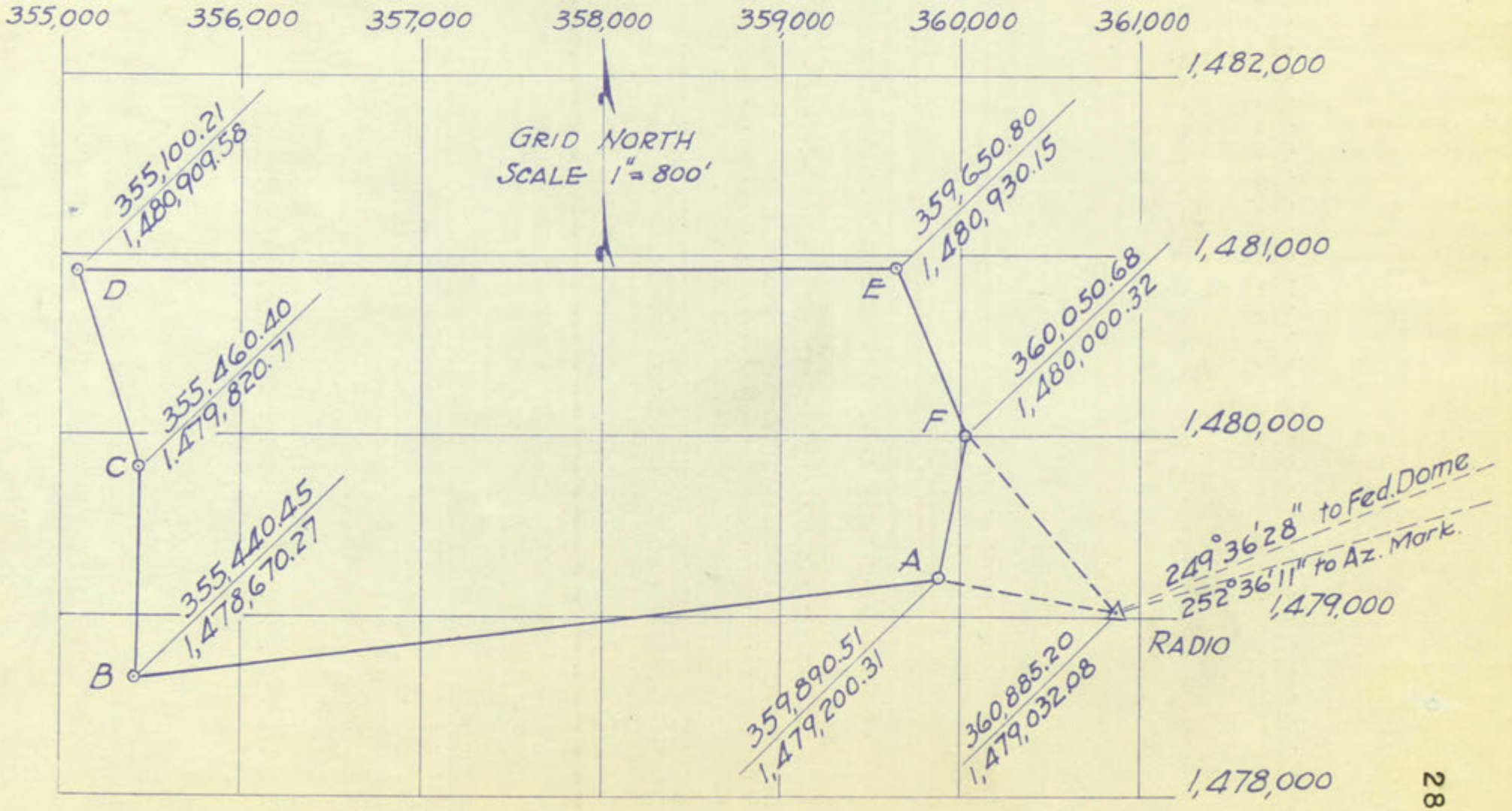


FIGURE 2. PLAT of BOUNDRY SURVEY.

distances to grid distances.

3. Calculation of Grid lengths and Adjusted Azimuths (see Table 4).
4. Calculation of Grid Coordinates for Traverse-Radio-A - B - C - D - E - F - Radio (see Table 5).
5. Adjustment for final Grid coordinates (see Table 6).

distances to grid distances.

3. Calculation of Grid Lengths and Adjusted Azimuths (see Table 4).

4. Calculation of Grid Coordinates for Traverse-Radio-A - B - C - D - E - F - Radio (see Table 5).

5. Adjustment for final Grid coordinates (see Table 6).

1. Closure of Radio-Albuquerque Federal Dome for Grid Azimuth.

	Grid Coordinates	
	X	Y
Radio	360,885.20	1,479,032.08
Albuquerque Federal Dome	379,698.17	1,486,025.70
Difference of Coordinates	18,812.97	6,993.62

	log.	18,812.97	4.2744574
	log.	6,993.62	3.8447020
bearing 69°36'28"	log. tan. bearing		0.4297554
	colog. Sin bearing		0.0281078
distance 20,070.82'	log distance		4.3025652

Check

		X	Y
Radio		360,885.20	1,479,032.08
	4.2744575		
N 69°36'28" E	9.9718922		
20,070.82	4.3025653	+ 18,813.00	+ 6,993.60
	9.5421340		
	3.8446993		
Albuquerque Federal Dome		379,698.20	1,486,025.68
		(379,698.17)	(1,486,025.70)

69°36'28"
180 00 00
249°36'28" Grid Azimuth Radio-Alb. Fed. Dome.

2. Combined Sea Level and Grid Factor.

As the difference in elevation between the high and low lines of the traverse is less than 100 feet, a mean elevation of 5120' will be used for the entire traverse.

From Table 3, for an average elevation of 5120 feet, we obtain a factor of 0.9997580

From Table 2, for an average x coordinate of 357,800 we obtain a factor of 0.999923

Adding for combined factor 0.999681

or (1.00 - 0.999681)1000 = 0.319 correction per 1000 feet to be subtracted from the measured length to obtain the Grid length.

3. Table 4 - Calculation of Grid Lengths and Adjusted Grid Azimuths.

Line	Horizontal Measured Lengths Feet	Grid Lengths Feet	Observed Azimuth	Adjusted Azimuth
Radio-Federal Dome			(249°36'28")	(249°36'28")
Radio-A	1009.05	1008.73	99°35'58"	99°35'53"
A - B	4482.60	4481.17	83°12'27"	83°12'17"
B - C	1150.94	1150.57	181°00'09"	180°59'54"
C - D	1147.20	1146.83	161°42'19"	161°41'59"
D - E	4552.45	4551.00	269°45'01"	269°44'36"
E - F	1012.55	1012.23	336°44'05"	336°43'35"
F - Radio	1278.76	1278.35	319°14'59"	319°14'24"
Radio-Federal Dome			249°37'08"	249°36'28"
			(249°36'28")	(249°36'28")
Adjust -5" per angle turned			+ 40"	0.00

3. Table 4 - Calculation of Grid Lengths and Adjusted Grid Azimuths.

4. Table 5 - Calculation of Grid Coordinates, Traverse, Radio - A - B - C - D - E - F - Radio.

		X	Y
Radio (Fixed)		(360,885.20)	(1,479,032.08)
Radio - A	2.9976536		
N 80°24'07" W	9.9938777		
1008.73	3.0037759	-994.61	+168.19
	9.2220272		
	2.2258031		
A		359,890.59	1,479,200.27
A - B	3.6483299		
S 83°12'17" W	9.9969385		
4481.17	3.6513914	-4,449.69	-530.23
	9.0730657		
	2.7244571		
B		355,440.90	1,478,670.04
B - C	1.3020441		
N 0°59'54" E	8.2411310		
1150.57	3.0609131	+20.05	+1,150.39
	9.9999341		
	3.0608472		
C		355,460.95	1,479,820.43
C - D	2.5564247		
N 18°18'01" W	9.4969256		
1146.83	3.0594991	-360.10	+1,088.83
	9.9774602		
	3.0369593		
D		355,100.85	1,480,909.26
D - E	3.6581024		
N 89°44'36" E	9.9999956		
4551.00	3.6581068	+4,550.96	+20.38
	7.6512454		
	1.3093522		
E		359,651.81	1,480,929.64
E - F	2.6020110		
S 23°16'25" E	9.5967318		
1012.23	3.0052792	+399.96	-929.87
	9.9631399		
	2.9684191		
F		360,051.77	1,479,999.77
F - Radio	2.9214911		
S 40°45'36" E	9.8148413		
1278.35	3.1066498	+834.63	-968.29
	9.8793546		
	2.9860044		
Radio		360,886.40	1,479,031.48
(Radio)		(360,885.20)	(1,479,032.08)
Correction (see Table 6)		+1.20	-0.60

4. Table 8 - Calculation of data concordance, Item-one, pp.3a - A - B - C - D - E - F - Radio.

Radio (Fixed)				
Radio - A				
B 90°38'07" X				
1008.75				
A				
A - B				
B 85°12'17" R				
4421.17				
B				
B - C				
R 0°09'58" R				
1350.87				
C				
C - D				
R 18°19'01" R				
1144.83				
D				
D - E				
R 89°44'36" E				
4081.00				
E				
E - F				
S 85°18'58" E				
1013.82				
F				
F - Radio				
S 40°58'38" E				
1276.35				
Radio				
(Radio)				
Correction (see Table 8)				

4. Table 5A - Check Calculations of Traverse - Radio - A - B - C - D - E - F - Radio.

Bearing Distance	Sine	Cosine	Grid Coordinates x	Grid Coordinates y
(Radio)			(360,885.20)	(1,479,032.08)
N 80°24'07" W 1008.73	-.986002	+.166735		
A			359,890.59	1,479,200.27
S 83°12'17" W 4481.17	-.992975	-.118322		
B			355,440.90	1,478,670.05
N 0°59'54" E 1150.57	+.017423	+.999848		
C			355,460.95	1,479,820.44
N 18°18'01" W 1146.83	-.313997	+.949424		
D			355,100.85	1,480,909.27
N 89°44'36" E 4551.00	+.999990	+.004480		
E			359,651.80	1,480,929.65
S 23°16'25" E 1012.23	+.395122	-.918628		
F			360,051.76	1,479,999.78
S 40°45'36" E 1278.35	+.652892	-.757451		
Radio			360,886.39	1,479,031.50
(Radio)			(360,885.20)	(1,479,032.08)
			+1.19	-0.58

NOTE: Above product of distance and sine or cosine made and added or subtracted directly on machine to obtain x or y coordinate.

5. Table 6 - Adjustment For Final Grid Coordinates.

	GRID COORDINATES	
Point	x	y
(Radio)	(360,885.20)	(1,479,032.08)
	359,890.59	1,479,200.27
	-0.08	+0.04
A	359,890.51	1,479,200.31
	355,440.90	1,478,670.04
	-0.45	+0.23
B	355,440.45	1,478,670.27
	355,460.95	1,479,820.43
	-0.55	+0.28
C	355,460.40	1,479,820.71
	355,100.85	1,480,909.26
	-0.64	+0.32
D	355,100.21	1,480,909.58
	359,651.81	1,480,929.64
	-1.01	+0.51
E	359,650.80	1,480,930.15
	360,051.77	1,479,999.77
	-1.09	+0.55
F	360,050.68	1,480,000.32
	360,886.40	1,479,031.48
	-1.20	+0.60
(Radio)	(360,885.20)	(1,479,032.08)

6. Table 6 - Adjustment for Final Grid Coordinates.

CALCULATION OF AREA

The area of a parcel of land at ground elevation may be obtained by first computing its grid area, using the State coordinates of its corners, and then dividing this grid area by the square of the combination factor which was employed in reducing its ground-level lengths to grid lengths.

The ground level area is:

$$A = \frac{1}{(0.999681^2)} \times \frac{1}{2} \times \left(\frac{x_1}{y_1} \diagdown\!\!\diagup \frac{x_2}{y_2} \diagdown\!\!\diagup \frac{x_3}{y_3} \diagdown\!\!\diagup \frac{x_4}{y_4} \diagdown\!\!\diagup \frac{x_5}{y_5} \diagdown\!\!\diagup \frac{x_6}{y_6} \diagdown\!\!\diagup \frac{x_1}{y_1} \right)$$

where:

A = ground-level area in square feet.

0.999681 = combined factor used to reduce to grid lengths.

x_1 = x coordinate of A; x_2 = x coordinate of B; etc.

y_1 = y coordinate of A; y_2 = y coordinate of B; etc.

$\diagdown$ indicates a positive product.

$\diagup$ indicates a negative product.

The calculation of the area follows:

$$A = \frac{1}{(0.999681)^2} \times \tfrac{1}{2} \Big(\frac{359,890.51}{1,479,200.3} \times \frac{355,440.45}{1,478,670.3} \times \frac{355,460.40}{1,479,820.7} \times \frac{355,100.21}{1,480,909.6} \times \frac{359,650.80}{1,480,930.2} \times \frac{360,050.68}{1,480,000.3} \times \frac{359,890.51}{1,479,200.3} \Big)$$

$$= \frac{1}{0.999361} \times \tfrac{1}{2} (+ 7,691,264,786 - 7,709,283,891)$$

$$= -\frac{9,009,552}{0.999361} = -9,015,302 \text{ square feet}$$

Ground-Level Area = 206.963 acres

NOTE: The - sign indicates clockwise calculations.

A PLANE COORDINATE GRID FOR BERNALILLO COUNTY

PART III

TRIANGULATION CONTROL EXTENSION

PAR

TRIANGULATION C

Geodetic surveying is
ing by the fact that it takes
the earth, usually necessitat
areas covered.

One of the fundamental
ing is the extension of contr
precise leveling.

Those control points e
latitude and longitude are kn
and those established by elev
precise leveling are called b

The data concerning th
the United States is publishe
tion of any given area may be
information from the Director
Survey, Washington, D. C.

Formulas, Tables, and
detic positions, triangulatio
ing, may be obtained from the
U. S. Government Printing Off
(10)(11)

In addition to the geo
ordinates in the various stat

PART III

TRIANGULATION CONTROL EXTENSION

Geodetic surveying is distinguished from plane surveying by the fact that it takes account of the curvature of the earth, usually necessitated by the large distances or areas covered.

One of the fundamental operations of geodetic surveying is the extension of control points by triangulation and precise leveling.

Those control points established as to location by latitude and longitude are known as triangulation stations and those established by elevation above mean sea level by precise leveling are called bench marks.

The data concerning these control stations throughout the United States is published by the government. Information of any given area may be obtained by requesting such information from the Director of the U. S. Coast and Geodetic Survey, Washington, D. C.

Formulas, Tables, and Manuals for computation of geodetic positions, triangulation, traverse, and precise leveling, may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. (4)(5)(9)(10)(11)

In addition to the geodetic positions, the plane coordinates in the various states have been computed and are

available upon request to the Director, U. S. Coast and Geodetic Survey. The methods and manner in which these plane coordinates are computed is shown in the following references: (1)(2)(3).

Table 1, Part II, gives the plane coordinates as established in Bernalillo County on the New Mexico Coordinate System, Central Zone.

The following pages list the Geographic Positions covering Bernalillo County. The description and location of these stations are given in Part II.

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 50-29

GEOGRAPHIC POSITIONS

Revised 11-30-50

22

Accession No. of Computation: G-183

Locality 35th Parallel — Datum North American 1927 — State New Mexico

	STATION	LATITUDE AND LONGITUDE	ELEVATION METERS and FEET	AZIMUTH	BACK AZIMUTH	TO STATION	DISTANCE Logarithm (meters)	DISTANCE Meters	DISTANCE Feet
102	Sandia Range Peak (Sharp) 1921	35 07 12.887		19 02 34.8	198 53 31.1	Belen North Base	4.873 719	74 768.6	245 303
	d	106 25 48.044		38 25 12.4	218 02 48.4	Ladrones	4.985 968	96 807.3	317 609
	Tompson Lone Butte Southeast of 1921	35 22 36.454		320 37 25.6	140 51 48.1	Pintada	4.777 340	59 888.0	196 483
	d	105 19 37.256		26 10 11.2	205 59 15.5	Pedernal	4.819 372	65 670.8	215 465
	Hill, small butte northwest of 1921	35 15 24.711		196 09 25.5	16 11 49.6	Corazon	4.353 446	22 565.6	74 034
	d	104 38 05.268		319 48 29.8	139 53 03.7	Hill	4.270 488	18 641.8	61 161
	Tucumcari city water tank 1921, d	35 10 43.297	1284.2	302 57 41.2	123 09 38.7	Martin	4.576 659	37 727.6	123 778
		103 43 54.826	4213	348 19 13.6	168 20 45.4	Redondo	4.301 104	20 003.4	65 628
	Tucumcari 1921	35 08 04.111	1516.1	115 24 57.3	295 15 03.2	Pablo	4.460 313	28 861.1	94 688
	d	103 41 53.503	4974	201 44 50.8	21 48 08.1	Dripping	4.367 484	23 306.9	76 466
	Becker, coal elevator 1921 d	34 29 46.003		78 56 11.7	258 53 14.9	Belen North Base	3.884 139	76584	25 126
		106 36 49.543		235 33 46.0	55 39 28.0	Manzano	4.270 262	18633.0	61 132
	Belen, A T & S F Railway, coal elevator 1921	34 39 10.621		283 03 24.6	103 14 20.9	Manzano	4.480 276	30 218.7	99 143
	d	106 46 01.655		340 47 45.4	160 50 11.5	Belen, North Base	4.300 600	19 980.2	65 552
	Hill between Belen base stations 1921	34 24 35.038		94 25 58.5	274 12 25.2	Ladrones	4.566 360	36 843.4	120 877
	d	106 41 05.496		173 04 29.2	353 04 07.4	Belen, North Base	3.912 158	8.168.8	26 800

No check on this position.

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 50-29
Ed. December 1944

GEOGRAPHIC POSITIONS

Revised 2-5-48; 4-30-48, 4th ord. Accession No. of Computation: G-183

12

Locality 35th Parallel — North American 1927 Datum — —order Triangulation, State New Mexico

	STATION	LATITUDE AND LONGITUDE	ELEVATION METERS and FEET	AZIMUTH	BACK AZIMUTH	TO STATION	DISTANCE Logarithm (meters)	DISTANCE Meters	DISTANCE Feet
	Pedernal 1921, r. '34; '49	34 50 42.383	2309.5	224 51 41.35	45 14 07.67	Aguilar	4.923 0202	83,756.83	274,792.2
	d.m.	105 38 37.240	7576	259 07 26.08	79 32 35.20	Pintada	4.833 3981	68,139.37	223,553.9
	Tompson 1921, r. 1945-'46	35 40 20.164	3223.8	293 37 00.44	114 05 20.38	Aguilar	4.906 2969	80,592.93	264,412.0
	d.m.	105 48 22.087	10577	313 56 23.94	134 27 26.77	Pintada	5.055 1423	113,538.28	372,500.2
				350 48 04.14	170 53 41.76	Pedernal	4.968 2513	92,950.40	304,954.8
				345 20 46.1		Azimuth Mark, 1945			
101	Sandia 1919, r. 1921, r. 1945-'46 r.-'48	35 12 36.149	3255.9	228 30 50.02	48 53 12.09	Tompson	4.890 4173	77,699.34	254,918.6
	d.m.	106 26 56.492	10682	298 36 59.86	119 04 43.97	Pedernal	4.923 8049	83,908.29	275,289.1
				324 38 35.0		Azimuth Mark, 1945			
	Manzano 1919, r. 1921, r. 1946, r. '34, r. '35	34 35 27.548	30775	179 47 22.28	359 47 16.57	Sandia	4.836 8041	68,675.86	225,314.0
	d.m.	106 26 46.518	10097	205 45 10.81	26 07 16.98	Tompson	5.125 1298	133,392.00	437,636.9
				248 47 33.43	69 14 59.00	Pedernal	4.896 1792	78,737.05	258,323.1
	Ladrones 1919, r. 1921, r. '34, r. '45	34 26 05.106	27990	213 52 37.31	34 14 23.73	Sandia	5.016 2495	103,812.46	340,591.4
	d.m.	107 05 04.238	9183	253 20 47.45	73 42 29.33	Manzano	4.786 1707	61,118.23	200,518.7
				103 45 36.0		Azimuth Mark, 1945			
	Los Lunas 1919, r. 1921	34 48 26.538	14790	210 13 35.08	30 23 25.91	Sandia	4.713 8547	51,743.37	169,761.4
	d.m.	106 44 06.339	4852	312 07 36.92	132 17 28.86	Manzano	4.553 0204	35,728.96	117,220.8
	Belen, South Base 1919 r. 1921, r. '46, r. '34, r. '35 d.m.	34 19 19.944	1672.9	107 29 52.35	287 15 10.57	Ladrones	4.621 2223	41,804.43	137,153.4
		106 39 02.634	5489	190 33 42.34	10 40 36.41	Sandia	5.000 8955	100,206.41	328,760.5
				212 09 40.43	32 16 36.91	Manzano	4.547 0550	35,241.55	115,621.7
	Belen, North Base 1920, r. '34, r. 1935, r. '45-'46 d.m.	34 28 58.210	1531.1	195 32 48.72	15 41 15.89	Sandia	4.923 0607	83,764.63	274,817.8
		106 41 44.096	5023	242 16 06.33	62 24 35.20	Manzano	4.412 3282	25,842.13	84,783.7
				346 57 20.76	166 58 51.99	Belen South Base	4.262 1911	18,289.04	60,003.3
				81 37 16.62	261 24 04.40	Ladrones	4.557 9085	36,133.38	118,547.6
				347 03 20.0		Az. Mark, 1946			
	Taylor, 1920, r. 1921, r. 1945	35 14 19.160	3444.5	271 23 20.96	92 03 27.33	Sandia	5.023 4685	105,552.50	346,300.2
	d.m.	107 36 28.476	11301	303 45 27.15	124 25 20.82	Manzano	5.107 8376	128,185.12	420,554.0
				314 52 55.44	135 24 12.80	Belen North Base	5.072 9111	118,279.95	388,056.8
				318 58 17.62	139 31 03.34	Belen South Base	5.127 7746	134,206.82	440,310.2
				331 37 16.78	151 55 13.16	Ladrones	5.005 2604	101,218.62	332,081.4
				218 45 57.1		Azimuth Mark, 1945			

† No check on this position. Abbreviations used: d.—described; m.—marked; s.—set; r.—recovered; l.—lost; p.—probably. (Examples: n. d.—not described; p. l.—probably lost.)

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 25-31
Ed. April 1946

GEOGRAPHIC POSITIONS

Rev. 2/15/52

241

Accession No. of Computation:

Locality Chama to Belen, New Mexico — North American 1927 Datum First —order Triangulation. State New Mexico

	STATION	LATITUDE AND LONGITUDE	ELEVATION METERS and FEET	AZIMUTH	BACK AZIMUTH	TO STATION	DISTANCE Logarithm (meters)	DISTANCE Meters	DISTANCE Feet
	Tongue, 1938, r.1946	35 24 06.780	1698.2	134 31 02.66	314 28 03.64	Rosa (USGS)	4.038 1278	10917.62	35 818.9
	(d.m)	106 24 23.781	5572	254 22 53.33	74 25 45.28	Comer	3.890 6031	7773.26	25 502.8
				354 36 58.22	174 37 20.59	Placitas	4.017 3131	10406.70	34 142.6
				194 31 47.2		Azimuth Mark			
	Jemez 1938; r. 1945	35 21 35.485	1754.0	225 05 55.36	45 10 39.57	Rosa (USGS)	4.241 9600	17456.61	57 272.2
	r.1949, r.1951 (d.m)	106 37 42.978	5755	256 55 14.64	77 02 57.38	Tongue	4.316 0517	20703.88	67 926.0
				285 00 16.37	105 08 20.94	Placitas	4.340 7132	21913.57	71 894.8
				315 26 31.44	135 32 44.88	Sandia	4.367 4592	23305.54	76 461.6
				278 13 08.4		Azimuth Mark			
103	Corrales, 1946, r.1951	35 14 10.765	1611.0	127 57 30.25	7 58 14.08	Jemez	4.140 8992	13832.45	45 382.0
	(d.m)	106 38 58.235	5285	250 49 03.29	70 57 50.92	Placitas	4.388 0971	24439.77	80 182.8
				279 01 47.11	99 08 43.73	Sandia	4.247 1672	17699.81	60 694.8
				296 46 51.6		Azimuth Mark			
104	Black, 1946	35 11 44.771	1590.4	207 56 33.48	27 57 27.99	Corrales	3.707 5859	5100.18	16 732.8
	(d.m)	106 40 33.352	5218	265 33 10.12	85 41 01.02	Sandia	4.316 4648	20723.58	67 990.6
				102 10 08.4		Azimuth Mark			
105	Tijeras, 1946, r.1948	35 02 36.123	1711.6	137 40 07.04	317 34 16.57	Black	4.359 5682	22885.91	75 084.9
	(d.m)	106 30 24.140	5615	148 43 06.61	328 38 10.37	Corrales	4.399 0476	25063.24	82 230.3
				175 51 25.19	15 53 24.67	Sandia	4.283 7966	19221.91	63 063.9
				268 54 53.4		Azimuth Mark			
106	Radio, 1946	35 03 52.060	1550.57	193 41 13.21	13 42 33.91	Black	4.175 9133	14993.86	49 192.4
	(d.m)	106 42 53.593	5087.2	197 17 09.31	17 19 24.47	Corrales	4.300 5275	19976.37	65 540.8
				276 57 31.60	97 04 42.05	Tijeras	4.228 8479	19135.85	62 781.6
				252 20 09.5		Azimuth Mark			

[1] No check on this position.

Abbreviations used: d.=described; m.=marked; n.=not; r.=recovered; l.=lost; p.=probably. (Examples: n. d.=not described; p. l.=probably lost.)

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 25-31
Ed. April 1946

GEOGRAPHIC POSITIONS

242

Accession No. of Computation:

Locality Chama to Belen, New Mexico — North American 1927 Datum First —order Triangulation. State New Mexico

	STATION	LATITUDE AND LONGITUDE	Elev. in Meters	AZIMUTH	BACK AZIMUTH	TO STATION	DISTANCE Logarithm (meters)	DISTANCE Meters	DISTANCE Feet
107	Isleta (USGS) 1946	34 55 11.736	1641.8	184 11 08.33	4 11 34.29	Radio	4.206 2111	16077.23	52 746.7
	(d.m)	106 43 39.904		235 46 37.98	55 54 14.21	Tijeras	4.337 2466	24391.96	80 026.0
				318 19 47.99		Azimuth Mark			
108	Loudon, 1946	34 59 53.484	1618.7	46 37 14.80	226 33 47.50	Isleta (USGS)	4.101 5579	12634.50	41 451.7
	(d.m)	106 37 38.126		132 37 11.45	312 34 10.36	Radio	4.035 9383	10862.72	35 632.8
				245 28 00.75	65 32 09.80	Tijeras	4.082 4598	12090.93	39 662.3
				277 49 07.3		Azimuth Mark			
109	Bernaval, 1946	34 54 31.875	1714.8	93 48 49.89	273 41 47.93	Isleta (USGS)	4.273 1156	18754.94	61 531.8
	(d.m)	106 31 22.665		136 09 43.68	316 06 08.58	Loudon	4.138 2016	13746.80	45 101.0
				185 40 33.09	5 41 06.64	Tijeras	4.176 0345	14998.04	49 206.1
				39 27 54.15		Azimuth Mark			
	Tome (USGS 1938) 1946	34 45 21.348	1592.0	173 07 17.29	353 06 27.90	Isleta (USGS)	4.263 0453	18325.05	60 121.4
	(d.m)	106 42 13.441		224 12 57.31	44 19 09.02	Bernaval	4.374 5753	23630.56	77 724.8
				118 34 28.4		Azimuth Mark			
	Lolito, 1946	34 47 55.251	1684.1	73 06 04.23	253 00 15.11	Tome (USGS)	4.211 3780	16269.64	53 378.0
	(d.m)	106 32 01.369		127 13 06.60	307 06 27.34	Isleta (USGS)	4.347 6370	22265.73	73 050.1
				184 35 46.66	4 36 08.78	Bernaval	4.088 5454	12261.55	40 222.1
				162 29 26.8		Azimuth Mark			
	Belenbeck, 1946	34 37 22.589	1517.9	180 53 19.44	0 53 24.56	Tome (USGS)	4.168 9228	14754.44	48 406.9
	(d.m)	106 42 22.439		218 58 56.35	39 04 60.01	Lolito	4.339 6145	25096.69	82 338.1
				278 22 53.54	98 31 45.09	Manzano	4.382 1690	24108.43	79 095.7
				356 23 52.24	176 24 13.99	Belen North Base	4.192 3586	15572.51	51 090.8
				28 24 06.4		Azimuth Mark (A Airway Beacon No. 20)			

[1] No check on this position.

Abbreviations used: d.=described; m.=marked; n.=not; r.=recovered; l.=lost; p.=probably. (Examples: n. d.=not described; p. l.=probably lost.)

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Forms 591 a
Ed. April 1946

GEOGRAPHIC POSITIONS

Rev. 2/15/52 9/9/47; 12/1/50

256

Accession No. of Computation:

Locality Chama to Belen, New Mexico — North American 1927 Datum Second —order Triangulation. State New Mexico

	STATION	LATITUDE AND LONGITUDE	ELEVATION METERS and FEET	AZIMUTH	BACK AZIMUTH	TO STATION	DISTANCE Logarithm (meters)	DISTANCE Meters	DISTANCE Feet
	Lookout Park BM	35 40 25.862	2053.79	85 27 51.72	265 25 42.16	Bear (USGS)	3.7485954	560.526	1838.99
	(USFS 1934) 1945 (d.m)	106 27 29.605	6738.01	125 55 10.13	305 52 49.02	Peralta	3.3754637	750.695	2462.91
				220 38 12.84	40 41 17.67	Dome RM3 (USGS)	4.0868284	12213.17	40069.4
				100 33 10.8		Azimuth Mark			
	Borrego (GLO) 1945	35 32 57.062	1874.5	186 01 13.69	6 01 46.37	Bear (USGS)	4.1290764	13460.97	44163.2
	(d.m)	106 32 07.917	6150	277 52 54.16	97 54 23.66	Domingo	3.592 6836	391.457	1284.31
				335 44 09.81	155 45 40.06	Rosa (USGS)	3.979 2036	953.243	3127.43
	Bernalillo Mag, 1946	35 17 52.705	1549.88	55 25 35.49	235 21 49.25	Corrales	4.080 3577	12 032.55	39476.8
	Y. 1951 (d.m)	106 32 27.003	5084.9	130 43 50.77	310 40 48.05	Jemez	4.022 3158	10527.27	34538.2
				154 06 01.2		Azimuth Mark			
	Bench Mark (GLO 1927) 1946 (d.m)	35 17 51.172		245 46 47	65 46 49	Bernalillo Mag	2.061 3771	115.18	377.9
		106 32 31.160							
201	Kirtland, 1946, Y.'47	35 02 55.150	1617.89	101 37 35.33	281 34 21.67	Radio	3.940 6179	8722.04	28615.6
	Y. 1951 (d.m)	106 37 16.435	5308.0	163 01 40.69	342 59 47.40	Black	4.232 1254	17065.75	55989.9
				172 54 47.77	352 53 48.83	Corrales	4.321 9524	20987.10	68865.2
				174 46 31.8		Azimuth Mark			
202	Albuquerque, Mun. Airport,	35 02 53.92		161 32 39	341 32 39	Kirtland	1.600 6462	39.87	130.8
	Flagpole, 1946 (d)	106 37 15.94							
	Bench Mark (USFS Fire	35 34 01.137		328 34	148 34	Pena Blanca	0.719 8283	5.246	17.21
	Control Station, 1938) 1945 (dm)	106 19 30.932							
	Pole in Cairn, near Dernal,	36 09 47.64		316 47	136 47	Dernal	0.575 6496	3.764	12.35
	1945 (d)	106 30 11.68							

[1] No check on this position. Abbreviations used: d.=described; m.=marked; n.=not; r.=recovered; l.=lost; p.=probably. (Examples: n. d.=not described; p. l.=probably lost.)

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Forms 591 a
Ed. April 1946

GEOGRAPHIC POSITIONS

Rev. 2/15/52

257

Accession No. of Computation:

Locality Chama to Belen, New Mexico — North American 1927 Datum Second —order Triangulation. State New Mexico

	STATION	LATITUDE AND LONGITUDE	ELEVATION METERS and FEET	AZIMUTH	BACK AZIMUTH	TO STATION	DISTANCE Logarithm (meters)	DISTANCE Meters	DISTANCE Feet
203	Golf, 1946, Y. 1949	35 05 31.199	1567.64	70 02 37.87	249 59 27.28	Radio	3.951 3356	893.996	2933.05
	Y. 1951 (d.m)	106 37 21.958	5143.2	157 11 29.43	337 09 39.25	Black	4.096 5707	12490.24	40978.4
				171 18 18.93	351 17 23.14	Corrales	4.209 6251	16204.11	53163.0
				298 35 38.4		Azimuth Mark (USGS BM)			
204	University (USGS 1931)	35 05 09.749	1573.67	155 29 25.52	335 29 18.68	Golf	2.861 2278	724.49	2383.6
	1946, Y. 1949 (d.m)	106 37 10.060	5162.9	157 05 59.32	337 04 02.30	Black	4.121 1139	13214.42	43360.9
	Y. 1951			170 38 09.59	350 37 06.95	Corrales	4.227 9958	16904.25	55460.0
				180 00 27.6		Azimuth Mark			
	Albuquerque Mag, 1946	35 05 13.071	1571.7	76 02 11.20	256 02 01.86	University (USGS)	2.627 6223	424.250	1391.89
	(d.m)	106 36 53.207	5156.	128 04 39.64	308 04 23.46	Golf	2.957 0566	905.85	2971.9
205	Workman, 1946	34 57 55.639	1735.8	22 33 12.42	202 32 13.59	Bernaval	3.832 4270	679.872	2230.5
	(d.m)	106 29 39.948	5695	106 42 24.33	286 37 50.18	Loydon	4.102 4511	12660.51	41537.0
206	Workman Azimuth Mark 1946	34 57 34.014	1736.8	182 55 52.3	2 55 53.1	Workman	2.824 3016	667.270	2189.20
	(d.m)	106 29 41.273	5698						
207	Bernaval Azimuth Mark	34 54 16.089	1679.6	44 26 56.84	224 20 54.16	Tome (USGS)	4.362 9119	23062.79	75665.2
	1946, Y. 1948 (d.m)	106 31 38.440	5510	95 24 22.72	275 17 29.81	Isleta (USGS)	4.264 6354	18394.81	60350.3
				219 27 45.12	39 27 54.15	Bernaval	2.799 4013	630.09	2067.2
208	Isleta Azimuth Mark	34 54 06.474	1516.9	358 33 44.17	178 33 53.29	Tome (USGS)	4.209 1640	16186.91	53106.6
	(USGS) 1946 (d.m)	106 42 29.410	4977	138 20 28.33	318 19 47.99	Isleta (USGS)	3.430 0749	2692.01	8832.0

[1] No check on this position. Abbreviations used: d.=described; m.=marked; n.=not; r.=recovered; l.=lost; p.=probably. (Examples: n. d.=not described; p. l.=probably lost.)

DEPARTMENT OF COMMERCE
U.S. COAST AND GEODETIC SURVEY
Forms 28-31
Ed. April 1940

GEOGRAPHIC POSITIONS

Accession No. of Computation: 260

Locality Chama to Belen, New Mexico — North American 1927 Datum Third — order Triangulation. State New Mexico

STATION	LATITUDE AND LONGITUDE	Elev. in Meters	AZIMUTH	BACK AZIMUTH	TO STATION	DISTANCE Logarithm (Meters)	DISTANCE Meters	DISTANCE Feet
Santa Fe, Indian School, stack, 1945 (d)	35 40 13.852	2109.5	65 01 53.3	244 57 34.8	Santa Fe West Base	4.090 360	12 312.9	40 397
	105 58 00.821		77 07 32.4	257 07 20.6	Santa Fe East Base	2.719 074	523.7	1 718
			117 54 28.4	297 48 07.3	Pankey Peak (USFS)	4.268 781	18 568.7	60 921
Santa Fe, Old Municipal Airport, wind sock, 1945 (d)	35 37 52.083	2003.5	82 08 11.7	262 05 52.0	Santa Fe West Base	3.784 459	6 090.6	19 982
	106 01 24.691		121 01 40.9	300 57 05.5	Tor	4.141 913	13 864.8	45 488
			227 20 06.0	47 21 53.0	Santa Fe East Base	3.797 723	6 276.6	20 592
Santa Fe, St Catherine's Industrial School, cross 1945 (n d)	35 41 45.310	2149.5	298 22 20.8	118 22 52.2	Ft. Marcy	3.186 551	1 536.6	5 041
	105 56 49.051		345 24 39.7	165 25 58.1	Vargas	4.128 356	13 438.7	44 090
			89 54 39.4	269 47 22.9	Tor	4.274 414	18 811.1	61 716
Santa Fe, Bruns General Hospital, church spire, 1946 (n d)	35 39 33.728	2078.1	68 20 29.3	248 16 38.2	Santa Fe West Base	4.030 838	10 735.9	35 223
	105 58 47.938		74 45 58.3	254 37 57.0	Tetilla (USGS)	4.333 334	21 544.4	70 684
			211 00 08.3	31 00 23.9	Santa Fe East Base	3.116 126	1 306.5	4 286
Los Alamos, water tower 1945 (n d)	35 52 56.49	2257.7	23 44 36	203 42 14	Dome (USGS)	4.180 568	15 155.4	49 722
	106 18 07.75		198 26 34	18 28 47	Clara	4.253 409	17 922.9	58 802
301 Alameda, Nativitati Church south spire, 1946 (n d)	35 11 18.39	1545.9	98 33 14	278 31 10	Black	3.738 571	54 774	17 970
	106 36 59.25		150 22 52	330 21 43	Corrales	3.786 632	6 118.3	20 073
303 Albuquerque, Radio Tower on City Hall, 1946 (n d)	35 05 07.77		254 19 03	74 19 57	Golf	3.383 079	2443.9	8 018
	106 38 54.85		68 25 09	248 22 52	Radio	3.813 280	6 505.5	21 343

¹ No check on this position. elev.

Abbreviations used: d.=described; m.=marked; n.=not; r.=recovered; l.=lost; p.=probably. (Examples: n. d.=not described; p. l.=probably lost.)

DEPARTMENT OF COMMERCE
U.S. COAST AND GEODETIC SURVEY
Forms 28-31
Ed. April 1940

GEOGRAPHIC POSITIONS

Accession No. of Computation: 261

Locality Chama to Belen, New Mexico — North American 1927 Datum Third — order Triangulation. State New Mexico

STATION	LATITUDE AND LONGITUDE	Elev. in Meters	AZIMUTH	BACK AZIMUTH	TO STATION	DISTANCE Logarithm (Meters)	DISTANCE Meters	DISTANCE Feet
304 Albuquerque, San Felipe School, spire, 1946 (d)	35 05 19.074		62 07 35.3	232 05 59.1	Radio	3.729 979	5 370.1	17 618
	106 40 06.301		176 31 30.0	356 31 14.4	Black	4.052 709	11 290.4	37 042
			273 19 24.2	93 20 58.7	Golf	3.620 117	4 169.8	13 680
305 Albuquerque, KOB Radio Mast, 1946 (d)	35 12 08.383	1661.1	2 52 37.7	182 52 18.2	Kirtland	4.232 240	17 070.3	56 005
	106 36 42.627		82 54 43.7	262 52 30.7	Black	3.749 510	5 281.8	19 297
			137 38 52.3	317 37 39.7	Corrales	3.708 628	5 112.4	16 773
302 Albuquerque, Indian School east tank, 1946 (d)	35 06 32.907	1545.0	47 19 18.1	227 17 16.2	Radio	3.863 903	7 309.8	23 982
	106 39 21.508		169 17 28.7	349 16 47.3	Black	3.990 391	9 781.2	32 090
			334 42 50.2	154 44 02.1	Kirtland	3.870 460	7 421.0	24 347
306 Albuquerque, Indian School, west tank, 1946 (d)	35 06 33.996	1545.1	46 37 14.3	226 35 14.5	Radio	3.861 147	7 263.5	23 830
	106 39 25.243		169 48 04.5	349 47 25.2	Black	3.982 157	9 731.0	31 926
			334 10 08.2	154 11 22.2	Kirtland	3.874 601	7 492.1	24 580
307 Albuquerque, Nazareth Hospital, cross on cupola, 1946 (n d)	35 11 22.836	1565.8	6 49 45.2	186 49 02.7	Kirtland	4.197 466	15 756.7	51 695
	106 36 02.505		95 39 21.1	275 36 45.0	Black	3.837 927	6 885.4	22 590
			139 17 36.7	319 15 55.0	Corrales	3.834 823	6 836.3	22 429
308 Albuquerque, Indian Hospital, stack, 1946 (d)	35 05 20.223		4 59 31.9	184 59 19.5	Kirtland	3.653 605	4 504.1	14 777
	106 36 54.800		73 23 16.9	253 19 50.7	Radio	3.977 140	9 487.2	31 126
			154 59 29.9	334 57 24.1	Black	4.116 554	13 078.4	42 908
309 Albuquerque, KGGM Radio Mast, 1946 (d)	35 04 39.959	1579.3	64 06 27.5	244 05 18.6	Radio	3.528 799	3 379.1	11 086
	106 40 53.622		182 14 35.6	2 14 47.3	Black	4.117 316	13 101.3	42 983
			300 23 27.6	120 25 32.4	Kirtland	3.804 294	6 381.1	20 935

¹ No check on this position. elev.

Abbreviations used: d.=described; m.=marked; n.=not; r.=recovered; l.=lost; p.=probably. (Examples: n. d.=not described; p. l.=probably lost.)

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 28-B
Ed. April 1946

GEOGRAPHIC POSITIONS

Accession No. of Computation: 262

Locality Chama to Belen, New Mexico — North American 1927 Datum Third — order Triangulation. State New Mexico

	STATION	LATITUDE AND LONGITUDE	Elev. in Meters	AZIMUTH	BACK AZIMUTH	TO STATION	DISTANCE Logarithm (meters)	Meters	Feet
310	Albuquerque, Hilton Hotel, tower sign, 1946 (d)	35 05 05.995 106 38 56.547	1567.8	168 43 47.7 179 48 09.2 252 01 54.7	348 42 52.0 359 48 07.9 72 02 49.1	Black Corrales Golf	4.097984 4.225163 3.401190	12531.0 16794.3 2518.8	41112 55099 8264
311	Albuquerque, Veterans Hospital, tank, 1946 (d)	35 03 11.044 106 34 55.502	1664.8	95 57 39.2 151 38 33.8 278 51 24.0	275 55 04.6 331 35 19.4 98 53 59.8	Radio Black Tijeras	4.085673 4.255144 3.842651	12180.7 17994.7 6960.7	39963 59038 22837
314	Albuquerque, Federal Building, dome, 1946 (d)	35 05 02.047 106 39 07.612		69 22 36.1 170 05 11.9 251 26 11.1	249 20 26.2 350 04 22.5 71 27 11.8	Radio Black Golf	3.786616 4.100337 3.450728	6118.1 12599.0 2823.1	20072 41335 9262
315	Albuquerque, Santa Fe R.R. Yards, stack, 1946 (d)	35 04 24.943 106 38 56.126		80 27 32.1 169 42 53.6 177 46 57.6	260 25 15.7 349 41 57.7 359 46 56.1	Radio Black Corrales	3.785434 4.139115 4.256704	6101.5 13775.7 18059.4	20018 45196 59250
316	Sandia Mtns., USFS Lookout Tower, 1946 (n.d)	35 13 00.591 106 27 06.771	3259.7	340 57 25.5 383 31 52.6 96 55 28.5	160 57 31.4 263 24 07.6 276 48 37.8	Sandia Black Corrales	2.901362 4.312506 4.258566	796.8 20535.5 18137.0	2614 67374 59504
317	Albuquerque, Municipal Airport, wind sock, 1946 (d)	35 02 52.533 106 37 07.096	1647.4	101 49 40.4 102 49 06.3 172 18 14.0	281 46 21.4 282 49 00.9 352 17 09.7	Radio Kirtland Corrales	3.952801 2.398030 4.324232	8970.2 250.1 21097.5	29430 821 69217
318	Los Angeles to Amarillo Airway Beacon No. 68, 1946 (d)	35 03 22.106 106 47 37.808	1767.4	213 15 46.2 214 43 06.2 272 58 12.5	33 20 44.9 34 47 10.4 93 04 09.4	Corrales Black Kirtland	4.378852 4.275390 4.197800	23925.0 18853.4 15762.8	78494 61855 51735

¹ No check on this position. Abbreviations used: d.=described; m.=marked; n.=not; r.=recovered; l.=lost; p.=probably. (Examples: n. d.=not described; p. l.=probably lost.)

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 28-B
Ed. April 1946

GEOGRAPHIC POSITIONS Revised 4-2-47

Accession No. of Computation: 263

Locality Chama to Belen, New Mexico — North American 1927 Datum Third — order Triangulation. State New Mexico

	STATION	LATITUDE AND LONGITUDE	Elev. in Meters	AZIMUTH	BACK AZIMUTH	TO STATION	DISTANCE Logarithm (meters)	Meters	Feet
319	Radio Mast, southernmost of two, 1946 (n.d)	34 57 20.52 106 27 44.13	1891.1	20 34 45 46 52 49	200 32 18 226 50 44	Lolito Bernaval	4.269601 3.880850	18603.8 7600.6	61036 24936
320	Albuquerque, center stack of three, 1946 (n.d)	35 06 16.132 106 39 35.965	1566.0	171 50 32.6 183 40 15.6 330 16 24.2	351 49 59.6 3 40 37.0 150 17 44.5	Black Corrales Kirtland	4.009928 4.166222 3.853170	10231.2 14663.0 7131.3	33567 48107 23397
321	Albuquerque, Cutter-Carr Airfield, wind sock, 1946 (d)	35 05 04.31 106 42 57.77	1574.2	294 41 09 357 16 38	114 44 25 177 16 40	Kirtland Radio	3.978670 3.348138	9520.7 2229.1	31236 7313
312	Albuquerque, Veterans Center, flagpole, 1946 (d)	35 03 18.192 106 35 00.653	1657.3	280 26 39.5 32 20 19.2 41 20 27.6	100 29 18.3 212 18 48.9 221 15 29.9	Tijeras Loudon Isleta (USGS)	3.852864 3.873046 4.300024	7126.3 7465.3 19953.7	23380 24492 65465
313	Albuquerque, Veterans Hospital, stack, 1946 (d)	35 03 10.982 106 34 57.789	1661.1	278 46 05.2 320 18 18.2 33 44 59.1	98 48 42.3 140 21 20.5 213 43 27.1	Tijeras Workman Loudon	3.846192 4.101217 3.864429	7017.7 12624.6 7318.6	23024 41419 24011
	Bernalillo, water tank, 1945; r. 1946 (n.d)	35 18 10.743 106 33 15.022	1583.7	133 01 00.4 267 31 20.3 294 36 46.1	312 58 25.4 87 36 49.7 114 37 13.9	Jemez Placitas Bernalillo Mag	3.966263 4.158681 3.125323	9252.6 14410.6 1334.5	30356 47279 4378
322	Oil Derrick, 1946 (n.d)	35 00 00.471 106 49 22.564	1751.0	253 38 31.2 270 38 03.9 315 38 14.4	73 46 27.9 90 44 47.9 135 41 30.7	Kirtland Loudon Isleta (USGS)	4.282824 4.252001 4.094808	19178.9 17864.9 12439.6	62923 58612 40812
323	Los Angeles to Amarillo, Airway Beacon No. 71 1945; r. 1946 (n.d)	35 03 10.351 106 21 05.187	2389.4	44 36 04.9 92 19 27.9 153 00 05.5	224 11 00.9 272 06 56.4 332 56 43.4	Ladrones Radio Sandia	4.982087 4.520880 4.291669	95959.3 33180.3 19573.5	314826 108859 64217

¹ No check on this position. Abbreviations used: d.=described; m.=marked; n.=not; r.=recovered; l.=lost; p.=probably. (Examples: n. d.=not described; p. l.=probably lost.)

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
FORMS 591 B
Ed. April 1946

GEOGRAPHIC POSITIONS

Accession No. of Computation: 264

Locality Chama to Belen, New Mexico — North American 1927 Datum Third — order Triangulation. State New Mexico

STATION	LATITUDE AND LONGITUDE	Elev. in Meters	AZIMUTH	BACK AZIMUTH	TO STATION	DISTANCE Logarithm (Meters)	Meters	Feet
Sandia Base, control tower, 1946 (n.d)	35 03 01.96	1666.6	280 37 55	100 39 31	Tijeras	3.633401	4299.3	14105
	106 33 10.86		350 05 16	170 06 18	Bernaval	4.202934	15956.4	52350
324 Radio Range Station, center mast of five, 1946 (n.d)	34 59 13.125	1657.2	52 59 53.9	232 56 11.2	Isleta (USGS)	4.091700	12350.9	40521
	106 37 11.312		151 19 59.4	331 19 44.0	Loudon	3.151512	1417.5	4651
			314 23 02.9	134 26 22.6	Bernaval	4.092835	12384.7	40632
Los Lunas, Municipal water tank, 1946 (n.d)	34 48 23.268	1517.4	306 17 10.3	126 23 29.2	Chaves	4.321964	20987.7	68857
	106 43 59.329		334 20 18.5	154 21 18.9	Tome (USGS)	3.793707	6218.8	20403
			126 09 01.1	306 08 32.7	Lunagallup	3.194501	1565.0	5135
El Paso to Pueblo Airway Beacon No. 21, 1946 (n.d)	34 48 50.683	1559.1	278 32 59.2	98 37 13.3	Lolito	4.058529	11442.7	37542
	106 39 26.507		33 21 23.0	213 19 47.8	Tome (USGS)	3.887710	7721.6	25333
			90 34 22.1	270 31 18.0	Lunagallup	3.913704	8197.9	26896
325 Isleta, cross on church, 1946 (n.d)	34 54 32.18	1507.0	60 40 13	240 39 41	Isleta Azimuth Mark	3.208706	1617.0	5305
	106 41 33.88		110 52 06	290 50 54	Isleta (USGS)	3.534449	3423.3	11231
El Paso to Pueblo Airway Beacon No. 19, 1946 (n.d)	34 25 13.786		187 35 59.2	7 37 05.8	Belenbeck	4.355193	226565	74332
	106 44 20.063		209 51 12.5	29 57 41.2	Chaves	4.544639	350460	114980
			209 55 04.5	29 56 32.7	Belen North Base	3.901967	7979.4	26179
Windmill, 1946 (n.d.)	34 29 07.944	1527.9	140 08 59.8	320 06 26.2	Bosque	4.032624	10780.1	35368
	106 42 47.703		180 24 18.3	0 24 19.9	Turn	4.028979	10690.0	35072
			280 27 55.2	100 28 31.2	Belen North Base	3.217621	1650.5	5415
El Paso to Pueblo Airway Beacon No. 20 (Belenbeck Azimuth Mark, 1946 (d.m)	34 37 16.793		208 24 04.2	28 24 06.4	Belenbeck	2.307560	20303	666.1
	106 42 26.230		240 51 19.7	60 56 44.8	Chaves	4.221592	16656.8	54648

[1] No check on this position. Abbreviations used: d.=described; m.=marked; n.=not; r.=recovered; l.=lost; p.=probably. (Examples: n. d.=not described; p. l.=probably lost.)

elev.

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
FORMS 591 B
Ed. April 1946

GEOGRAPHIC POSITIONS Rev. 2/15/52

266

Accession No. of Computation:

Locality Vicinity of Datil, Albuquerque, Vaughn N.M. — North American 1927 Datum First — order Triangulation. State New Mexico

STATION	LATITUDE AND LONGITUDE	Elevation Meters and Feet	AZIMUTH	BACK AZIMUTH	TO STATION	DISTANCE Logarithm (Meters)	Meters	Feet
Datil, 1948	34 05 49.543	2202.5	117 38 42.28	297 34 06.36	Loaf	4.1529589	14221.94	46659.8
d.m.	107 45 58.333	7226	175 31 23.93	355 30 52.83	Rincon	4.258833	18150.70	59549.4
			221 05 06.39	41 12 31.83	Gallinas	4.489019	30833.25	101,158.8
			209 46 29.5		Azimuth mark			
Tres Montosas 2., 1948	34 05 47.931	2600.3	90 11 11.77	270 00 55.90	Datil	4.4496533	28161.34	92,392.7
d.m.	107 27 39.735	8531	121 38 22.31	301 27 34.04	Rincon	4.5400564	34678.19	113,773.4
			161 24 22.45	341 21 30.36	Gallinas	4.3900998	24552.73	80,558.4
			33 57 45.6		Azimuth mark (BM L 41)			
110 Hanger, 1948, r. 1951	35 03 11.855	1628.19	215 56 52.56	36 01 39.60	Sandia	4.3322661	21491.47	70,509.9
d.m.	106 35 15.299	5341.8	278 27 00.02	98 29 47.22	Tijeras	3.8727631	7460.42	24,476.4
			339 45 56.27	159 48 09.60	Bernaval	4.2323748	17075.56	56,022.1
			30 38 58.44	210 37 36.43	Loudon	3.8515540	7104.83	23,309.8
City, 1948	34 35 53.737		137 47 50.81	317 47 33.30	Vaughn	3.0680462	1169.62	3837.3
d.m.	105 12 40.617		186 32 18.74	6 32 54.31	Leon	4.1453002	13973.34	45844.2
			211 10 55.26	31 16 21.03	Argonne	4.4484795	28085.33	92143.3
			227 53 07.13	47 58 56.68	Winkle	4.3238720	21080.07	69160.2
			137 47 50.81		Azimuth mark (Vaughn)			

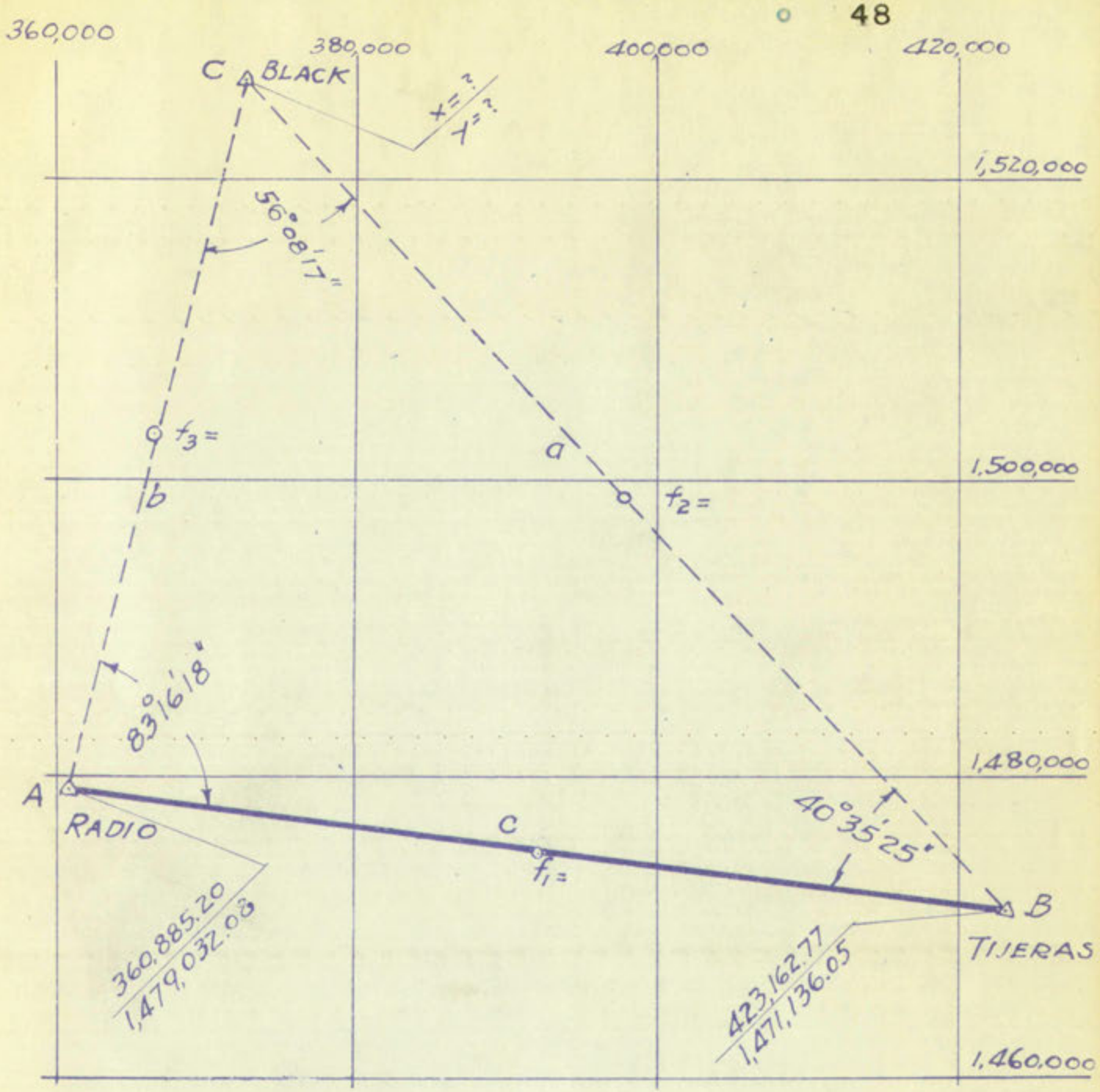
[1] No check on this position. Abbreviations used: d.=described; m.=marked; n.=not; r.=recovered; l.=lost; p.=probably. (Examples: n. d.=not described; p. l.=probably lost.)

The control stations shown in the preceeding pages have been established by the U. S. Coast and Geodetic Survey and other government and state agencies. The usual procedure used in establishing these stations is covered in quoted references. However, it is emphasized that the method is based upon geodetic surveying on the curved surface of the earth, establishing location of points by latitude and longitude. Once these points have been established, the plane coordinates are computed by formulae as outlined in references quoted previously.

CONTROL EXTENSION BY PLANE COORDINATES

It is believed that the hereinafter described method of control extension by triangulation, using plane coordinates, is sufficiently accurate for city and county surveying requirements up to approximately 10 mile length of lines.

The triangle chosen to demonstrate is Radio-Tijeras-Black as shown on Plate 2 and Figure 3. Black will be the unknown point for which plane coordinates are sought. The plane angles will be computed from data obtained in "Geographic Positions" and the plane coordinates of the three stations obtained from Table 1, Part II. While this triangle chosen has sides longer than the 10 miles, mentioned above, we must remember that the three stations are of first order and the accuracy obtained is not likely to hold for second and third order stations.



Given:- Coordinates of A & B; angles A, B & C.

Required:- GRID COORDINATES of POINT C.

CONTROL EXTENSION.

FIGURE 3. PLAT of COORDINATE CALCULATIONS

The steps in the development of the method are as follows:

1. Close between given coordinates of Radio and Tijeras, obtaining bearing and distance.
2. Compute plane angles of triangle by using azimuths as given in "Geographic Positions" and calculating spherical excess. (NOTE: Normally these angles will be observed in the field.)
3. Make a rough calculation of one side and calculate the x coordinate to nearest foot of point C (Black).
4. Compute the grid factors f_1, f_2, and f_3, for the three lines c, a, b.
5. Compute the sea level length of the base line c, i.e., Radio-Tijeras.
6. Compute the length of lines Radio-Black and Tijeras-Black by the law of sines, using sea level length of base.
7. Reduce the length of the two lines just computed to grid length.
8. Coordinate from points Radio and Tijeras to Black. The discrepancy between the coordinates obtained for Black from Radio and Tijeras compared with the actual coordinates as given

in Table 1, Part II, is an indication of the accuracy of the method.

NOTE: Steps 5, 6, and 7 may be consolidated into one operation by the use of the following formula:

$$\text{Length grid a} = \frac{(f_1)\ \text{length grid c}.\sin A}{(f_2).\sin C}$$

$$\text{Length grid b} = \frac{(f_1)\ \text{length grid c}.\sin B}{(f_3).\sin C}$$

where (f_1) = grid factor for line c
(f_2) = grid factor for line a
(f_3) = grid factor for line b.

1. Grid closure Radio to Tijeras.

	X	Y
Radio	360,885.20	1,479,032.08
Tijeras	423,162.77	1,471,136.05
	62,277.57	7,896.03

S 82°46'27" E

	62,277.57	4.7943317
	7,896.03	3.8974088
Sin		0.8969229
		0.0034630
log. grid dist. C		4.7977947

2. Compute angles of triangle.

Angle	Observed	Spherical Excess	Plane Angle
A	83°16'18:39	.24"	83°16'18:15
B	40°35'24:99	.24"	40°35'24:75
C	56°08'17:34	.24"	56°08'17:10
			180°00'00"

Spherical Excess: -(10)

$e = a_1 b_1 \text{SinCm}$

(for County)

m	1.40501 - 10
Sin 56°08'20"	9.91928 - 10
b_1 meters	4.17592
a_1 "	4.35955
e = 0.72"	9.85976 - 10

3. Calculate x coordinate of C to nearest foot.

$$a^1 = \frac{c\text{SinA}}{\text{SinC}}$$

	c	4.7977947
Sin 83°16'20"		9.9969991
Sin 56°08'20"		0.0807175
	a^1	4.8755113

			x	
N 42°11'00" W		4.7025606	423,163	
		9.8270493	- 50,415	
	a^1	4.8755113	372,748	approx x of C.

4. Compute grid factors (see Table 3, Part II).

a, for x = 397.955; f_2 = -382.5

b, for x = 366,817; f_3 = -345.3

c, for x = 392,024; f_1 = -376.3

5. Compute sea level length of base c.

grid c	4.7977947
+ f_1	0.0000376
log. sea level length of c	4.7978323

6. Compute sea level lengths of a and b.

$$a = \frac{c \sin A}{\sin C} \qquad b = \frac{c \sin B}{\sin C}$$

log.	a	4.8755525
log.	SinA	9.9969986
log sea level	c	4.7978323
colog.	Sin C	0.0807216
log.	Sin B	9.8133443
log.	b	4.6918982

7. Reduce sea level lengths to grid lengths.

sea level	a	4.8755525
factor	$-f_2$	0.0000383
grid	a	4.8755142
sea level	b	4.6918982
factor	$-f_3$	0.0000345
grid	b	4.6918637

8. Coordinate from Radio to Black to Tijeras and adjust to close triangle. Compare adjusted coordinate with actual coordinate as published.

		X	Y
A		360,885.20	1,479,032.08
N 13°57'15" E	4.0741431		
	9.3822794		
grid b	4.6918637	+ 11,861.60	+ 47,736.91
	9.9869906		
	4.6788543		
C		372,746.80	1,526,768.99
	4.7025681	- 0.03	- 0.17
S 42°11'02" E	9.8270539	372,746.77	1,526,768.82
grid a	4.8755142	+50,416.04	-55,632.50
	9.8698144		
	4.7453286		
B		423,162.84	1,471,136.49
		-0.07	-0.44
		423,162.77	1,471,136.05
		(423,162.77)	(1,471,136.05)

	X	Y
adjusted grid coordinates of C	372,746.77	1,526,768.82
grid coordinates C (Black) as published	372,747.03	1,526,768.82
discrepancy	- 0.26	0.00

7. Reduce sea level lengths to grid lengths.

sea level	S	
factor	-1	
grid	s	
sea level	b	
factor	-1	
grid	b	

8. Coordinate from basis to place to X, area and adjust to close triangle. Compare adjusted coordinate with natural coordinate as published.

		X	Y
A			
B 13°57'15" E			
grid b			
C			
B 48°11'02" E			
grid a			
B			
adjusted grid coordinates C (B1:C)			
grid coordinates C (B1:C) as published			
discrepancy			

STATION SIGNALS

This refers to that object at a station which is sighted at by observers at other stations. A satisfactory signal or target must be distinctly visible against any background and of suitable width for accurate bisection and, preferably, free from phase. When the face of a target is partially illuminated and partially in shadow, the observer usually sees only the illuminated portion, and thus makes an erroneous bisection, the apparent displacement of the center of the target being called phase. The target may be a permanent part of the station (such as a flagpole carried by an overhead construction so as to clear the instrument), or only brought into service when the station is not occupied (such as flagpoles, heliotropes or night signals).

Pole Signals. Round or square poles, painted black and white in alternate lengths, are frequently used for signals. Their diameter should be about 1½ inches for the first mile, increasing roughly as the square root of the distance.

Heliotropes. Any devise by which the rays of the sun may be reflected in a given direction is called a heliotrope, the essential features being a plane mirror and a line of sight. If the reflecting surface is of proper size, such a signal is entirely satisfactory for any distance from the smallest to the largest. A simple form of a home-made instrument is shown in Figure 4.

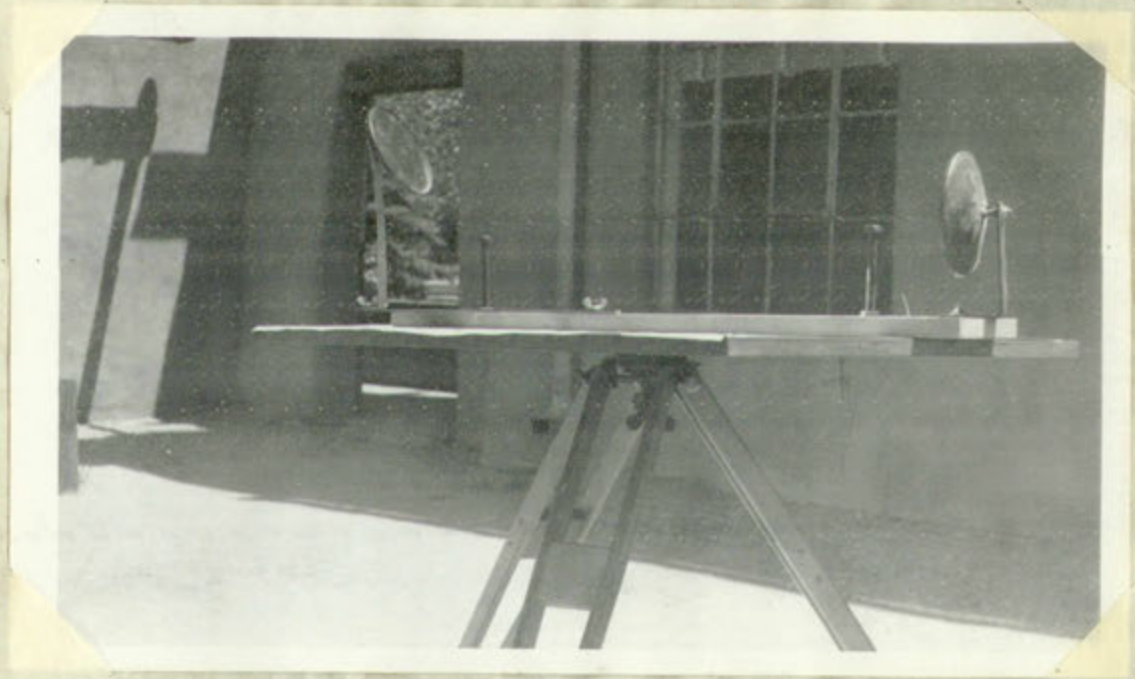
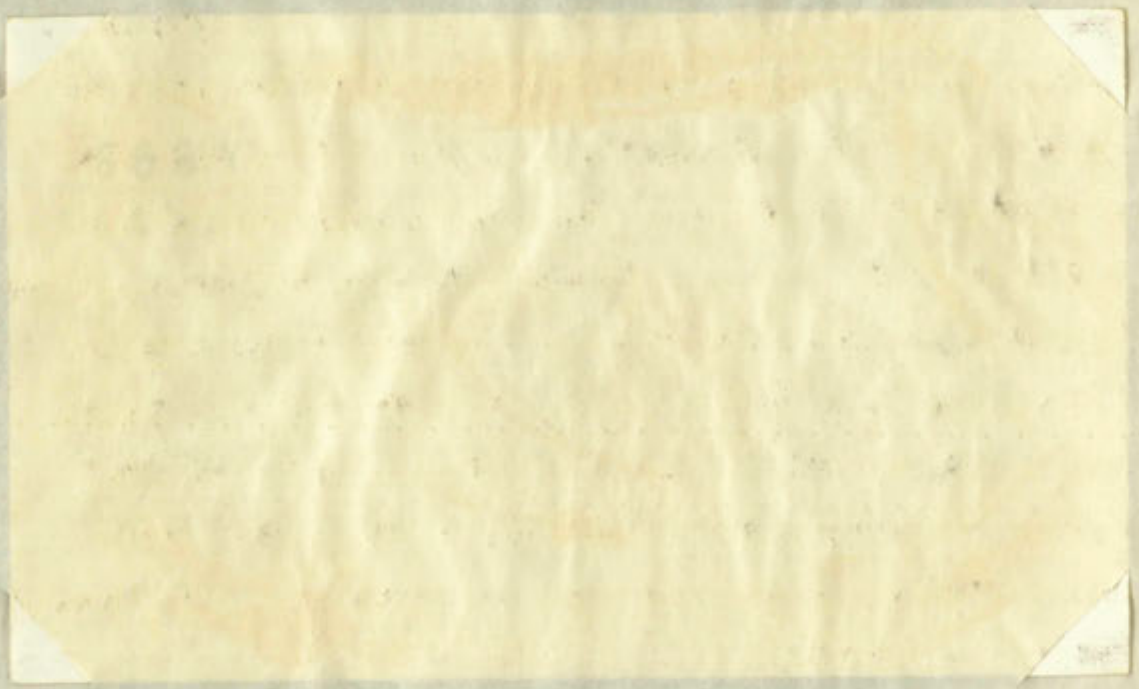


FIGURE 4.



In using the instrument, it is pointed toward the observation station by means of a small peep sight or telescope, and the mirror is turned so as to throw the shadow of the near vane centrally on the farther vane, an attendant moving the mirror slightly every few minutes as required. The cone of rays reflected by the mirror subtends an angle of about 32 minutes (the angular diameter of the sun as seen from the earth), or about 50 feet in width per mile. The light will, therefore, be seen at the observing station if the error of pointing is less than 16 minutes or about 25 feet per mile. The topographical features of the country generally enable the heliotroper to locate a station with this degree of approximation without other aid, though it is well to be provided with a pair of field glasses if the heliotrope has no telescope. When each station has a heliotrope, they soon find each other by swinging the rays around slowly until either catches the others light, when the two heliotropes are quickly centered on each other.

The best size mirror to use depends on the character of the observing instrument, the state of the atmosphere, and the distances between stations. If the light is too bright it is readily reduced by covering the mirror with a cardboard disc containing a suitable sized opening. A mirror whose diameter is proportioned at the rate of 0.2 inch per mile of distance will answer for average conditions of climate and instruments.

The apparent size of the heliotrope light varies remarkably with the time of day and the condition of the atmosphere, this phenomenon being an actual measurable fact and not an optical illusion. At sunrise and sunset the light appears as small as a star, almost covered by the vertical hair, and giving a perfect pointing. Anywhere within two hours of sunrise and sunset the image is circular, clean-cut, and readily bisected, the size of the image increasing rapidly with distance of the sun above the horizon. After the sun has risen a couple of hours above the horizon until noon the image gradually gets more and more irregular in outline and gains in size at an enormous rate, sometimes filling 25 per cent of the field of view of the telescope at noon. The image then decreases in size and gradually becomes more regular in outline, becoming fit to observe again about two hours before sunset. For the best class of work, the afternoon period is much the best, as great risk of sidewise (lateral) refraction always endangers the work of the morning period.

Night Signals. A great deal of geodetic work has been done at night, using an artificial light as a signal, aided by a lens or parabolic reflector. Up to midnight fully as good work can be done as in the day time, but the remainder of the night does not provide favorable atmospheric conditions for close work.

Plate 2 shows a suggested net of control extension for the vicinity of Albuquerque. Permanent signals have been built at some of these stations in cooperation with the Civil Engineering Department of the University of New Mexico. It is anticipated that the University will continue, as a future program, the accomplishment of this control in connection with the field and office studies of the students in the surveying classes.

It will be noted that this control net consists of three well proportioned quadrilaterals, all to be adjusted to the three first order established stations: Tijeras, Radio and Black. The stations for which plane coordinates are sought are Libra, Vulcan, Elena, U, and Rosemoon. The details on each of these stations follow:

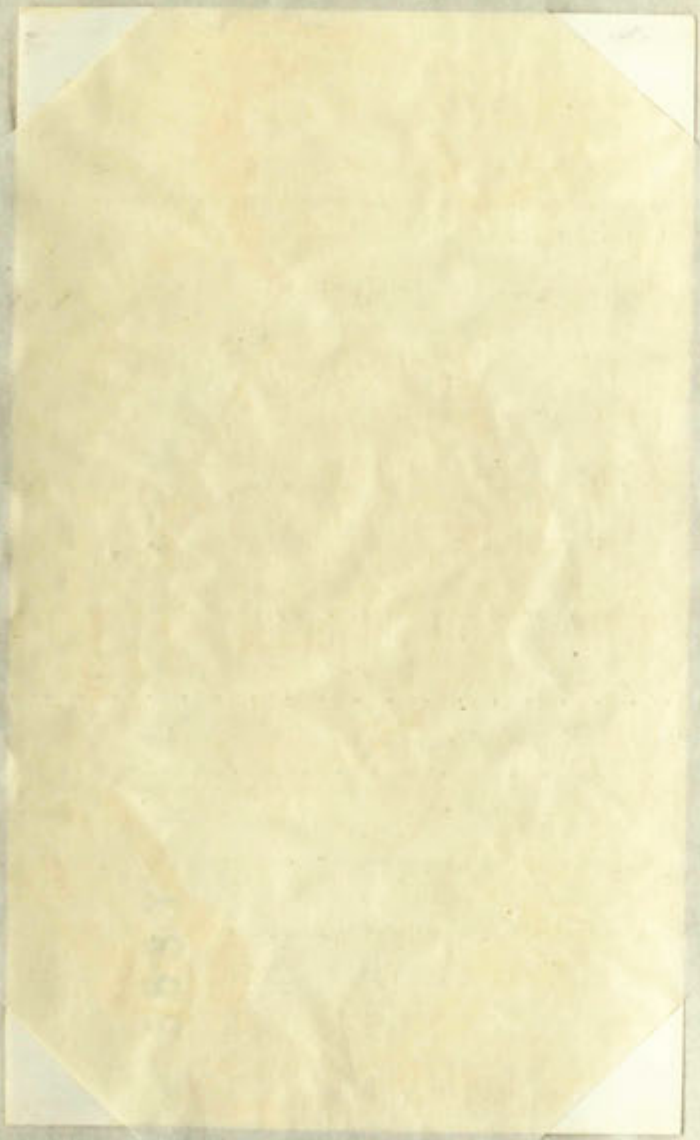
LIBRA - This station is located about 500 feet southwest of the triangulation station "University" on top and in the center of the 75-foot high University Library stack tower. Crosses have been cut on the top of the parapet wall at each corner on tangents through the station. The signal consists of a 3"x3"x11' hexagon pole, painted white, with a 14"x3/8" rod inserted in the top. Almost all the area in the vicinity of Albuquerque can be seen from this point. With permission of the Department of Civil Engineering and the University Librarian, access to this station is via a double trap in the roof. The traps should be slid to the north to avoid interference with the skylight.

VULCAN - The U. S. Forest Service in Albuquerque reports the following information on this station: The northmost of three rocky buttes on Mesa Prieta, about six miles northwest of Albuquerque, the highest point in the vicinity. The station can be reached from the junction of Laguna cutoff road (now highway 66) with the road north to the T.W.A. air port (now Cutter-Carr), then by dim road northwest over the mesa to the end of the right hand fork under the east face of the most northerly of the three highest volcances (the three rocky buttes referred to).

In 1905 the U. S. Geological Survey occupied the station and set an aluminum tablet in a large rock. In 1934 the U. S. Forest Service occupied the station and found the aluminum tablet gone but its shank still there--latitude 35°08'28".93; longitude 106°46'16".17.

ELENA - This station is a G.L.O. monument set in concrete, 14" above the surface, on the grant line of the Elena Gallegos Grant and the closing corner of sections 33 and 34, T 11 N -- R 4 E, New Mexico Principal Meridian. A permanent signal was erected at this station and is shown in Figure 5. To reach the station, go north from Menaul Boulevard on Wyoming Boulevard 1.7 miles to the fence line of the Elena Gallegos Grant, turn east and go 2 miles along the road by the fence to the station.

FIGURE 5.- STATION ELENA.



U - This station is marked by a cross on a large rock (a U. N. M. brass cap marker will be placed in this rock in the future) located on the high point of the hill on which the large white-washed "U" is located. The station is reached by going east on Central Avenue from Wyoming Boulevard 3.15 miles and taking the first road beyond Monte Cerro Road to the northeast. Follow this toward the large "U" to its base. Climb the hill on the south or southeast side. A permanent signal has been erected at this station (see Figure 6).

ROSEMOON - This station is located ½ mile east of Wyoming Boulevard on Constitution Avenue. It is located approximately 30 feet north and 30 feet west of a University of New Mexico brass cap monument 10" below the surface, being the accepted location of the center of section 17 T 10 N - R 4 E - NMPM. The station is marked by a 2"x2" stake, flush with the surface (a U. N. M. brass cap, in concrete, will be placed to mark this station in the future). A permanent signal has been erected at this station (see Figure 7).

FIGURE 6.- STATION U.

FIGURE 7.- STATION ROSEMOON.

REFERENCE

(1) The State Coordinate System, special publication No. 235, U. S. C. & G. S.

(2) Manual of Plane-Coordinate Computation, special publication No. 193, U. S. C. & G. S., 1935.

(3) Manual of Traverse Computations on the Transverse Mercator Grid, special publication No. 195, U. S. C. & G. S., 1935; 50¢.

(4) Manual of Geodetic Triangulation, special publication No. 247, 1950; $1.50.

(5) Triangulation in New Mexico (1927 Datum), special publication No. 219, U. S. C. & G. S.

(6) Description of Triangulations Stations, Chama to Belen, New Mexico, No. 900, pp. 11 to 20 incl., U. S. C. & G. S.

(7) Plane Coordinates, State of New Mexico, Chama to Belen, New Mexico, Transverse Mercator, Central Zone, pp. 18, 19, 21, 22, 23, 24, U.S. C. & G. S.

(8) Geographic Positions, 35th Parallel, State of New Mexico, pp. 12, 22; Chama to Belen, New Mexico, pp. 241, 242, 257, 256, 260, 261, 262, 263, 264, 266, U. S. C. & G. S.

(9) Tables for A Polyconic Projection of Maps and Lengths of Terrestrial Arcs of Meridian and Parallels, Sixth Edition, special publication No. 5, Coast and Geodetic Survey, 1935.

(10) Formulas and Tables for the Computations of Geodetic Position, Seventh Edition, special publication No. 8, U. S. C. & G. S., 1933.

(11) Manual of First-Order Leveling, special publication No. 140, U. S. C. & G. S., 1939.

(12) Natural Sines and Cosines to Eight Decimal Places, special publication No. 231, U. S. Dept. of Commerce, Coast and Geodetic Survey, 1942, price $1.75 (note: this price may have gone up since).

IMPORTANT!

Special care should be taken to prevent loss or damage of this volume. If lost or damaged, it must be paid for at the current rate of typing.


DIETER
BINDS
BETTER