NOAA Technical Memorandum NOS NGS 18

Determination of Astronomic Positions for California-Nevada Boundary Monuments Near Lake Tahoe

Rockville, Md.
March 1979

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Survey

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NOAA geodetic publications

Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys. Federal Geodetic Control Committee, John O. Phillips (Chairman), Department of Commerce, NOAA, NOS, 1974 reprinted annually, 12 pp (PB265442). National specifications and tables show the closures required and tolerances permitted for first-, second-, and third-order geodetic control surveys.

Specifications To Support Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys. Federal Geodetic Control Committee, John O. Phillips (Chairman), Department of Commerce, NOAA, NOS, 1975, reprinted annually 30 pp (PB261037). This publication provides the rationale behind the original publication, "Classification, Standards of Accuracy, ..." cited above.

NOAA Technical Memorandums, NOS/NGS subseries

NOS NGS-1 Use of climatological and meteorological data in the planning and execution of National Geodetic Survey field operations. Robert J. Leffler, December 1975, 30 pp (PB249677). Availability, pertinence, uses, and procedures for using climatological and meteorological data are discussed as applicable to NGS field operations.

NOS NGS-2 Final report on responses to geodetic data questionnaire. John F. Spencer, Jr., March 1976, 39 pp (PB254641). Responses (20%) to a geodetic data questionnaire, mailed to 36,000 U.S. land surveyors, are analyzed for projecting future geodetic data needs.

NOS NGS-3 Adjustment of geodetic field data using a sequential method. Marvin C. Whiting and Allen J. Pope, March 1976, 11 pp (PB253967). A sequential adjustment is adopted for use by NGS field parties.

NOS NGS-4 Reducing the profile of sparse symmetric matrices. Richard A. Snay, June 1976, 24 pp (PB-258476). An algorithm for improving the profile of a sparse symmetric matrix is introduced and tested against the widely used reverse Cuthill-McKee algorithm.

NOS NGS-5 National Geodetic Survey data: availability, explanation, and application. Joseph F. Dracup, June 1976, 45 pp (PB258475). The summary gives data and services available from from NGS, accuracy of surveys, and uses of specific data.

(Continued at end of publication)

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Determination of Astronomic Positions for California-Nevada Boundary Monuments Near Lake Tahoe

James E. Pettey

National Geodetic Survey
Rockville, Md.
March 1979

U.S. DEPARTMENT OF COMMERCE
Juanita M. Kreps

National Oceanic and Atmospheric Administration
Richard A. Frank, Administrator

National Ocean Survey
Allen L. Powell, Director

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DETERMINATION OF ASTRONOMIC POSITIONS FOR CALIFORNIA-NEVADA BOUNDARY MONUMENTS NEAR LAKE TAHOE

James E. Pettey
National Geodetic Survey
National Ocean Survey, NOAA
Rockville, Md. 20852

ABSTRACT. At the request of the California State Lands Commission, NOAA/National Ocean Survey's National Geodetic Survey (NGS) conducted astronomic observations at three California-Nevada boundary monuments near Lake Tahoe to verify the reported position of the 120th meridian, as given in U.S. Coast and Geodetic Survey Report for 1900, appendix no. 3. Results and documentation are provided.

INTRODUCTION

These results are published at the request of the California State Lands Commission (CSLC), which requested verification of the reported position of the 120th west meridian, as published by the U.S. Coast and Geodetic Survey (USC&GS) (predecessor agency of the National Ocean Survey) in their annual report for 1900, entitled Report for 1900, appendix no. 3 (Sinclair 1901).

Correspondence with the California State Lands Commission relative to their requested resurvey is documented in appendix A of this publication. As a result of discussions between F. D. Uzes, CSLC Senior Boundary Determination Officer, and Joseph F. Dracup, chief of NGS's Control Networks Division, three boundary monuments were selected for determination of astronomic positions. Two monuments are north of Lake Tahoe; one is south of Lake Tahoe. The two northern monuments, designated VON SCHMIDTS IRON MONUMENT 1893* and CALIFORNIA-NEVADA IRON MONUMENT 1897*, purportedly lie on the 120th meridian west of Greenwich. The southern monument, designated CALIF-NEV BOUNDARY MONUMENT NO.2 1894, lies on the oblique boundary running southeasterly from Lake Tahoe to the Colorado River. Appendix B shows station descriptions for the three monuments.

*NGS has continued the policy originated by the Coast Survey and later the Coast and Geodetic Survey to assign to a station name the year that the position of a point (monument) was first determined by us and not the year the point was set or stamped.

OBSERVATIONS

Latitude and longitude determinations were obtained at each boundary monument from observations taken on two nights by different observers using a Wild T-4 Universal theodolite and a Datametrics model SP-300 digital timing system. Astronomic observations were taken under the direction of Richard Maxey, chief of NGS Geodetic Field Party G-48.

Latitude determinations were observed by using a modified version of the Sterneck method. This method was applied using the specifications given in appendix C. Longitude determinations were made using the meridian transit method (Hoskinson and Duerksen 1947).

Time synchronization for the Datametrics timing system was maintained from radio signals transmitted by the National Bureau of Standards (NBS) Time Service Station (call letters WWV) located at Fort Collins, Colo.

Stellar positions taken from the Fourth Fundamental Catalogue (FK4) (Fricke and Kopff 1963) were used exclusively for reducing astronomic latitudes and longitudes. These positions, which were initially based on NBS Universal Coordinated Time (UTC) and referred to the instantaneous pole of epoch, were reduced to the Greenwich mean meridian by applying polar coordinates and time information published by the Bureau International de l'Heure (BIH) (Guinot and Feissel 1969). (A complete discussion of the BIH reference system can be found in the BIH Annual Report for 1968).

Table 1 summarizes the astronomic positions for the three boundary monuments.

Table 1.--Astronomic positions

Station	Latitude	$\hat{\sigma}$	Longitude	$\hat{\sigma}$
CALIFORNIA-NEVADA IRON MON.	39° 31' 27".00	±0".27	119° 59' 56".59	±0".28
VON SCHMIDTS IRON MON.	39° 13' 12".79	±0".28	120° 00' 15".49	±0".28
CALIF-NEV BOUNDARY MON. NO.2	38° 57' 37".75	±0".28	119° 56' 35".20	±0".28

The standard errors assigned to the astronomic positions are considered to be the most probable estimates of accuracy. These estimates, based on a general analysis of NGS astronomic observations, take into account an additional error component associated

Differences between the 1893 and the 1978 observations could be caused by procedural changes. These would include the following: (1) astronomic positions observed in 1893 were not reduced to a mean pole, (2) the star catalogs used were in a slightly different coordinate system, and (3) observation methods, reduction procedures, and instrumentation techniques were different. A detailed analysis of these differences is not part of this study. We feel that agreement, commensurate with the known differences in techniques, has been obtained between the 1893 and the 1978 astronomic positions.

REFERENCES

Fricke, W., and Kopff, A., 1963: Fourth Fundamental Catalogue (FK4). Verlag G. Braun, Karlsruhe, 144 p.

Guinot, B., and Feissel, M., 1969: Annual Report for 1968. Bureau International de l'Heure, Paris, 109 p.

Hoskinson, A. J., and Duerksen, J. A., 1947: Manual of geodetic astronomy, Special Publication No. 237. U.S. Coast and Geodetic Survey, Washington, D.C. (Available from National Technical Information Service, Springfield, VA 22151. Refer to accession no. PB267465.)

Schott, C. A., 1900: The transcontinental triangulation and the American arc of the parallel, Special Publication No. 4, part IV, The results of the astronomic determinations of longitude. U.S. Coast and Geodetic Survey, Washington, D.C. (out of print). (Publication may be viewed at NOAA/NOS National Geodetic Survey reference library, Rockville, Md.)

Sinclair, C. H., 1901: Report for 1900, appendix 3, Oblique boundary line between California and Nevada. U.S. Coast and Geodetic Survey, Washington, D.C., pp. 255-484 and eight maps in pocket insert (out of print). (Publication may be viewed at NOAA/NOS National Geodetic Survey reference library, Rockville, Md.)

APPENDIX A.--CORRESPONDENCE WITH CALIFORNIA STATE LANDS COMMISSION

STATE OF CALIFORNIA—STATE LANDS COMMISSION EDMUND G. BROWN JR., Governor

STATE LANDS COMMISSION
1807 13TH STREET
SACRAMENTO, CALIFORNIA 95814
(916) 322-3589

September 13, 1978

File Ref.: W 21362

Director Rear Admiral Allen L. Powell
National Ocean Survey
Rockville, MD 20800

Dear Admiral Powell:

You are of course aware of the California-Nevada border dispute, which is the subject of an action in the U. S. Supreme Court. Recently the validity of the oblique boundary as surveyed by the U.S.C. & G.S. in 1893-99 was challenged, and is now part of the lawsuit.

For the purpose of verifying the reported position of the 120th meridian as set forth in the Sinclair Report (Appendix No. 3, U.S.C. & G.S. Annual Report of 1900), it appears necessary to redetermine positions of astronomic latitude and longitude for two stations at Lake Tahoe, one at the North shore and one at the South shore.

From discussions with Mr. Joe Dracup, we understand your organization will soon have field parties with that capability in California. If so, it would be very helpful in our preparation for the suit if the needed astronomic work at Lake Tahoe could be performed by these personnel.

Thank you for any assistance you might be able to render.

Very truly yours,

F. D. Uzes

F. D. UZES
Senior Boundary
Determination Officer

FDU:gc

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

C11

SEP 28 1978

Mr. F. D. Uzes
Senior Boundary Determination
Officer
State Lands Commission
1307 13th Street
Sacramento, California 95814

Dear Mr. Uzes:

This is in reply to your letter of September 13, 1978, and subsequent telephone calls requesting astronomic observations at three points in the vicinity of Lake Tahoe.

We can arrange for one of our astronomic field parties to observe the astronomic latitude and longitude as requested. The astronomic party is presently located in Nevada and will be instructed to proceed to the vicinity of Lake Tahoe upon reaching a break point in their schedule. This should occur in the next few days, weather permitting.

Assuming that observing conditions will be favorable, we expect to complete the observations by November. The final values from office computations will be available approximately 90 days later since time corrections are delayed by 60 days.

Please let me know if you have any questions.

Sincerely,

(signed) GORDON LILL

for Allen L. Powell
Rear Admiral, NOAA
Director
National Ocean Survey

C11:J.Annis:38218:cms:9/25/78

FILE COPY

CODE	SURNAME	DATE	CODE	SURNAME	DATE
C11	[illegible]	[illegible]	C5	[illegible]	[illegible]
C121	[illegible]	9/25			
C1					

NOAA FORM 61-2

APPENDIX B.--STATION DESCRIPTIONS

RECOVERY NOTE, TRIANGULATION STATION Quad 391201 **R**

NAME OF STATION: CALIFORNIA-NEVADA IRON MONUMENT
ESTABLISHED BY: CHS YEAR: 1897 STATE: CA-NV BENCH MARK ALSO ☐
RECOVERED BY:* R.Maxey YEAR: 1978 COUNTY: Washoe,NV Sierra,CA
AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN: 1 mi W of Verdi
HEIGHT OF TELESCOPE ABOVE STATION MARK FEET. HEIGHT OF LIGHT ABOVE STATION MARK FEET.

DISTANCES AND DIRECTIONS TO AZIMUTH MARK, REFERENCE MARKS AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE GROUND AT THE STATION

OBJECT	BEARING	DISTANCE		DIRECTION
		FEET	METERS	° ′ ″

The station is located about one mile west of Verdi, Nevada, along the Nevada-California Stateline and on the south side of Dog Valley Road.

To reach the station from the Verdi Post Office, go west on old Highway 40 0.6 mile to a crossroad. Turn right and go north and west on Dog Valley Road 0.4 mile to bridge over Truckee River. Continue west 0.15 mile to a fork just after crossing a small bridge. Turn right and go north and west on paved road 0.4 mile to the station on the left.

The station is an iron monument 5-1/2 feet in height, 1 foot at the base and 6 inches at the top with the following raised letters: NEVADA on the east side, CALIFORNIA on the west side, LONGITUDE 120 WEST OF GREENWICH on the south side, OREGON 170 MILES 47 CHAINS on the north side, surrounded by a 6 foot by 4 foot chain link fence and directly in line of a north-south fenceline. It is 69 feet south of the center-line of paved road and 28 feet east-southeast of the most easterly one of three large trees which bears the sign IMMIGRANT TRAIL.

*Name of chief of party should be inserted here. The person who actually visited the station should sign his name at the end of the recovery note.

RM

NOAA FORM 76-96 (1-72) SUPERSEDES C&GS FORM 526A WHICH MAY BE USED. U.S. DEPARTMENT OF COMMERCE NOAA
☆ U. S. GOVERNMENT PRINTING OFFICE 1972: 780-439

FORM C&GS-525a
(12-68)

U.S. DEPARTMENT OF COMMERCE
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION
COAST AND GEODETIC SURVEY

Quad 391201

DESCRIPTION OF ASTRONOMICAL { LATITUDE / LONGITUDE / ~~AZIMUTH~~ } STATION

(Strike out as necessary)

CALIFORNIA-NEVADA IRON MONUMENT

NAME OF STATION:

STATE: CA-NV COUNTY: Washoe, Nev. Sierra, Cal.

CHIEF OF PARTY: R.Maxey YEAR: 1978 LOCALITY: 1 mi. W of Verdi

OBSERVER { LATITUDE: B.E.Kelly,R.Maxey / LONGITUDE: B.E.Kelly,R.Maxey / AZIMUTH:

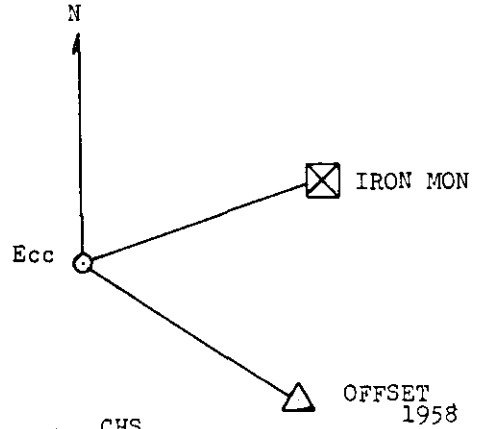
DETAILED DESCRIPTION:
(See triangulation station description files, card No. _____)

Ecc;

IRON MON
Dist: 23.470 m.
Angle: 71 02 '

OFFSET
Dist: 25.040 m
Angle: 123 20 '

SKETCH OF GEODETIC CONNECTION



Described by RM *Marked by* CHS

Note: The initial direction must be to a main scheme station.

(Over)

USCOMM-DC 36289-P68

U.S. DEPARTMENT OF COMMERCE
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION
COAST AND GEODETIC SURVEY

Quad 391202

FORM C&GS-525a
(12-65)

DESCRIPTION OF ASTRONOMICAL { LATITUDE / LONGITUDE / AZIMUTH } STATION

(Strike out as necessary)

VON SCHMIDTS

NAME OF STATION: IRON MONUMENT STATE: CA-NV COUNTY: Washoe, Nev. Eldorado,Cal.

CHIEF OF PARTY: R.Maxey YEAR: 1978 LOCALITY: Crystal Bay

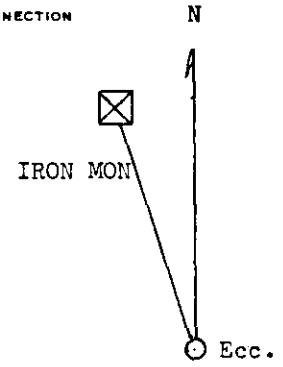
OBSERVER { LATITUDE: R.Maxey,B.E.Kelly / LONGITUDE: R.Maxey,B.E.Kelly / AZIMUTH: }

DETAILED DESCRIPTION:
(See triangulation station description files, card No. _____)

Ecc:

Dist: 10.276 m.
Angle: 344 23

SKETCH OF GEODETIC CONNECTION



Described by RM *Marked by* VS

Note: The initial direction must be to a main scheme station.

(Over)

USCOMM-DC 36289-P65

RECOVERY NOTE, TRIANGULATION STATION Quad 381194

R

NAME OF STATION: CALIF-NEV BOUNDARY MONUMENT NO.2
ESTABLISHED BY: CHS (USC&GS) YEAR: 1894 STATE: CA-NV BENCH MARK(S) ALSO ☐
RECOVERED BY: R.Maxey YEAR: 1978 COUNTY: Douglas,NV Eldorado,CA
AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN:
in S Lake Tahoe

Detailed statement as to the fitness of the original description; including marks found, stampings, changes made, and other pertinent facts:

The station is located on the Nevada-California Stateline, in the sidewalk corner of the northwest corner of the intersection of U.S Highway 50 and Stateline Road and at the southeast corner of Harvey's Hotel and Casino.

The station is a granite monument 4-1/2 feet in height, 1 foot at the base, 6 inches at the top with the imprinted letter C on the south side, N on the north side and a General Land Office brass disk stamped MON NO 2 embedded in the east side about 18 inches above the base. Monument is loose in its moorings.

RLS mark is a 2-inch disk stamped RLS 1633-LS 2990, flush with the surface of the sidewalk and 2 feet west of the monument.

FORM C&GS-526 (5-66)
USCOMM-DC 36496-P66

RM

U.S. DEPARTMENT OF COMMERCE
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION
COAST AND GEODETIC SURVEY

FORM C&GS-525a
(12-65)

U.S. DEPARTMENT OF COMMERCE
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION
COAST AND GEODETIC SURVEY

Quad 381194

DESCRIPTION OF ASTRONOMICAL { LATITUDE / LONGITUDE / [illegible] } STATION

(Strike out as necessary)

CALIF-NEV BOUNDARY
NAME OF STATION: MONUMENT NO.2 STATE: CA-NV COUNTY: Douglas,NV Eldorado,CA
CHIEF OF PARTY: R.Maxey YEAR: 1978 LOCALITY: in S Lake Tahoe

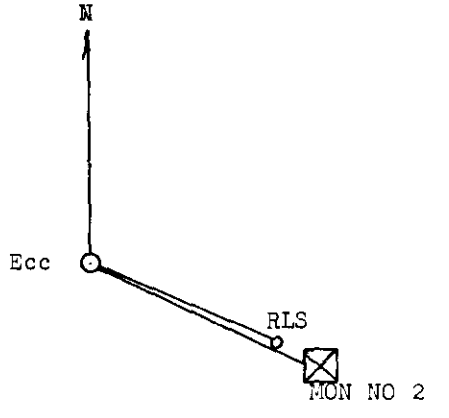
OBSERVER { LATITUDE: R.Maxey,B.E.Kelly / LONGITUDE: R.Maxey,B.E.Kelly / AZIMUTH:

DETAILED DESCRIPTION:
(See triangulation station description files, card No. _____)

Ecc:
MON NO 2
Dist: 73.533 m
Angle: 113 45

RLS 1633
Dist: 72.686 m.
Angle: 113 36

SKETCH OF GEODETIC CONNECTION



Described by RM Marked by CHS
Note: The initial direction must be to a main scheme station. (Over)
USCOMM-DC 36289-P65

APPENDIX C.--NGS APPLICATION OF STERNECK METHOD

LATITUDE INSTRUCTIONS
FOR
MODIFIED STERNECK METHOD

I. The purpose of these interim instructions is to provide observer guidelines that will insure uniformity of records and observations in the determination of latitude by the Sterneck method. At an appropriate time, definitive instructions, based on a careful analysis of observations obtained by the following specifications, will be issued.

The main distinction between latitude determinations made by the Horrebow-Talcott and Sterneck methods is one of differential zenith distances versus absolute zenith distances.

The simplicity of the Sterneck method is apparent from the generalized expression $\Phi = \delta \pm \zeta$, which states that the latitude of a station is provided from the meridian zenith distance (ζ) of a star of known declination (δ).

Modification of this method for NGS latitude determinations involves the replacement of a single meridian zenith distance measurement with two symmetrical circum-meridian zenith distances. The salient feature of this modification is the elimination of index error and consequently the zenith point correction.

Observations by this modified method may be obtained with either the Wild T-4 or Kern DKM 3A theodolites. For optimum precision the collimation level should have a sensitivity of $\leq$ 2 arc seconds per division.

II. Specifications

a) A latitude determination should, in general, depend on the observations of 32 stars evenly divided north and south of the zenith. In addition, star selection must be made such that the algebraic sum of the zenith distances is less than the total number of stars observed. This is equivalent to the condition that the mean declination be within 1° (degree) of the station latitude.

b) A latitude determination may be obtained in a single night provided a minimum of 26 star observations are obtained.

c) Suitable stars are to be taken from the Apparent Place of Fundamental Stars only. Generally, a computer generated list of candidate stars will be provided by NGS for this purpose.

d) The zenith distance of a star will be measured in both ocular positions. To allow sufficient time for instrument reversal, observations should be made approximately 10 arc minutes before and after stellar transit. This is equivalent to making the observations at the sixth and fourteenth wire with the Wild T-4 theodolite or fifth and fifteenth wire with the Kern theodolite. It is essential that the theodolite remain in the meridian, within limits specified below, while making these observations. The eyepiece is placed in the longitude position for this purpose.

e) Azimuth orientation of the theodolite with respect to the local meridian is to be $\leq$ 1 time second.

f) Preferably, zenith distances should be $\leq 35°$, but in no case will they exceed 45°.

g) Timing records are to be obtained for each observation by incorporating a momentary contact switch into the transit circuit of the digital recorder. The time event should be made by the observer at the instant of his stellar bisection.

h) All final motions of the theodolite's slow motion adjusting screws should be in the direction of spring compression.

i) Temperature and barometric reading should be carefully recorded at approximately 30-minute intervals, beginning immediately before and ending immediately after the observation program.

j) Periodic calibration of barometers and thermometers, not to exceed 120 days, are to be made at local (NWS) weather stations. For barometric comparisons, it is essential that correct terminology be used in requesting information from NWS personnel. By requesting "station pressure" you will be assured that the Weather Service pressure readings furnished <u>have</u> <u>not</u> been reduced to sea level.

k) Calibration of the collimation level should be made either before or after each observation program. This calibration is obtained by displacing the level at approximately two division intervals and recording the angular change of the vertical circle. Two traverses of the level bubble from end to end will constitute a calibration. Temperature and barometric pressure should be recorded at the time of calibration.

APPENDIX D.--ASTRONOMIC ABSTRACTS OF RESULTS FOR OBSERVED STATIONS

NOAA FORM 76-49 (11-77)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Quad. .....
State Calif-Nev. Border

Station: CALIFORNIA-NEVADA IRON MONUMENT 1897

ASTRONOMY, ABSTRACT OF RESULTS

LATITUDE

Station: CALIFORNIA-NEVADA IRON MONUMENT 1897 Chief of Party: R. Maxey

Observer: R.Maxey,B.Kelly Date: 16, 17 October 1978

	PRELIMINARY	FINAL		INSTRUMENT NO.	CHRONOMETER NO.
Mean Observed Latitude	39° 31′	26.88″ ±	0.08″	T-4 87024	D-254
Reduction to Sea Level (m.)					
Variation of Pole CIO 1968 BIH		-0.13″			
Eccentric Reduction--in Latitude		+0.25″			
Astronomic Latitude (ϕ_A)	39° 31′	27.00″ ±	0.08″		
Geodetic Latitude (ϕ_G)					
Deflection in the Meridian ($\phi_A - \phi_G$)					

No. of Observations: Accepted 49, Rejected 1

in Longitude -0.93″

VALUE OF 1/2 TURN OF MICROMETER ± ″

(λ_G) ± ″

Remarks: Coordinates of CIO Pole x= +0.267, y= +0.303

LONGITUDE

Station: CALIFORNIA-NEVADA IRON MONUMENT 1897 Chief of Party: R. Maxey

Observer: R.Maxey,B.Kelly Date: 16, 17 October 1978

	PRELIMINARY	FINAL		INSTRUMENT NO.	CHRONOMETER NO.
Mean Observed Longitude Time	07h 59m s	59.856s ±	0.007s	T-4 87024	D-254
Mean Observed Longitude Arc	119° 59′	57.84″ ±	0.10″	NO. OF SETS 6	
Eccentric Reduction--in Longitude		-0.93″		in Latitude +0.25″	
Variation of Pole CIO 1968 BIH		-0.32″			
Astronomic Longitude (λ_A)	119° 59′	56.59″ ±	0.10″	Cos ϕ .7714	
Geodetic Longitude (λ_G)				(ϕ_G)	
Deflection in Longitude ($\lambda_A - \lambda_G$)					
Deflection in Prime Vertical ($\lambda_A - \lambda_G$) Cos ϕ					

Remarks: Coordinates of CIO Pole x= +0.267, y= +0.303

AZIMUTH

Station: Mark:

Observer: Date:

Chief of Party: Instrument No.:

Mean Observed Azimuth ° ′ ″ ± ″

No. of Observations: Accepted, Rejected

Diurnal Aberration

Elevation of mark (m.) Sin ϕ Cos ϕ

Eccentricity (ϕ_G)

Variation of Pole (λ_G)

Astronomic Azimuth (α_A) ± ″ (α_G)

($\lambda_A - \lambda_G$) ($\lambda_A - \lambda_G$) Sin ϕ ($\alpha_A - \alpha_G$) Cot ϕ

Laplace Azimuth $-(\alpha_A - \alpha_G)$ Cot ϕ

Remarks: Coordinates of CIO Pole x= y=

ACCESSION NUMBERS 941 A 1978, A-5144

NOAA FORM 76-49 (11-77) U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Quad. .....
State Calif-Nev. Border

Station: VON SCHMIDTS IRON MONUMENT 1893

ASTRONOMY, ABSTRACT OF RESULTS

LATITUDE

Station VON SCHMIDTS IRON MONUMENT 1893 Chief of Party R. Maxey

Observer B.Kelly,R.Maxey Date 18, 19 October 1978

	PRELIMINARY	FINAL		INSTRUMENT NO.	CHRONOMETER NO.
Mean Observed Latitude	39° 13′ ″	12.59	± 0.08	T-4 87024	D-254

Reduction to Sea Level (m.) .....
Variation of Pole CIO 1968 BIH -0.12
Eccentric Reduction—in Latitude +0.32
No. of Observations: Accepted 47; Rejected 1
in Longitude +0.12
VALUE OF 1/2 TURN OF MICROMETER ± .....

Astronomic Latitude (ϕ_A)	39° 13′ ″	12.79	± 0.08
Geodetic Latitude (ϕ_G)			
Deflection in the Meridian ($\phi_A - \phi_G$)			

(λ_G) .....

Remarks: Coordinates of CIO Pole x= +0.267, y= +0.296

LONGITUDE

Station VON SCHMIDTS IRON MONUMENT 1893 Chief of Party R. Maxey

Observer B.Kelly,R.Maxey Date 18, 19 October 1978

		PRELIMINARY	FINAL		INSTRUMENT NO.	CHRONOMETER NO.
Mean Observed Longitude	Time	08h 00m s	01.045	± 0.006	T-4 87024	D-254
	Arc	120 00 ″	15.68	± 0.10	NO. OF SETS 6	

Eccentric Reduction—in Longitude +0.12 in Latitude +0.32
Variation of Pole CIO 1968 BIH -0.31

Astronomic Longitude (λ_A)	120° 00′ ″	15.49	± 0.10
Geodetic Longitude (λ_G)			
Deflection in Longitude ($\lambda_A - \lambda_G$)			
Deflection in Prime Vertical ($\lambda_A - \lambda_G$) Cos ϕ			

Cos ϕ .7747
(ϕ_G) .....

Remarks: Coordinates of CIO Pole x= +0.267, y= +0.296

AZIMUTH

Station ..... Mark .....
Observer ..... Date .....
Chief of Party ..... Instrument No. .....
Mean Observed Azimuth ..... ± .....
Diurnal Aberration .....
Elevation of mark (m.) .....
Eccentricity .....
Variation of Pole .....
Astronomic Azimuth (α_A) ..... ± .....
($\lambda_A - \lambda_G$) ..... ($\lambda_A - \lambda_G$) Sin ϕ .....
Laplace Azimuth .....

No. of Observations: Accepted ..... Rejected .....
Sin ϕ ..... Cos ϕ .....
(ϕ_G) .....
(λ_G) .....
(α_G) .....
($\alpha_A - \alpha_G$) ..... Cot ϕ .....
$-(\alpha_A - \alpha_G)$ Cot ϕ .....

Remarks: Coordinates of CIO Pole x= , y=

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NOAA FORM 76-49 (11-77) U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Quad.

State Calif.-Nev. Border

Station: CALIF-NEV BOUNDARY MONUMENT NO.2 1894

ASTRONOMY, ABSTRACT OF RESULTS

LATITUDE

Station CALIF-NEV BOUNDARY MONUMENT NO.2 1894 Chief of Party R. Maxey

Observer R.Maxey,B.Kelly Date 23, 24 October 1978

	PRELIMINARY	FINAL		INSTRUMENT NO.	CHRONOMETER NO.
Mean Observed Latitude	38° 57′ ″	38.82	± 0.08	T-4 87024	D-254
Reduction to Sea Level (m.)				No. of Observations Accepted	48
Variation of Pole CIO 1968 BIH		-0.11		Rejected	1
Eccentric Reduction—in Latitude		-0.96		in Longitude	-2.80
Astronomic Latitude (ϕ_A)	38° 57′ ″	37.75	± 0.08	VALUE OF 1/2 TURN OF MICROMETER	±
Geodetic Latitude (ϕ_G)					±
Deflection in the Meridian ($\phi_A - \phi_G$)				(λ_G)	

Remarks: Coordinates x= +0.268
of CIO Pole y= +0.278

LONGITUDE

Station CALIF-NEV BOUNDARY MONUMENT NO.2 1894 Chief of Party R. Maxey

Observer R.Maxey,B.Kelly Date 23, 24 October 1978

	PRELIMINARY	FINAL		INSTRUMENT NO.	CHRONOMETER NO.
Mean Observed Longitude Time	07h 59m s	46.553	± 0.005	T-4 87024	
Mean Observed Longitude Arc	119° 56′ ″	38.30	± 0.08	NO. OF SETS 6	
Eccentric Reduction—in Longitude		-2.80		in Latitude	-0.96
Variation of Pole CIO 1968 BIH		-0.30			
Astronomic Longitude (λ_A)	119° 56′ ″	35.20	± 0.08	Cos ϕ	.7775
Geodetic Longitude (λ_G)				(ϕ_G)	
Deflection in Longitude ($\lambda_A - \lambda_G$)					
Deflection in Prime Vertical ($\lambda_A - \lambda_G$) Cos ϕ					

Remarks: Coordinates x= +0.268
of CIO Pole y= +0.278

AZIMUTH

Station Mark

Observer Date

Chief of Party Instrument No.

Mean Observed Azimuth		No. of Observations	Accepted
Diurnal Aberration			Rejected
Elevation of mark (m.)		Sin ϕ	Cos ϕ
Eccentricity		(ϕ_G)	
Variation of Pole		(λ_G)	
Astronomic Azimuth (α_A)	±	(α_G)	
($\lambda_A - \lambda_G$)	($\lambda_A - \lambda_G$) Sin ϕ	($\alpha_A - \alpha_G$)	Cot ϕ
Laplace Azimuth		$-(\alpha_A - \alpha_G)$ Cot ϕ	

Remarks: Coordinates x=
of CIO Pole y=

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(Continued from inside front cover)

NOS NGS-6 Determination of North American Datum 1983 coordinates of map corners. T. Vincenty, October 1976, 8 pp (PB262442). Predictions of changes in coordinates of map corners are detailed.

NOS NGS-7 Recent elevation change in Southern California. S.R. Holdahl, February 1977, 19 pp (PB265-940). Velocities of elevation change were determined from Southern Calif. leveling data for 1906-62 and 1959-76 epochs.

NOS NGS-8 Establishment of calibration base lines. Joseph F. Dracup, Charles J. Fronczek, and Raymond W. Tomlinson, August 1977, 22 pp (PB277130). Specifications are given for establishing calibration base lines.

NOS NGS-9 National Geodetic Survey publications on surveying and geodesy 1976. September 1977, 17 pp (PB275181). Compilation lists publications authored by NGS staff in 1976, source availability for out-of-print Coast and Geodetic Survey publications, and subscription information on the Geodetic Control Data Automatic Mailing List.

NOS NGS-10 Use of calibration base lines. Charles J. Fronczek, December 1977, 38 pp (PB279574). Detailed explanation allows the user to evaluate electromagnetic distance measuring instruments.

NOS NGS-11 Applicability of array algebra. Richard A. Snay, February 1978, 22 pp (PB281196). Conditions required for the transformation from matrix equations into computationally more efficient array equations are considered.

NOS NGS-12 The TRAV-10 horizontal network adjustment program. Charles R. Schwarz, April 1978, 52 pp (PB283087). The design, objectives, and specifications of the horizontal control adjustment program are presented.

NOS NGS-13 Application of three-dimensional geodesy to adjustments of horizontal networks. T. Vincenty and B. R. Bowring, June 1978, 7 pp (PB286672). A method is given for adjusting measurements in three-dimensional space without reducing them to any computational surface.

NOS NGS-14 Solvability analysis of geodetic networks using logical geometry. Richard A. Snay, October 1978, 29 pp (PB291286). No algorithm based solely on logical geometry has been found that can unerringly distinguish between solvable and unsolvable horizontal networks. For leveling networks such an algorithm is well known.

NOS NGS-15 Goldstone validation survey - phase 1. William E. Carter and James E. Pettey, November 1978, 44 pp (PB292310). Results are given for a space system validation study conducted at the Goldstone, Calif., Deep Space Communication Complex.

NOS NGS-16 Determination of North American Datum 1983 coordinates of map corners (Second Prediction). T. Vincenty, April 1979, 6 pp. New predictions of changes in coordinates of map corners are given.

NOS NGS-17 The HAVAGO three-dimensional adjustment program. T. Vincenty, May 1979, 18 pp.

NOAA Technical Reports, NOS/NGS subseries

NOS 65 NGS 1 The statistics of residuals and the detection of outliers. Allen J. Pope, May 1976, 133 pp (PB258428). A criterion for rejection of bad geodetic data is derived on the basis of residuals from a simultaneous least-squares adjustment. Subroutine TAURE is included.

NOS 66 NGS 2 Effect of Geoceiver observations upon the classical triangulation network. R. E. Moose and S. W. Henriksen, June 1976, 65 pp (PB260921). The use of Geoceiver observations is investigated as a means of improving triangulation network adjustment results.

NOS 67 NGS 3 Algorithms for computing the geopotential using a simple-layer density model. Foster Morrison, March 1977, 41 pp (PB266967). Several algorithms are developed for computing with high accuracy the gravitational attraction of a simple-density layer at arbitrary altitudes. Computer program is included.

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(Continued)

NOS 68 NGS 4 Test results of first-order class III leveling. Charles T. Whalen and Emery Balazs, November 1976, 30 pp (GPO# 003-017-00393-1) (PB265421). Specifications for releveling the National vertical control net were tested and the results published.

NOS 70 NGS 5 Selenocentric geodetic reference system. Frederick J. Doyle, Atef A. Elassal, and James R. Lucas, February 1977, 53 pp (PB266046). Reference system was established by simultaneous adjustment of 1,233 metric-camera photographs of the lunar surface from which 2,662 terrain points were positioned.

NOS 71 NGS 6 Application of digital filtering to satellite geodesy. C. C. Goad, May 1977, 73 pp (PB-270192). Variations in the orbit of GEOS-3 were analyzed for M_2 tidal harmonic coefficient values which perturb the orbits of artificial satellites and the Moon.

NOS 72 NGS 7 Systems for the determination of polar motion. Soren W. Henriksen, May 1977, 55 pp (PB274698). Methods for determining polar motion are described and their advantages and disadvantages compared.

NOS 73 NGS 8 Control leveling. Charles T. Whalen, May 1978, 23 pp (GPO# 003-017-00422-8) (PB286838). The history of the National network of geodetic control, from its origin in 1878, is presented in addition to the latest observational and computational procedures.

NOS 74 NGS 9 Survey of the McDonald Observatory radial line scheme by relative lateration techniques. William E. Carter and T. Vincenty, June 1978, 33 pp (PB287427). Results of experimental application of the "ratio method" of electromagnetic distance measurements are given for high resolution crustal deformation studies in the vicinity of the McDonald Lunar Laser Ranging and Harvard Radio Astronomy Stations.

NOS 75 NGS 10 An algorithm to compute the eigenvectors of a symmetric matrix. E. Schmid, August 1978, 5 pp (PB287923). Method describes computations for eigenvalues and eigenvectors of a symmetric matrix.

NOS 76 NGS 11 The application of multiquadric equations and point mass anomaly models to crustal movement studies. Rolland L. Hardy, November 1978, 63 pp (PB293544). Multiquadric equations both harmonic and non-harmonic, are suitable as geometric prediction functions for surface deformation and have potentiality for usage in analysis of subsurface mass redistribution associated with crustal movements.

NOAA Manuals, NOS/NGS subseries

NOS NGS 1 Geodetic bench marks. Lt. Richard P. Floyd, September 1978, 56 pp. Reference guide provides specifications for highly stable bench marks, including chapters on installation procedures, vertical instability, and site selection considerations.

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