NOAA Technical Memorandum NOS NGS 32

REPORT OF SURVEY FOR McDONALD OBSERVATORY, HARVARD RADIO ASTRONOMY STATION, AND VICINITY

Rockville, Md.
May 1981

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

NOAA Technical Publications

National Ocean Survey/National Geodetic Survey subseries

The National Geodetic Survey (NGS) of the National Ocean Survey (NOS), NOAA, establishes and maintains the basic National horizontal and vertical networks of geodetic control and provides governmentwide leadership in the improvement of geodetic surveying methods and instrumentation, coordinates operations to assure network development, and provides specifications and criteria for survey operations by Federal, State, and other agencies.

NGS engages in research and development for the improvement of knowledge of the figure of the Earth and its gravity field, and has the responsibility to procure geodetic data from all sources, process these data, and make them generally available to users through a central data base.

NOAA Technical Memorandums and some special NOAA publications are sold by the National Technical Information Service (NTIS) in paper copy and microfiche. Orders should be directed to NTIS, 5285 Port Royal Road, Springfield, VA 22161 (telephone: 703-487-4650). NTIS customer charge accounts are invited; some commercial charge accounts are accepted. When ordering, give the NTIS accession number (which begins with PB) shown in parentheses in the following citations.

Paper copies of NOAA Technical Reports that are of general interest to the public are sold by the Superintendent of Documents, U.S. Government Printing Office (GPO), Washington, DC 20402 (telephone: 202-783-3238). For prompt service, please furnish the GPO stock number with your order. If a citation does not carry this number, then the publication is not sold by GPO. All NOAA Technical Reports may be purchased from NTIS in hard copy and microform. Prices for the same publication may vary between the two Government sales agents. Although both are nonprofit, GPO relies on some Federal support whereas NTIS is self-sustained.

An excellent reference source for Government publications is the National Depository Library program, a network of about 1,300 designated libraries. Requests for borrowing Depository Library material may be made through your local library. A free listing of libraries currently in this system is available from the Library Division, U.S. Government Printing Office, 5236 Eisenhower Ave., Alexandria, VA 22304 (telephone: 703-557-9013).

NOAA geodetic publications

Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys, 1974, reprinted 1980, 12 pp., and Specifications To Support Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys, revised 1980, 51 pp. Geodetic Control Committee, Department of Commerce, NOAA, NOS. (GPO Stock no. 003-017-00492-94, $3.75 set.)

Proceedings of the Second International Symposium on Problems Related to the Redefinition of North American Geodetic Networks. Sponsored by U.S. Department of Commerce; Department of Energy, Mines and Resources (Canada); and Danish Geodetic Institute; Arlington, Va., 1978, 658 pp (GPO #003-017-0426-1).

NOAA Professional Paper 12, A priori prediction of roundoff error accumulation in the solution of a super-large geodetic normal equation system, by Meissl, P., 1980, 139 pp. (GPO #003-017-00493-7, $5.00 for domestic mail, $6.25 for foreign mail.)

NOAA Technical Memorandums, NOS/NGS subseries

NOS NGS-1 Leffler, R. J., Use of climatological and meteorological data in the planning and execution of National Geodetic Survey field operations, 1975, 30 pp (PB249677).

NOS NGS-2 Spencer, J. F., Jr., Final report on responses to geodetic data questionnaire, 1976, 39 pp (PB254641).

NOS NGS-3 Whiting, M. C., and Pope, A. J., Adjustment of geodetic field data using a sequential method, 1976, 11 pp (PB253967).

NOS NGS-4 Snay, R. A., Reducing the profile of sparse symmetric matrices, 1976, 24 pp (PB258476).

NOS NGS-5 Dracup, J. F., National Geodetic Survey data: availability, explanation, and application, Revised 1979, 45 pp (PB80 118615).

NOS NGS-6 Vincenty, T., Determination of North American Datum 1983 coordinates of map corners, 1976, 8 pp (PB262442).

NOS NGS-7 Holdahl, S. R., Recent elevation change in Southern California, 1977, 19 pp (PB265940).

NOS NGS-8 Dracup, J. F., Fronczek, C. J., and Tomlinson, R. W., Establishment of calibration base lines, 1977, 22 pp (PB277130).

NOS NGS-9 NGS staff, National Geodetic Survey publications on surveying and geodesy 1976, 1977, 17 pp (PB275181).

(Continued at end of publication)

NOAA Technical Memorandum NOS NGS 32

REPORT OF SURVEY FOR McDONALD OBSERVATORY, HARVARD RADIO ASTRONOMY STATION, AND VICINITY

William E. Carter and
James E. Pettey

National Geodetic Survey
Rockville, Md.
May 1981

UNITED STATES
DEPARTMENT OF COMMERCE
Malcolm Baldrige, Secretary

National Oceanic and
Atmospheric Administration
James P. Walsh, Acting Administrator

National Ocean
Survey
Herbert R. Lippold, Jr., Director

CONTENTS

REPORT OF SURVEY FOR McDONALD OBSERVATORY, HARVARD RADIO ASTRONOMY STATION, AND VICINITY

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

ABSTRACT. A special purpose three-dimensional geodetic survey was conducted in the vicinity of the McDonald Observatory and Harvard Radio Astronomy Station (HRAS) near Ft. Davis, Texas. The observing program included astronomic positions and azimuths, zenith distances, electromagnetic distance measurements, leveling, gravity measurements, Doppler satellite positioning, and a variety of ancillary measurements. Particular care was taken in designing the survey to ensure the vectors connecting the reference points of the McDonald lunar laser ranging system, HRAS very long base line interferometry, and the mobile laser ranging system were determined to uncertainties of a few centimeters (3-5 cm). This report contains descriptive information on the methods employed in the collection, reduction, and analysis of the survey data, tabulations of the observational data, and numerical and interpretive results of our analysis. Particularly significant are the excellent results attained in the zenith distance measurements that enabled us to determine the vertical components of the longest vectors (about 8 km) with estimated accuracies of 2 to 4 cm.

INTRODUCTION

During the period from January to May 1980, the National Ocean Survey/ National Geodetic Survey (NOS/NGS) performed several special purpose surveys in the vicinity of the University of Texas McDonald Observatory and the Harvard Radio Astronomy Station (HRAS), which are located near the small town of Ft. Davis, Texas. The surveys were part of a cooperative program by NGS and the National Aeronautics and Space Administration (NASA) to validate and compare advanced geodetic surveying systems (i.e., Satellite Laser Ranging (SLR), Lunar Laser Ranging (LURE), Very Long Base Line Interferometry (VLBI) and Doppler satellite observations), and to monitor the stability of the area on local and regional scales. The surveys were funded jointly by NGS and

NASA. A report on one particular aspect of this work, the establishment of a radial-line relative lateration scheme to monitor regional stability, was published earlier (Carter and Vincenty 1978).

This report presents the results of the surveys conducted to relate the McDonald LURE, HRAS VLBI, McDonald MOBLAS, McDonald and HRAS Doppler reference marks, and several other points of interest within the immediate area, to one another in a well-defined frame of reference. The individual surveys were designed such that, taken in combination, they yield a highly accurate three-dimensional network. Uncertainties in the components of the vectors connecting the primary points are no more than a few centimeters (3-5 cm).

DESCRIPTION OF THE PRIMARY SURVEY NETWORK

A small-scale plan view of the primary survey network is shown in figure 1. The network was designed to relate the McDonald Observatory and HRAS complexes to prominent topographical features in the local setting, and to provide a high accuracy tie between the two complexes. The triangle formed by stations McDONALD RM 4, McIVOR, and HARVARD is particularly significant because it effectively controls the accuracy of the intercomplex vectors.

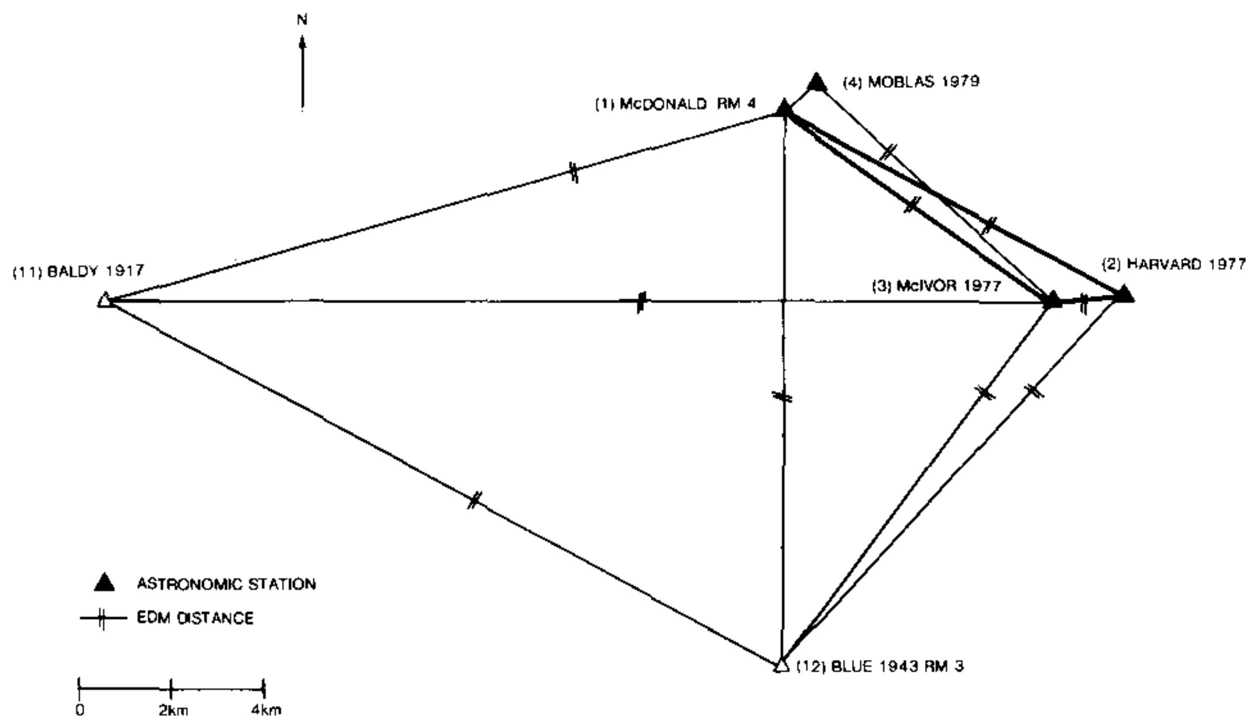


Figure 1.--Plan view of primary survey network.

Figure 2 is an enlarged plan view of the survey scheme in the McDonald Observatory complex and the immediate vicinity. The McDonald Observatory 107-inch telescope has been used regularly since 1969 for LURE observations. Station MCDONALD 107 is located inside the observatory beneath the floor of the telescope room. It is the nearest monumented survey point to the LURE reference point, which is the intersection of the telescope polar axis and the plane which contains the declination axis. The offsets used to relate the LURE reference point to station MCDONALD 107 were measured by personnel of the University of Texas. Appendix A contains a copy of a letter from Dr. Eric C. Silverberg with the results.

As part of the intercomparison and validation studies, NASA constructed a facility for use by mobile SLR and VLBI systems on a slightly lower prominence, about 1 km from the main McDonald Observatory complex. This "pad" was not

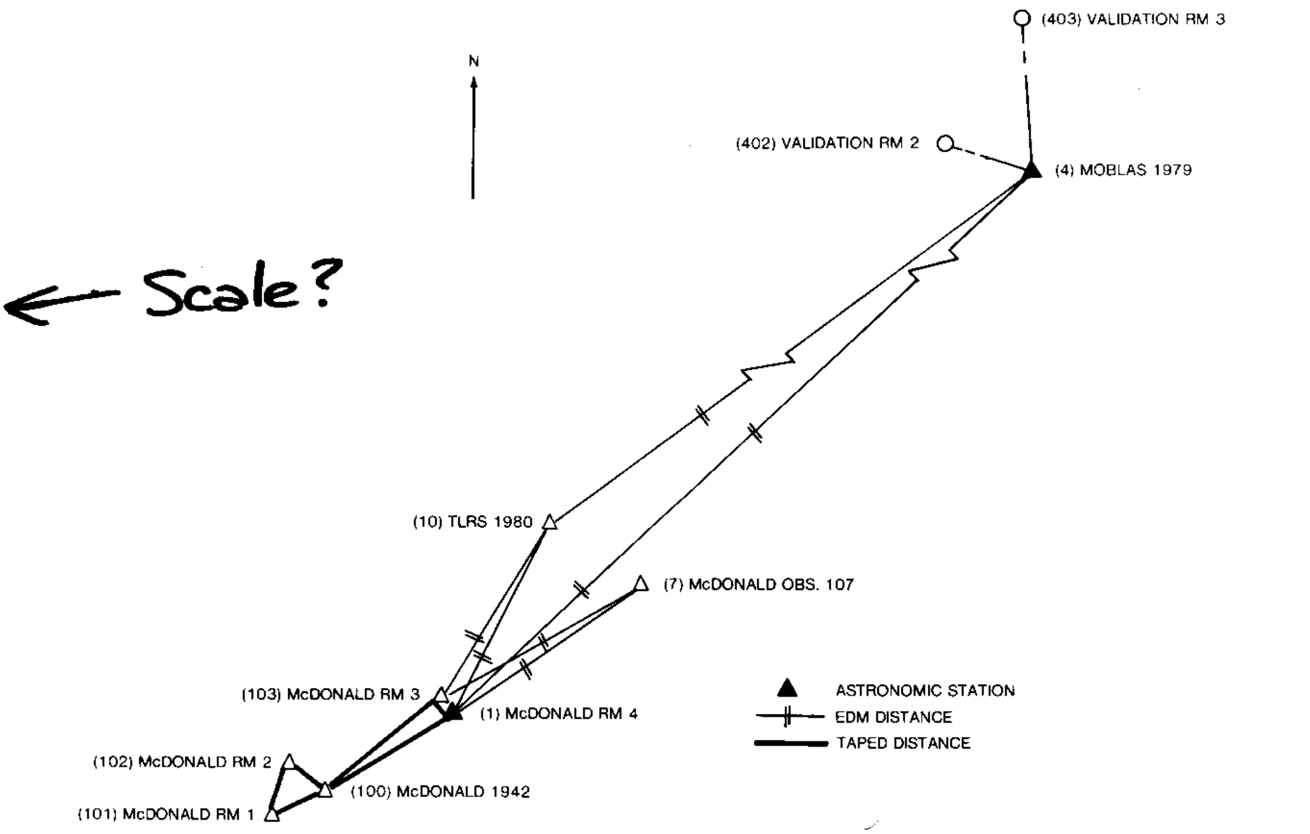


Figure 2.--Plan view of survey scheme at McDonald Observatory complex and immediate vicinity.

installed until after the primary survey in 1977. Thus, it was connected to the main scheme by later surveys, first by a NASA Goddard Space Flight Center (GSFC) survey team and then by NGS teams. The primary monumented survey station is MOBLAS, which was installed by a NASA/GSFC contractor.

Although the MOBLAS pad had not been built at the time of the 1977 NGS survey, the location had been tentatively selected and NGS teams installed three bench marks near the site, connecting them to the level line leading to the McDonald Observatory. It was our understanding that the primary station would be designated VALIDATION; so the NGS marks were designated VALIDATION RM 1, RM 2, and RM 3. Two of these marks have been tied to MOBLAS and serve as reference marks to that station.

Station TLRS marks the site used for testing the Transportable Laser Ranging System (TLRS) being developed by the University of Texas for NASA.

Figure 3 is an enlarged plan view of the survey scheme in the HRAS complex. The NGS and NASA have jointly equipped the HRAS 85-foot radio telescope with a

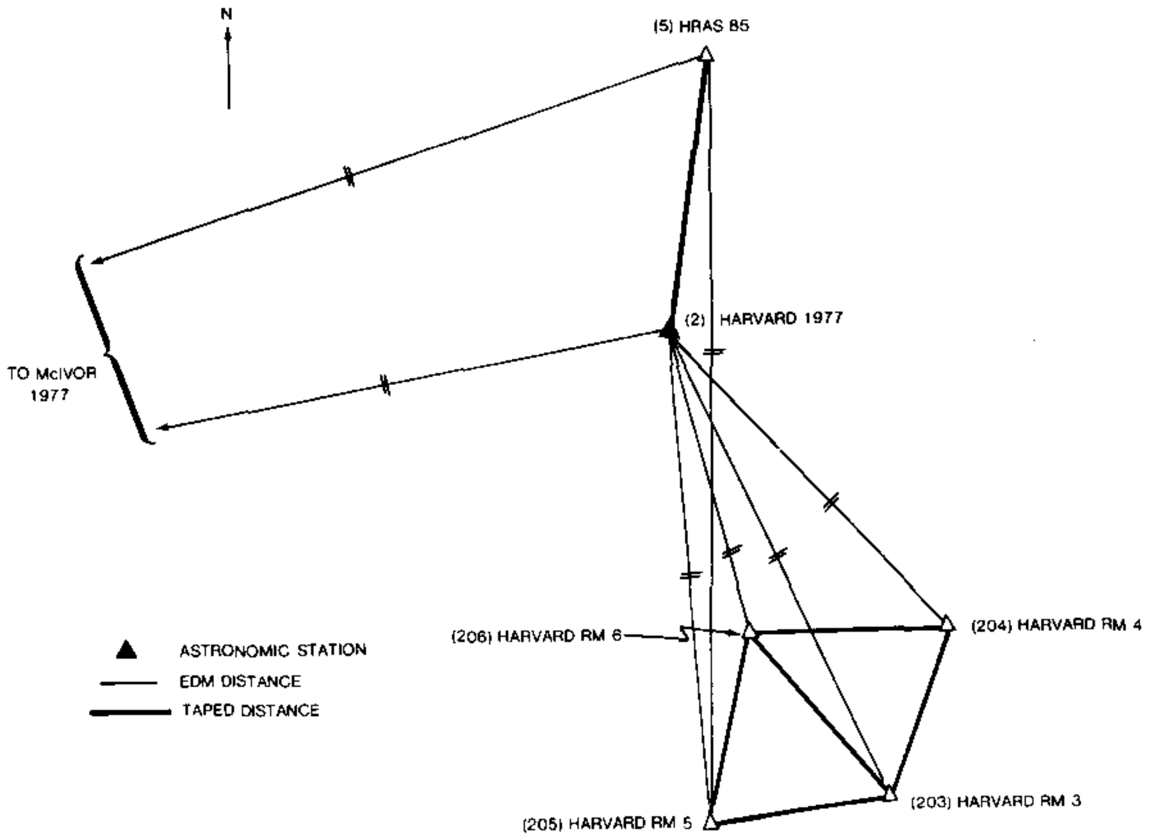


Figure 3.--Plan view of survey scheme at the Harvard Radio Astronomy Station.

Mark III VLBI data acquisition system. It is intended that HRAS will be a "permanent" component of the POLARIS network (Carter et al. 1979b) and a base station in the National Crustal Motion Network (NCMN) being established by NGS and NASA. The primary survey station, HARVARD, was established by NGS during the 1977 survey. In 1980 a special survey was performed to tie the VLBI reference point to the network. At that time, station HRAS 85 was established directly under the telescope, and the offsets from this monument to the VLBI reference point, i.e., the intersection of the polar axis of the telescope and the plane containing the declination axis, were measured. (See fig. 4.) Gravity and satellite Doppler observations have also been made at several points within the HRAS complex.

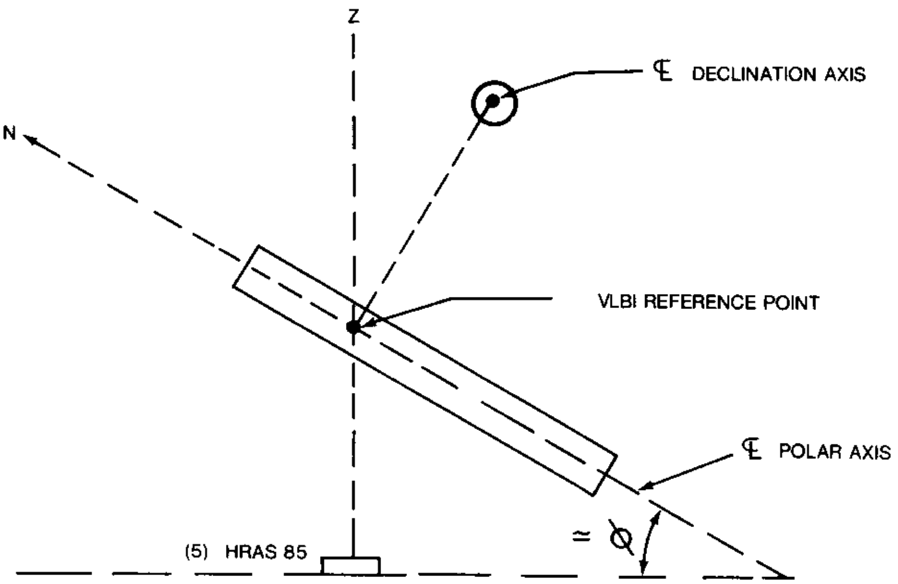


Figure 4.--Schematic showing HRAS VLBI reference point.

OBSERVATIONAL PROGRAMS

To attain the highest possible accuracy, redundancy and multiplicity of measurements were employed. Instruments of various types from several manufacturers were used to minimize systematic instrumental errors. Whenever practical, measurements were made by more than one observer to minimize personal biases and to discover blunders. The observing periods were also scheduled to minimize the effects of time-dependent atmospheric anomalies.

Astronomic Observations

The stations at which astronomic positions were determined were selected to achieve the highest accuracy measurements of the vectors between points in the McDonald and HRAS complexes, within such practical constraints as ease of access and total resources to be invested. The astronomic latitude and longitude were determined at stations HARVARD, McIVOR, McDONALD RM 4, and MOBLAS. Astronomic azimuths were observed from stations HARVARD, McIVOR, and McDONALD RM 4. All of the astronomic observations were reduced using star positions from the Fourth Fundamental Catalogue (FK 4) (Fricke et al. 1963). The longitude determinations were made by the meridian transit method (Hoskinson and Duerksen 1947), the latitude by the absolute zenith distance method, after Sterneck (Muller 1973), and the azimuths by the direction method (Hoskinson and Duerksen 1947) using α Ursae Minoris (Polaris) at any hour angle. The reduced observations were referenced to the Conventional International Origin (CIO) and to the Origin of Longitude using polar coordinates and time information published by the Bureau International de l'heure (1968 system).

The uncertainties assigned to the astronomic quantities were based on the Analysis of Variance studies reported in Pettey and Carter (1978). With the observers, instruments, procedures, and numbers of observations used in this survey it is highly unlikely that errors in the astronomic latitudes and longitudes could cause errors in the interstation vectors of more than 1 or 2 parts in 10^6 (less than 2 cm). The azimuth uncertainties could be much larger, perhaps 5 to 10 parts in 10^6. Our analyses and conclusions concerning the azimuth measurements are summarized under Analysis and Interpretation.

Zenith Distance Observations

In addition to the reciprocal zenith distance measurements made during many of the Electromagnetic Distance Measurement (EDM) observing periods to determine the coefficient of refraction, as discussed in Carter and Vincenty (1978: appendix C), zenith distance observations were also observed expressly for the purpose of determining the vertical components of the vectors connecting stations HARVARD, McIVOR, and McDONALD RM 4. These zenith distances were observed following procedures analogous to horizontal angulation or azimuth determinations, i.e., 16 positions of direct and reverse pointings. In fact, several of the zenith distance and azimuth determinations were made with interleaved observing routines--alternating zenith distance and azimuth rounds. The observations were conducted during several different periods. Most were performed by two observers from NGS astronomic survey party G-48, using a Wild T-4 or Kern DKM3-A theodolite. A third observer also observed from each end of the line between McDonald RM 4 and HARVARD with a Wild T-3 theodolite. Temperature and barometric pressure were measured at both ends of the lines to allow corrections for computing atmospheric refraction.

The NGS has had only limited experience in highly accurate zenith distance measurements. In fact, geodesists have generally shunned the use of zenith distance measurements because they believe the effects of unpredictable refraction severely limit the attainable accuracy. However, Heiskanen and Moritz (1967) suggested that an accuracy of ±1" (second of arc) in the measurement of zenith distances might be achieved in mountainous areas. For the HRAS-McDonald intercomplex vectors, a 1" uncertainty in the zenith distance is equivalent to about $(\pm 5 \times 10^{-6})$ $(8 \times 10^{5}) \approx \pm 4$ cm in the vertical component. Our analyses and conclusions concerning the zenith distance measurements are summarized under Analysis and Interpretation.

Electromagnetic Distance Measurements

A very extensive program of Electromagnetic Distance Measurements (EDM) was executed for this project. The individual measurements are tabulated under the heading "Absolute Distances" in appendix D. Special efforts were made to minimize any scale bias by measuring the lines during daylight and darkness, measuring from both ends of the lines, and using a selection of different instruments. Plans to measure the three sides of the McDONALD RM 4-McIVOR-HARVARD triangle using a multicolor EDM instrument have not yet come to fruition, so we do not presently have an independent verification of the scale. Based on experience, we would expect the scale bias to be less than 1 or 2 parts in 10^{6} (less than 2 cm for the HRAS-McDonald intercomplex vectors).

Leveling

Leveling surveys were conducted for two purposes: to establish initial epoch elevations for the McDonald Observatory and HRAS complexes for vertical stability studies, and to obtain differences in heights between the various points of interest in the complexes.

Figure 5 shows the route of leveling conducted in conjunction with the primary survey in 1977. The main line originates several kilometers south of the city of Alpine, in an area where rock outcrops facilitate the setting of stable reference marks, and follows the route of a previously established level line northwest along Highway 118 to Ft. Davis. Just north of Ft. Davis, the existing level line continued northerly along Highway 17. The 1977 level line follows Highway 118 toward HRAS and McDonald Observatory. Some additional leveling was performed during May 1980 to tie in additional points (most notably, station McIVOR) and to resolve some discrepancies and ambiguities detected during the three-dimensional adjustment. Appendix B contains the survey adjustment performed by the NGS Vertical Network Branch.

Leveling suffers certain incongruities relative to the determination of interstation vectors. The leveling process does not yield purely geometric quantities, but rather "geopotential height differences," which can only be converted to geometric quantities to the extent that the true nature of the Earth's gravitational field is known within the survey area. Even if surface gravity values are measured over the entire course of a level line, as they were for this survey, the so-called "true orthometric" height obtained is still dependent upon assumptions about the subsurface gravity field. For a detailed discussion of the definitions of height systems and estimates of the uncertainties attendant to the assumed gravitational models, see Heiskanen and Moritz (1967). Staying within the realm of "reasonable" gravity field models for the rugged mountainous terrain in west Texas, the errors in the vertical components of vectors between the McDonald Observatory and HRAS complexes derived from leveling could be several centimeters.

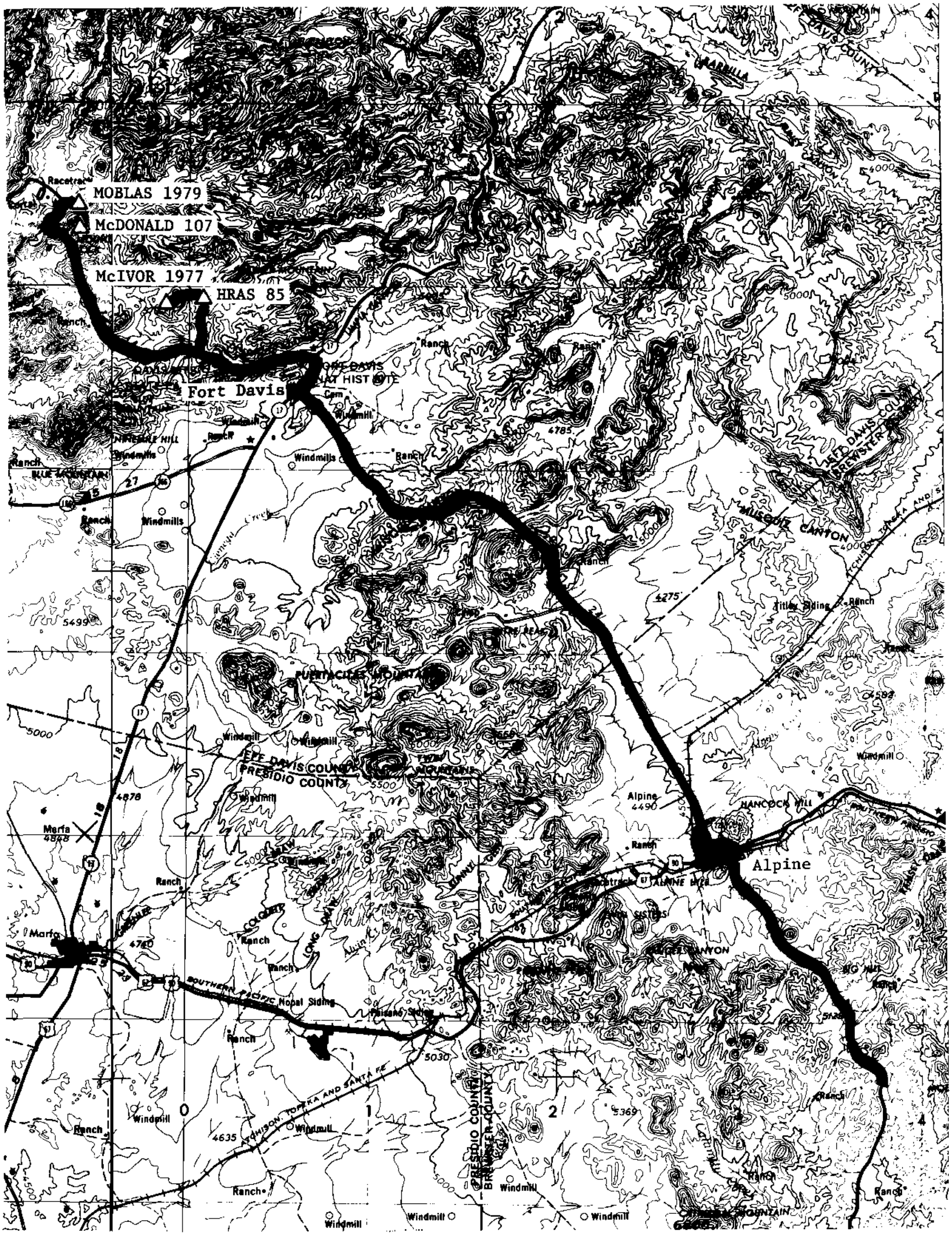


Figure 5.--Route of first-order leveling connecting Harvard and McDonald Observatories to the National Geodetic Vertical Datum.

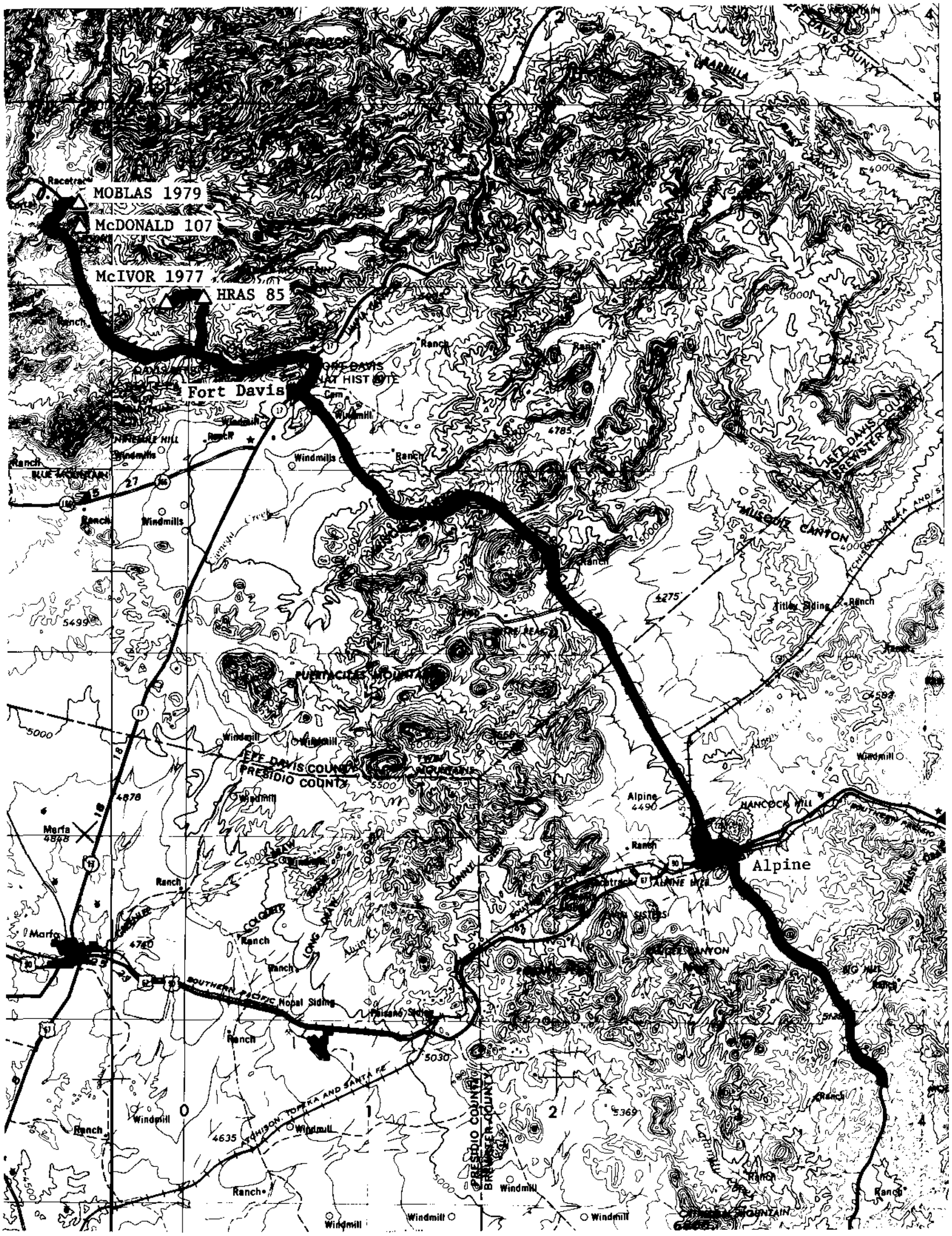


Figure 5.--Route of first-order leveling connecting Harvard and McDonald Observatories to the National Geodetic Vertical Datum.

Gravity

An exceptionally comprehensive program of initial epoch observations and long-term monitoring of gravity has been designed for the region encompassing McDonald Observatory and HRAS. The intent is to amass a gravity data set to support the global, regional, and local scale geodetic and geodynamic programs planned for the area.

On a global scale, geodesists have been investigating the feasibility of establishing a network of absolute gravity observatories to monitor motions of the geocenter (center of mass of the Earth) within the physical body. It would be desirable to locate at least some subset of the gravity observatories at high resolution space geodesy stations. The absolute value of gravity has been measured at two points within the immediate McDonald Observatory complex by two different research groups using two independently developed instruments. The stations are designated McDONALD AA and McDONALD AB. Appendix C contains reproductions of the station descriptions. The first measurement was made at station McDONALD AA in July 1979 by the Air Force Geophysics Laboratory using the "Faller-Hammond" instrument. The second measurement was made at station McDONALD AB in June 1980 by researchers from the Instituto di Metrologia "G. Colonnetti" (IMGC). This survey was jointly sponsored by the Air Force Geophysics Laboratory (AFGL), the Defense Mapping Agency (DMA), the U.S. Geological Survey (USGS), and NGS. The two absolute stations were tied together and to the surrounding gravity network by NGS using LaCoste and Romberg model D gravimeters.

Both of the absolute gravimeters used at McDonald are "developmental" instruments with limited historical records to document their accuracies. In fact, the primary motivation for sponsoring the measurement by IMGC was to obtain an independent check on the measurement made by AFGL. While both systems generally yield formal standard errors of approximately 8 to 20 μgal, there have been discrepancies as large as 60 to 80 μgals which have not been satisfactorily explained. At this time, it seems fair to say that the accuracies are probably a few tens of microgalS.

On a regional scale, the U.S. National Gravity Base Network has been densified by adding several base stations, including stations at Alpine, Ft. Davis, and McDonald Observatory. (See fig. 6.) The new stations were established with multiple ties using four LaCoste and Romberg model G gravimeters, following the most stringent NGS gravity survey procedures. The relative accuracy is estimated to be approximately 20 to 25 μgal.

On the local scale, gravity measurements have been made along the primary level lines. (See fig. 5.) An area survey extending several kilometers in all directions from the McDonald Observatory and HRAS has been planned. The measurements along the level lines were accomplished with two or more meters and care was exercised to attain the highest accuracy. Copies of the input and output portions of the adjustment of the gravity measurements performed by the NGS Gravity and Astronomy Section are presented in appendix C. The relative accuracy of the point values is estimated to be 20 to 40 μgal.

The University of Texas, Marine Science Institute's Geophysics Laboratory, has already performed a portion of the area survey, but NGS did not have the results at the time this report was prepared.

Satellite Doppler Observations

The NGS has made satellite Doppler observations from several stations within the McDonald Observatory-HRAS survey area. The first observations were made from station McDONALD RM 1 in March 1975, as part of an NGS program to check the scale and orientation of the satellite Doppler network by comparing the results with other newly developing techniques --in this case, lunar laser ranging (Hothem et al. 1978). In January and February, 1978, a much more extensive set of observations was made from this same station to support Session II of the NASA/NGS Validation and Intercomparison Experiments (Hothem 1979). During January to March, 1980, a third, more intricate, observational campaign was conducted in the area. Observations were made at station HARVARD RM 3 simultaneously with observations at the Haystack-Westford Observatory complex in Massachusetts and the U.S. Naval Observatory Timing Substation in Florida to obtain initial values for the POLARIS (Carter et al. 1979b) vector base lines. In addition, observations were made at several other stations, including BALDY, McDONALD RM 4, HARVARD RM 4, RM 5, RM 6, and others, as part

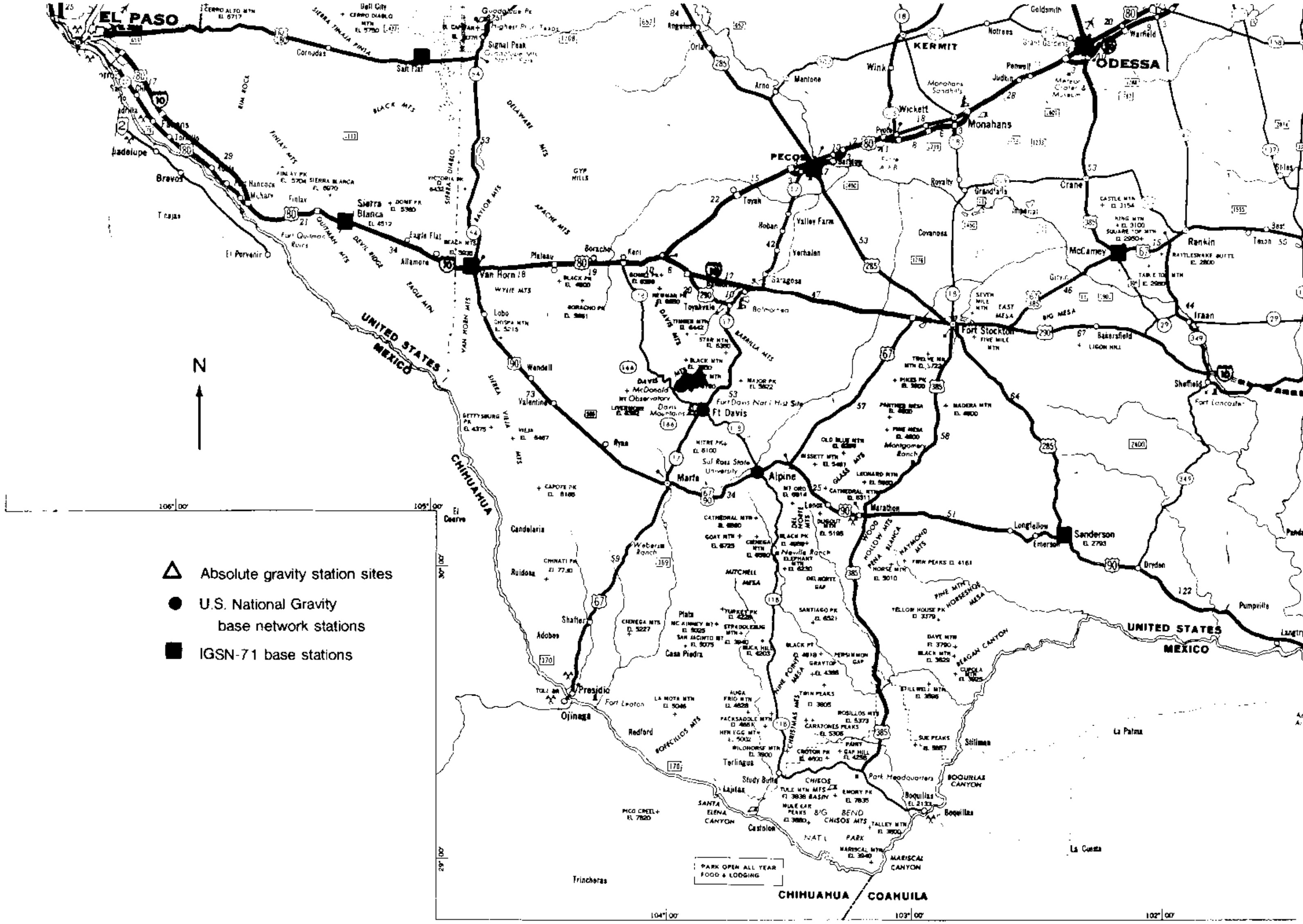


Figure 6.--Regional distribution of gravimetry stations.

of a test of satellite Doppler relative positioning techniques. The relative-mode Doppler observations were still being reduced and analyzed when this report was prepared and will be reported separately.

The satellite Doppler observations do not have the inherent resolution or accuracy to affect significantly a localized high quality survey network, and they were not included in the network adjustment. The differences between the X, Y, Z Cartesian coordinates of station McDONALD RM 1 (as computed from the NAD 1927 horizontal position, NGVD 1929 elevation, and a geoidal separation of +2.87 meters) and the NSWC 9Z-2 Doppler coordinates were used to relate the network to the geocenter. The Doppler station designation is 52123 and the position was derived from observations of 367 satellite passes collected during January and February 1978, using program DOPPLR (Feb. 1976 version) on April 21, 1978. The NAD 1927 and transformed coordinates are tabulated on page 75 of appendix D, under the heading "Adjusted Cartesian Coordinates."

NETWORK ADJUSTMENT

After the various types of observations had been individually preprocessed (i.e., corrections added, statistical tests applied, outliers rejected, and least squares adjustments performed when appropriate) the total survey was adjusted using NGS program HAVAGO (Vincenty 1979).

The complete input and output portions of the "final adjustment," i.e., an adjustment using what we judged to be the best available data set, are reproduced in appendix D. A considerable amount of time was spent on the formats and labels used in HAVAGO in order to make the results self-explanatory. The reader should be able to find the important information concerning any particular station or vector base line without difficulty.

We caution that the standard errors stated in appendix D are formal values which may not be reliable <u>accuracy</u> estimators. The question of accuracy is addressed in some detail in the next section.

ANALYSIS AND INTERPRETATION

The VLBI and SLR surveying systems are thought to be capable of measuring interstation vectors, over distances of several hundreds or even thousands of kilometers, with decimeter or perhaps centimeter accuracies. Intercomparisons of the measurements of collocated systems are intended to detect systematic errors and verify the accuracies of the systems. When the "collocated" observational systems are actually dispersed over distances of several kilometers, it is important that the accuracy of the local survey used to refer the measurements to a common reference point be well known, so that discrepancies will not be incorrectly ascribed to the space systems.

In describing the observational programs earlier in this report, we touched lightly on the "expected" accuracy of each of the various types of measurements performed. In this section we return to the subject of accuracy and discuss in greater detail the dominate sources of the uncertainties in the interstation vectors.

The components of a vector initiating at the observer's standpoint and terminating at a remote station are given by equations 1.

$$\left.\begin{aligned} \Delta X_E &= B[\cos\lambda\ (\cos\phi\cos z - \sin\phi\cos A\sin z) - \sin\lambda\sin A\sin z] \\ \Delta Y_E &= B[\sin\lambda\ (\cos\phi\cos z - \sin\phi\cos A\sin z) + \cos\lambda\sin A\sin z] \\ \Delta Z_E &= B[\cos\phi\cos A\sin z + \sin\phi\cos z] \end{aligned}\right\} \quad (1)$$

where:

B is the straight line distance between the stations,
A is the astronomic azimuth of line B measured clockwise from north,
z is the zenith distance of line B,
ϕ is the astronomic latitude of the standpoint, positive north,
λ is the astronomic longitude of the standpoint, positive east, and
subscript E indicates an equatorial reference frame.

The mapping of the uncertainties of the parameters B, A, z, ϕ, and λ into the components of a particular vector base line depends on the orientation of the base line and is not the issue in the present discussion. Rather, we are addressing the more central question of realistic estimates of the uncertainties of the parameters.

Extensive studies of the accuracies of the determinations of B, ϕ, and λ by the methods of measurement used in this survey indicate that they are almost certainly no worse than 1 or 2 parts in 10^6. For base lines of B $\sim$ 8 km, this corresponds to less than 2 cm. The uncertainties of A and z are not as well known, but generally are thought to be considerably larger--perhaps 5 to 10 parts in 10^6, corresponding to 4 to 8 cm. Therefore, we paid particular attention to the observational programs and have concentrated our analyses on estimating the accuracies of A and z.

Accuracy of Azimuth Determinations

Personal biases in astronomic azimuth determinations have been shown to be as large as 1" or more (Pettey and Carter 1978). The source of the bias is thought to be primarily individualistic pointing on the ground line target. Assume, for example, that an observer tends to point the theodolite to the right of the target reference point, i.e., the point which is centered vertically over the survey mark. Figure 7 depicts, in a simplified manner, the error that such a pointing bias would cause. From station B, the observer

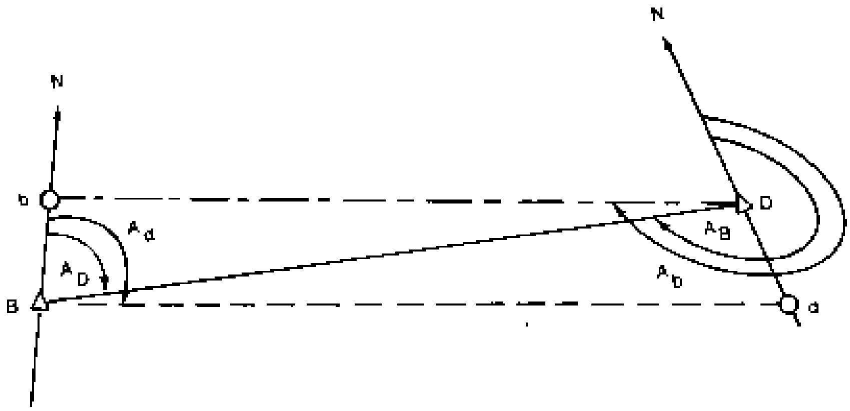


Figure 7.--Effect of personal bias on astronomic azimuth determinations.

would determine the azimuth, A_d of line B-d, which is larger than the azimuth A_D of the true interstation vector B-D. From station D, the observer would determine the azimuth A_b of vector D-b, which again is larger than the azimuth A_D of the true interstation vector D-B. The two erroneous azimuths would be fully "consistent" and reveal no evidence of the bias.

One approach which tries to eliminate, or at least reduce, the effect of personal bias uses two or more observers. The underlying assumption is that personal biases tend to be random and the combined bias of a sufficiently large group of observers will tend toward zero. Unfortunately, it is usually not economically feasible to use more than a few observers; so even if the basic assumption about group biases is true, the bias of such a small group may be aberrant.

Two observers performed a sufficient number of azimuth determinations during the McDonald-HRAS survey to facilitate Analysis of Variance (ANOVA) studies to detect personal bias. Table 1 lists the azimuths.

Table 1.--Personal bias associated with astronomic azimuths
(Kern DKM 3A theodolite was used for all determinations.)

Interstation vectors	Local date	A(North) °	'	Observers A "	Observers B "	Observers A–B "	/A–B/* cm
[1] - [3]	5/30/78	125	23	46.78	46.60	+0.18	0.6
[1] - [2]	5/30/78	118	20	50.22	48.51	+1.71	6.8
[2] - [3]	5/31/78	263	08	20.85	20.05	+0.80	0.6
[2] - [1]	5/31/78	298	23	06.20	05.29	+0.91	3.6
[1] - [3]	6/05/78	125	23	46.80	45.88	+0.92	3.1
[1] - [2]	6/05/78	118	20	49.30	48.77	+0.53	2.1
[2] - [3]	6/06/78	263	08	19.96	19.48	+0.48	0.3
[2] - [1]	6/06/78	298	23	06.10	05.73	+0.37	1.5
[3] - [1]	5/07-08/79	305	25	35.99	34.42	+1.56	5.3
[3] - [2]	5/07-08/79	83	07	49.86	50.15	-0.29	0.2
[3] - [1]	5/09-14/79	305	25	35.88	33.61	+2.27	7.7
[3] - [2]	5/09-14/79	83	07	53.00	50.75	+2.25	1.6

*/ / indicates absolute values. Mean Δ +0".97; $\hat{\sigma}_{\bar{\Delta}}$ ±0".23.

Except for one instance, the differences in azimuth are of the same sign. The ANOVA study indicates the presence of a highly significant statistical difference of 0".97 ±0".23 in the biases of the two observers. Again, we emphasize that this is a difference in personal bias and is not necessarily indicative of the group bias. We can only obtain the group bias by comparison with another independent method that is not subject to personal bias.

Another possible source of systematic error in azimuth determinations is lateral refraction. It is generally agreed that lateral refraction effects must be site and line peculiar, making it extremely difficult to develop a reliable "universal" model associated formula. One observer did make note of the fact that the excursions of the target, viewed through the theodolite, appeared to be larger in azimuth than in the zenith distance. No corrections for lateral refraction were applied to the azimuths observed during this survey.

A recent survey of the 1.24-kilometer Haystack-Westford vector provided one direct comparison with a VLBI azimuth determination (Carter et al. 1979a) In that survey the azimuth determinations were comparatively noisy (greater noise level was expected for reasons not discussed), which made it more difficult to detect the difference in personal biases of the observers. Two observers (not the same ones as in the present survey) were used. The difference between the survey and VLBI results was consistent with the random error level (as indicated by the formal standard errors), suggesting that the group bias was probably less than 0".5.

Another comparison between conventional geodetic azimuth and VLBI determinations was reported by Niell et al. (1979). A vector base line across the Santa Monica Bay in southern California, approximately 42 km in length, was measured by NGS using conventional geodetic methods and by the California Institute of Technology's Jet Propulsion Laboratory (JPL) using the Astronomical Radio Interferometric Earth Surveying (ARIES) transportable VLBI system. The difference in the azimuth of the vector base line was 0".5.

To summarize, we cannot rule out the possibility of systematic errors as large as 5 to 10 parts in 10^6 in the azimuthal orientation of the McDonald HRAS interstation vectors, but we think that the observers, instrumentation, procedures, and numbers of observations should yield accuracies closer to 3 to 5 parts in 10^6 (2 to 4 cm).

Accuracy of Zenith Distance Determinations

We expected personal biases and residual atmospheric refraction effects to be the most important sources of systematic errors in the zenith distance determinations. If the personal biases detected in the azimuth determinations are, in fact, caused by individualistic pointing on the ground line target, zenith distance observations are almost certainly subject to the same type of error. However, owing to differences in the resolution of the human eye in the vertical and horizontal planes, differences in the image motion caused by atmospheric refraction, and differences in the theodolite that may influence the observer to a greater or lesser degree in observing horizontal or vertical directions, the errors may be significantly different for the two types of measurements.

In contrast to the azimuth determinations, personal bias in the zenith distance determinations is, in principle, detectable by comparing reciprocal observations. Assume, for example, that an observer tends to point above the reference point of the ground line target, i.e., the point to which the height of target above the survey mark is measured. Figure 8 shows, in simplified form, the effect of the pointing bias on the zenith distance determinations.

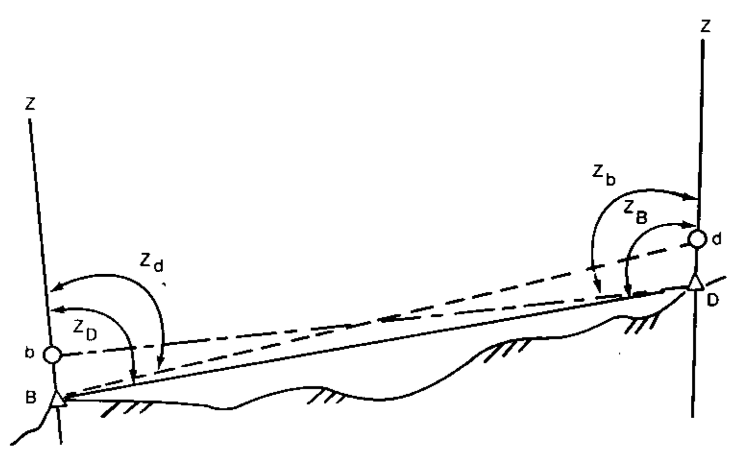


Figure 8.--Effect of personal bias on zenith distance observations.

From point B, the observer would measure the zenith distance Z_d of the line B-d which is a smaller value than the zenith distance Z_D of the true vector B-D. From point D, the same observer would measure the zenith distance Z_b of the line D-b, again a smaller value than the zenith distance Z_B of the true vector D-B. The two erroneous zenith distances would be mutually inconsistent.

Whether or not the personal bias can be recovered in practice depends on its magnitude relative to noise and other systematic errors. Separating personal bias from refraction-induced errors may prove to be particularly difficult.

The vertical component of atmospheric refraction is quite significant, typically about 2" per kilometer, and cannot be ignored in zenith distance determinations. The refraction problem can be approached in several ways: for example, (1) by using only simultaneous reciprocal observations, (2) by observing "groups" (several lines radiating from a central station) and solving for group refraction parameters in the least-squares adjustment, or (3) by measuring the pertinent meteorological parameters and correcting each individual zenith distance observation with a refraction "formula." Program HAVAGO has been designed to admit all three techniques.

We were particularly interested in testing the refraction formula approach because it affords the simplest and most direct implementation of equation 1. That is, it permits the vector components, ΔX, ΔY, ΔZ, to be determined from observations at a single endpoint, augmented only by height of target and meteorological data at the remote endpoint. We used equation 2 to compute the refraction corrections (Rapp 1975).

$$\Delta z = B\left[\frac{16.3}{2T}\left(\frac{P}{T}\frac{dt}{dh} - \frac{dp}{dh}\right)\right]\sin z \qquad (2)$$

where

Δz is the correction in seconds of arc to be applied to the observed zenith distance for correcting atmospheric refraction, P is the barometric pressure in millibars,

T is the temperature in degrees Kelvin,

$\frac{dp}{dh}$ is the change in barometric pressure per meter change in height along the line of sight,

$\frac{dt}{dh}$ is the change in temperature per meter change in height along the line of sight,

z is the observed zenith distance, and

B is the straight line distance between the stations in kilometers.

Table 2 lists the reduced zenith distances for the two observers who made sufficient observations in order to detect personal biases reliably. Unfortunately, the noise was so great that ANOVA studies produced no statistically significant conclusions. The mean difference between the zenith distance determinations of the two observers was only 0".47 while the variance was ±0".81. There are similarities in the patterns of the variations of repeat determinations by the two observers, suggesting the data are still contaminated with residual atmospheric refraction effects. We are continuing our studies of these and additional zenith distance determinations in the hope of better identifying the sources and magnitudes of the component errors.

Although the differences between the vertical components of the longest interstation vectors based on the zenith distances of the two observers is only about 2 cm, biases could still exist, particularly refraction effects, which would further degrade their <u>accuracies</u>. The differences in heights determined from the zenith distance and leveling observations are surprisingly small, i.e., well within the combined estimated errors. This may simply be a fortuitous result of the small number of values available for intercomparison, but the differences certainly suggest that the biases are probably no greater than a few centimeters for the longest vectors.

CONCLUSIONS

The McDonald Observatory-HRAS intercomplex vectors determined from the three-dimensional geodetic survey have estimated accuracies of 3 to 5 cm. The

Table 2.--Personal bias associated with zenith distances.

Interstation vectors	Local date	z °	'	Observers A "	B "	Observers A–B "	/A–B/* cm
[1] - [2]	5/30-31/78	93	16	05.96	06.47	-0.51	2.0
	6/05/78			06.41	06.66	-0.25	1.0
	5/10-11/79			06.30	06.15	+0.15	0.6
	5/10-11/79			09.18	06.54	+2.64	10.5
	5/10-11/79			10.58	05.17	+5.41	21.5
[2] - [1]	5/31-01/78	86	48	16.43	15.68	+0.75	3.0
	6/06-07/78			16.11	17.50	-1.39	5.5
	5/10-11/79			19.45	21.44	-1.99	7.9
	5/10-11/79			23.16	25.51	-2.35	9.3
	5/10-11/79			21.50	29.48	-7.98	31.7
[1] - [3]	5/10-11/79	92	42	03.77	04.33	-0.56	1.9
	5/10-11/79			04.95	06.61	-1.66	5.7
	5/10-11/79		(41)	04.38	(56.40)	+7.98	27.2
[3] - [1]	5/10-11/79	87	21	45.06	46.35	-1.29	4.4
	5/10-11/79			42.89	43.51	-0.62	2.1
[2] - [3]	5/10-11/79	84	50	36.71	37.80	-1.09	0.8
	5/10-11/79			41.02	42.15	-1.13	0.8
	5/10-11/79			40.95	38.68	+2.27	1.7
[3] - [2]	5/07-08/79	95	10	11.24	05.42	+6.71	4.9
	5/09-14/79			09.69	05.42	+4.27	3.1

*/ / indicates absolute values. Mean Δ +0".47; $\hat{\sigma}_{\overline{\Delta}}$ ±0".81.

largest uncertainties appear to be in the azimuthal orientation of the network, caused by the possible existence of an observer group bias that cannot be detected without additional measurements by an independent method. The group bias may be of the order of 1". It appears unlikely that the vertical components of the longest vectors are biased by more than about 0".5. The magnitudes of the vectors should be accurate to ±1 to 2 cm.

There are very few, if any, other locations in the world where there is such an accurate survey connecting a variety of space-geodesy facilities. It would be particularly valuable to have VLBI measurements of the HRAS-MOBLAS vector. These should be straightforward and inexpensive to obtain with the 4-meter ARIES system being developed by JPL. We have requested the measurement be made as soon as priorities permit.

REFERENCES

Carter, W. E., Fronczek, C. J., and Pettey, J. E., 1979a: Haystack-Westford Survey. NOAA Technical Memorandum NOS NGS 21, 57 pp. National Technical Information Service, Springfield, Va. (accession no. PB81 108383).

Carter, W. E., Robertson, D. S., and Abell, M. D., 1979b: An improved polar motion and Earth rotation monitoring service using radio interferometry, Time and the Earth's Rotation, Mc Carthy, D. D. and Pilkington, J. D. (eds.). D. Reidel Publishing Co., Boston, 191-197.

Carter, W. E. and Vincenty, T., 1978: Survey of the McDonald Observatory radial line scheme by relative lateration techniques. NOAA Technical Report NOS 74 NGS 9, 34 pp. National Technical Information Service, Springfield, Va. (accession no. PB 287427).

Fricke, W., Kopff, A., Gliese, W., Gondolatsch, F., Lederle, T., Nowacki, H., Strobel, W., and Stumpff, P., 1963: Fourth Fundamental Catalogue (FK 4). Veroff. des Astron. Rechen-Instituts, Heidelberg, No. 10, Federal Republic of Germany.

Heiskanen, W. A. and Moritz, H., 1967: Physical Geodesy. W. H. Freeman and Co., San Francisco, Calif.

Hoskinson, A. J. and Duerksen, J. A., 1947: Manual of Geodetic Astronomy, Special Publication 237, U.S. Coast and Geodetic Survey (now National Ocean Survey, NOAA), Dept. of Commerce, Washington, D.C., 205 pp. National Technical Information Service, Springfield, Va. (accession no. PB 267465).

Hothem, L. D., 1979: Determination of accuracy, orientation and scale of satellite Doppler point-positioning coordinates. Proceedings of the Second International Geodetic Symposium on Satellite Doppler Positioning, Jan. 22-26, 1979, Defense Mapping Agency/National Ocean Survey, vols. 1 and 2, 609-630. University of Texas at Austin, Tex.

Hothem, L. D., Robertson, D. S., and Strange, W. E., 1978: Orientation and scale of satellite Doppler results based on combination and comparison with other space systems. Proceedings of Second International Symposium on Problems Related to the Redefinition of North American Geodetic Networks, April 24-28, 1978, National Oceanic and Atmospheric Administration, pp. 167-180. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. (stock no. 003-017-0426-1).

Muller, Helmut, 1973: Astronomical position. Time and Azimuth Determinations with the Kern DKM 3-A, Kern and Co., Ltd., Aaran, Switzerland.

Niell, A. E., Ong, K. M., MacDoran, P. F., Resch, G. M., Morabito, D. C., Claflin, E. S., and Dracup, J. F., 1979: Comparison of a radio interferometric baseline measurement with conventional geodesy, Tectonophysics 52, 49-58.

Pettey, J. E. and Carter, W. E., 1978: Uncertainties of astronomic positions and azimuths. Proceedings of Second International Symposium on Problems Related to the Redefinition of North American Geodetic Networks, April 24-28, 1978, National Oceanic and Atmospheric Administration, Arlington, Va., pp. 135-141. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. (stock no. 003-017-0426-1).

Rapp, R. H., 1975: Geometric Geodesy Notes, vol. II. Ohio State University, Columbus, pp. 111-134.

Vincenty, T., 1979: The HAVAGO three-dimensional adjustment program. NOAA Technical Memorandum NOS NGS-17, 18 pp. National Technical Information Service, Springfield, Va. (accession no. PB 297069).

APPENDIX A.--UNIVERSITY OF TEXAS MEASUREMENTS

Dr. Eric C. Silverberg's letter of February 26, 1980, reproduced on the following page, contains the offsets between the McDonald LURE reference point and NGS station McDONALD 107, as determined by the University of Texas. While the letter indicates that an NGS field team assisted in the measurements, the reduction, analysis, and distribution of the results were performed independently by the University of Texas. The National Geodetic Survey disclaims any responsibility for the numerical values of the offsets or their uncertainties.

THE UNIVERSITY OF TEXAS
McDONALD OBSERVATORY AT MOUNT LOCKE

Robert Lee Moore Hall
Austin, Texas 78712

Date: 26 Feb 1980

MEMORANDUM

To: All Lunar Range Users, c/o Peter Shelus

From: E.C. Silverberg

Subject: McDonald Calibration Data

With the help of an NGS Field Team we have finally determined definitive calibrations for the McDonald lunar range data. Since 1973 we have been using a geometrically constant system; but one which was uncertain by as much as 2-3 nanoseconds in the overall range bias. This uncertainty has been greatly reduced by our recent work. Additional data has also been added to relate the 2.7 meter axes to the NGS survey mark on the telescope pier.

All laser range measurements should be referred to that range which would be observed if you used an infinitesimally small instrument placed at the first non-moving point along the receive path. The latter is usually the intersection of the telescope axes. Thus, a dynamical solution for station site coordinates will determine the geocentric position of a point on the #4 mirror in the 2.7 meter reflector. The relevant dimensions are given on the next page. A raw McDonald range measurement can be corrected to these conditions by subtracting a value equal to K - K' + 70.573 meters or K - K' + 235.4 nanoseconds. (The estimated error is about ± 1 cm.) K and K' are observed shot by shot by the feedback calibration system. In the past we have divided this calibration correction into an electrical component, ELCOR = K - K' + 13.19 nanoseconds and a geometric component (including the finite telescope size) of GEOC = 222.2 nanoseconds (66.621 meters) but the division is somewhat arbitrary. All McDonald data should be uniformly corrected by the difference between the constants you are using and these newer values. (We have always been certain of the relative biases of the various older systems, so any implied change in the last setup pertains to the entire eleven years.)

In addition to determining the system calibration constants we have accurately determined the offset of the 2.7 meter axes from the NGS survey mark on the dome floor. The survey marker is 5.304 meters down, .739 meters north and 0.143 meters east from the 2.7 meter calibration point.

Barring any further discoveries, this should be the last calibration work on the 2.7 meter system. I trust these calculations will lay this area to rest prior to abandoning the instrument sometime next year.

Eric C. Silverberg

Relevant Dimensions Used for the Calculations

Primary to Secondary Mirror	= 7.513 meters
Secondary to #3 Mirror	= 6.309 meters
#3 Mirror to #4 Mirror	= 3.039 meters
#4 Mirror to #6 Mirror	= 12.250 meters
#6 Mirror to PMT along the receive path	= 240.875"
#6 Mirror to the start diode behind #6	= 5 "
#6 Mirror to the feedback beam splitter along the receive path	= 195.75"
Feedback beam splitter to PMT along the feedback path	= 45.125"

Therefore: ELCOR, the difference measured if light hits the start diode and PMT simultaneously,

= K - K' (feedback calibration values)
+ 13.19 nanoseconds

and

GEOC, the correction to the intersection of telescope axes plus the correction for finite telescope size

= 30.491 meters + 36.130 meters (respectively)
or 222.2 nanoseconds

APPENDIX B.--LEVELING ADJUSTMENT

This appendix contains the results of the least-squares adjustment of the leveling observations. Station S 706 was fixed at an elevation of 1614.0340 GPU (kgal meters). All heights in appendix B are given in geopotential units.

```
LEVEL  1.05     29 OCT 80      ADJUSTMENT OF LEVELING       11:01:58     PAGE   1
                              ADJUSTMENT OF OCTOBER 21, 1980
-------------------------------------------------------------------------------

STANDARD VALUES

      0-0  SIGMA(MM)
SUPER 1-0       2.00
      1-1       3.00
      1-2       4.00
      2-0       8.40
      2-1       6.00
      2-2       8.00
      3-0      12.00

-------------------------CONSTRAINTS------------------------

MARK# LINE      SPSN         HEIGHT    SIGMA(MM)   DESIGNATION
   29 L24157      21   1614.034390       0.001   S 706

OBSERVATIONS WITH RESIDUALS GREATER THAN  0.500MM WILL BE FLAGGED
OBSERVATIONS THAT FAIL THE TAU TEST WITH ALPHA=0.050 WILL BE FLAGGED
OBSERVATIONS WHOSE NORMALIZED RESIDUAL IS GREATER THAN  1.00 WILL BE FLAGGED
ALL OBSERVATIONS WILL BE LISTED
   10 METERS WILL BE USED AS THE MINIMUM DISTANCE FOR WEIGHT COMPUTATION
```

LEVEL 1.06 29 OCT 80 ADJUSTMENT OF LEVELING 11:02:32 PAGE 1

ADJUSTMENT OF OCTOBER 21, 1980

LINF=1.245891

XREF	SPSN	ACRN	DESIGNATION	SPUR	CORR(M)	ADJ HT(M)	SIGMA(MM)
1	1000	BP0531	HARVARD		-1.4913	1569.8524	9.6
2	1025	BP0537	HARVARD RM 2	*	-1.4911	1569.8656	9.6
3	1026	BP0538	HRAS 85	*	-1.4142	1569.0948	9.6
4	1027	BP0539	HARVARD RM 1	*	-1.4913	1569.5074	9.6
1	1000	BP0531	HARVARD	*	-1.4913	1569.8524	9.6
5	1001	BP0532	MCHARV 1		-1.4143	1594.2623	9.8
6	1002	BP0533	MCHARV 2		-1.4143	1643.7379	9.8
7	1003	BP0534	MCIVOR RM 2		-1.4143	1701.3339	9.9
8	1004	BP0535	MCIVOR		-1.4143	1701.9769	9.9
9	1005	BP0536	MCIVOR RM 1		-1.4143	1702.1075	9.9

ADJUSTMENT OF OCTOBER 21, 1980

LINE=L245892

XREF	SPSN	ACRN	DESIGNATION	SPUR	CORR(M)	ADJ HT(M)	SIGMA(MM)
10	1014	BQ0289	T 1098		-1.4915	2007.9225	10.6
11	1015	BQ0290	MCDONALD AA	*	-1.9086	1982.4997	10.6
12	1016	BQ0291	MCDONALD CA	*	-1.9086	1982.4927	10.6
13	1013	BQ0292	S 1098		-1.4913	2004.1840	10.6
14	1006	BQ0293	MCDONALD RM 4		-1.4917	2022.6151	10.6
15	1012	BQ0294	MCDONALD OBSERVATORY 107	*	-1.9085	2031.2772	10.6
16	1007	BQ0295	MCDONALD	*	-1.4914	2023.1933	10.6
17	1009	BQ0296	MCDONALD RM 1	**	-1.9770	2022.1777	10.6
18	1010	BQ0297	MCDONALD RM 2	**	-1.0064	2022.6632	10.6
16	1007	BQ0295	MCDONALD	**	-1.4914	2023.1933	10.6
19	1008	BQ0298	MCDONALD RM 3	*	-1.4920	2023.2733	10.6
20	1011	BQ0299	TLRS 7897 NASA	**	-1.9086	2018.4965	10.6
14	1006	BQ0293	MCDONALD RM 4	*	-1.4917	2022.6151	10.6
21	1017	BQ0300	GRAVITY TIDE SITE CU		-1.9089	2024.0029	10.6

LEVEL 1.06 29 OCT 80 ADJUSTMENT OF LEVELING 11:02:32 PAGE 1

ADJUSTMENT OF OCTOBER 21, 1980

LINE=L245893

XREF	SPSN	ACRN	DESIGNATION	SPUR	CORR(M)	ADJ HT(M)	SIGMA(MM)
22	1022	BQ0305	B 1097		-1.4909	1940.9731	10.5
23	1019	BQ0302	VALIDATION RM 2		-1.4909	1941.5134	10.5
24	1020	BQ0303	VALIDATION RM 3		-1.4909	1939.0228	10.6
25	1023	BQ0306	MORLAS 7086 NASA	*	-1.8278	1941.6803	10.6
26	1024	BQ0307	MORLAS EAST NASA	*	-1.8281	1941.8900	10.6
26	1024	BQ0307	MORLAS EAST NASA		-1.8281	1941.8900	10.6
27	1018	BQ0301	VALIDATION RM 1		-1.4911	1945.5227	10.5
28	1021	BQ0304	A 1097		-1.4913	1944.4893	10.5
22	1022	BQ0305	B 1097		-1.4909	1940.9731	10.5

ADJUSTMENT OF OCTOBER 21, 1980

LINE=L24157

XREF	SPSN	ACRN	DESIGNATION	SPUR	CORR(M)	ADJ HT(M)	SIGMA(MM)
29	21	BP0387	S 706		-1.4913	1614.0344	0.0 CON
30	20	BP0386	R 706		-1.4913	1568.2523	1.4
31	19	BP0540	J 1096		-1.4913	1550.2869	1.8
32	18	BP0385	Q 706		-1.4913	1549.8890	2.1
33	17	BP0541	H 1096		-1.4913	1538.4056	2.2
34	16	BP0542	G 1096		-1.4913	1558.7298	2.7
35	15	BP0543	F 1096		-1.4913	1535.9104	2.9
36	14	BP0383	M 706		-1.4913	1469.9179	3.2
37	13	BP0382	L 706		-1.4913	1423.7582	3.5
38	12	BP0381	K 706		-1.4913	1397.0134	3.8
39	11	BP0380	J 706		-1.4913	1377.1516	4.1
40	10	BP0544	E 1096		-1.4913	1364.2194	4.2
41	9	BP0545	D 1096		-1.4913	1356.1473	4.5
42	8	BP0546	C 1096		-1.4913	1338.0312	4.6
43	4	BP0363	E 1105	*	-1.4913	1352.5451	4.7
44	5	BP0547	Z 1095	*	-1.4913	1369.6448	4.7
45	6	BP0548	A 1096	*	-1.4913	1380.3473	4.8
46	7	BP0549	B 1096	*	-1.4913	1374.1281	4.8
47	1	BP0412	I 25		-1.4913	1338.9083	4.7
48	3	BP0360	J 25 USGS		-1.4913	1337.1059	4.7
49	2	BP0359	S 1103	*	-1.4913	1349.2130	4.9
50	124	BP0358	T 1103	*	-1.4913	1363.9929	5.1
51	59	BP0413	E 1114		-1.4913	1328.8594	5.0
52	58	BP0415	A 469 RESET 1952		-1.4913	1325.7895	5.2
53	57	BP0550	V 1096		-1.4913	1325.8391	5.2
54	56	BP0417	B 469 RESET 1952	*	-1.4913	1324.7086	5.2
55	60	BP0551	W 1096	*	-1.4913	1318.7508	5.4
56	61	BP0411	Z 468	*	-1.4913	1308.0365	5.6
57	7401	$T0001	TBM 7401	*	-1.4913	1308.8976	5.6
58	62	BP0552	X 1096	*	-1.4913	1294.3505	5.7
59	63	BP0410	Y 468	*	-1.4913	1279.1781	5.9
60	54	BP0418	L 1114		-1.4913	1325.9305	5.2
61	55	BP0419	M 1114	*	-1.4913	1326.5808	5.2
62	53	BP0420	F 1114		-1.4913	1321.9838	5.4
63	52	BP0422	C 469 RESET 1952		-1.4913	1320.8095	5.6
64	51	BP0423	G 1114		-1.4913	1312.0157	5.8
65	50	BP0425	D 469 RESET 1952		-1.4913	1313.7760	6.0
66	49	BP0553	H 1114		-1.4913	1324.3093	6.2
67	48	BP0426	J 1114		-1.4913	1318.4231	6.3
68	47	BP0427	K 1114		-1.4913	1324.4866	6.5

ADJUSTMENT OF OCTOBER 21, 1980

LINE=L24157

XREF	SPSN	ACRN	DESIGNATION	SPUR	CORR(M)	ADJ HT(M)	SIGMA(MM)
69	46	BP0554	U 1096		-1.4913	1333.0974	6.6
70	45	BP0429	N 1114		-1.4913	1314.9619	6.6
71	44	BP0555	T 1096		-1.4913	1315.7084	6.7
72	43	BP0430	P 1114		-1.4913	1327.3933	6.9
73	42	BP0556	S 1096		-1.4913	1328.5673	7.0
74	41	BP0432	MUSQUIZ AZ MK		-1.4913	1339.2317	7.1
75	40	BP0433	Q 1114		-1.4913	1345.1786	7.2
76	39	BP0434	R 1114		-1.4913	1351.6090	7.3
77	38	BP0435	H 469		-1.4913	1371.5837	7.4
78	37	BP0557	R 1096		-1.4913	1368.8978	7.5
79	36	BP0437	S 1114		-1.4913	1411.2766	7.5
80	35	BP0558	Q 1096		-1.4913	1387.6725	7.6
81	34	BP0439	T 1114		-1.4913	1397.1681	7.7
82	33	BP0559	P 1096		-1.4913	1411.7399	7.8
83	32	BP0440	K 469		-1.4913	1415.2678	7.9
84	31	BP0441	U 1114		-1.4913	1422.9778	8.0
85	30	BP0560	N 1096		-1.4913	1478.4792	8.1
86	29	BP0561	M 1096		-1.4913	1480.7465	8.2
87	28	BP0562	L 1096		-1.4913	1461.3713	8.2
88	27	BP0563	K 1096		-1.4913	1446.1430	8.3
89	26	BP0444	M 469		-1.4913	1459.7089	8.4
90	24	BP0446	DAVIS		-1.4913	1478.2004	8.5
91	25	BP0447	DAVIS AZ MK	*	-1.4913	1479.8611	8.6
92	23	BP0448	W 1114		-1.4913	1473.6401	8.5
93	66	BP0564	Z 1096		-1.4913	1463.3916	8.7
94	22	BP0450	N 469	*	-1.4913	1462.4815	8.7
95	67	BP0565	D 1097		-1.4913	1456.9177	8.8
96	68	BP0566	E 1097		-1.4913	1443.5958	8.8
97	69	BP0454	X 1114	*	-1.4913	1431.4804	8.9
98	70	BP0455	R 469	*	-1.4913	1423.4573	9.1
99	71	BP0456	Y 1114	*	-1.4913	1409.7177	9.2
100	72	BP0567	F 1097		-1.4913	1454.3784	8.9
101	73	BP0568	G 1097		-1.4913	1462.5970	9.0
102	74	BP0569	H 1097		-1.4913	1468.0555	9.1
103	75	BP0570	J 1097		-1.4913	1478.4903	9.2
104	76	BP0571	K 1097		-1.4913	1491.2352	9.2
105	77	BP0572	L 1097		-1.4913	1489.1144	9.3
106	78	BP0573	M 1097		-1.4913	1498.2815	9.4
107	79	BP0574	N 1097	*	-1.4913	1514.6078	9.5
108	80	BP0575	P 1097	*	-1.4913	1542.0149	9.5

ADJUSTMENT OF OCTOBER 21, 1980

LINE=L24157

XREF	SPSN	ACRN	DESIGNATION	SPUR	CORR(M)	ADJ HT(M)	SIGMA(MM)
109	81	BP0576	Q 1097	*	-1.4913	1563.3476	9.5
110	82	BP0577	R 1097	*	-1.4913	1579.2054	9.6
1	83	BP0531	HARVARD	*	-1.4913	1569.8524	9.6
4	84	BP0539	HARVARD RM 1	*	-1.4913	1569.5074	9.6
2	85	BP0537	HARVARD RM 2	*	-1.4911	1569.8656	9.6
111	86	BP0578	S 1097		-1.4913	1524.6647	9.5
112	87	BP0579	T 1097		-1.4913	1536.9513	9.5
113	88	BP0580	U 1097		-1.4913	1561.9418	9.6
114	89	BP0581	V 1097		-1.4913	1535.6352	9.7
115	90	BQ0308	W 1097		-1.4913	1548.7609	9.7
116	91	BQ0309	X 1097		-1.4913	1561.7340	9.8
117	92	BQ0310	Y 1097		-1.4913	1580.7862	9.9
118	93	BQ0311	Z 1097		-1.4913	1612.7315	10.0
119	94	BQ0312	A 1098		-1.4913	1666.6858	10.1
120	95	BQ0313	B 1098		-1.4913	1688.2089	10.1
121	96	BQ0314	C 1098		-1.4913	1677.8552	10.1
122	97	BQ0315	D 1098		-1.4913	1706.6285	10.2
123	98	BQ0316	E 1998		-1.4913	1732.3474	10.2
124	99	BQ0317	F 1098		-1.4913	1766.0753	10.2
125	100	BQ0318	G 1098		-1.4913	1811.4866	10.3
126	101	BQ0319	H 1098		-1.4913	1818.0812	10.3
127	102	BQ0320	J 1098		-1.4913	1816.9210	10.3
128	103	BQ0321	K 1098		-1.4913	1826.5823	10.4
129	104	BQ0322	L 1098		-1.4913	1844.8934	10.4
130	105	BQ0323	M 1098		-1.4913	1874.5344	10.5
131	106	BQ0324	N 1098		-1.4913	1904.1739	10.5
132	107	BQ0325	P 1098		-1.4913	1927.3982	10.5
28	108	BQ0304	A 1097	*	-1.4913	1944.4893	10.5
27	109	BQ0301	VALIDATION RM 1	*	-1.4911	1945.5227	10.5
22	110	BQ0305	B 1097	*	-1.4909	1940.9731	10.5
23	111	BQ0302	VALIDATION RM 2	*	-1.4909	1941.5134	10.5
24	112	BQ0303	VALIDATION RM 3	*	-1.4909	1939.0228	10.6
133	113	BQ0326	C 1097	*	-1.4909	1944.9820	10.6
134	114	BQ0327	Q 1098		-1.4913	1955.0234	10.6
135	115	BQ0328	R 1098		-1.4913	1981.6614	10.6
13	116	BQ0292	S 1098		-1.4913	2004.1840	10.6
10	117	BQ0289	T 1098		-1.4915	2007.9225	10.6
14	119	BQ0293	MCDONALD RM 4		-1.4917	2022.6151	10.6
19	118	BQ0298	MCDONALD RM 3		-1.4920	2023.2733	10.6

ADJUSTMENT OF OCTOBER 21, 1980

FROM XREF	TO XREF	FROM LINE#	FROM SPSN	TO LINE#	TO SPSN	HEIGHT DIFFERENCE(M) OBSERVED	HEIGHT DIFFERENCE(M) ADJUSTED	LENGTH (KM)	SIGMA(MM) PRIOR	SIGMA(MM) POST	RESIDUAL (MM)	RESIDUAL NORM	TAU	YEAR	O-C
1	2	L245891	1000	L245891	1025	0.0134	0.0132	0.02	0.6	0.2	-0.2	0.32	1.19	1980	1-2
2	3	L245891	1025	L245891	1026	-0.7707	-0.7708	0.05	0.9	0.2	-0.0	0.05	0.18	1980	1-2
3	4	L245891	1026	L245891	1027	0.4126	0.4126	0.02	0.5	0.2	-0.0	0.03	0.18	1980	1-2
4	1	L245891	1027	L245891	1000	0.3451	0.3450	0.02	0.6	0.1	-0.2	0.27	0.82	1980	1-2
1	5	L245891	1000	L245891	1001	24.4098	24.4098	1.23	4.4	1.7	0.0	0.00	0.0	1980	1-2
5	6	L245891	1001	L245891	1002	49.4757	49.4757	0.42	2.6	1.0	0.0	0.00	0.0	1980	1-2
6	7	L245891	1002	L245891	1003	57.5960	57.5960	0.35	2.4	0.9	0.0	0.00	0.0	1980	1-2
7	8	L245891	1003	L245891	1004	0.6429	0.6429	0.02	0.6	0.2	0.0	0.00	0.0	1980	1-2
8	9	L245891	1004	L245891	1005	0.1306	0.1306	0.02	0.5	0.2	0.0	0.00	0.0	1980	1-2
10	11	L245892	1014	L245892	1015	-25.4228	-25.4228	0.24	1.9	0.8	0.0	0.00	0.0	1980	1-2
11	12	L245892	1015	L245892	1016	-0.0070	-0.0070	0.03	0.7	0.3	0.0	0.00	0.0	1980	1-2
10	13	L245892	1014	L245892	1013	-3.7382	-3.7385	0.10	1.2	0.3	-0.3	0.20	0.66	1980	1-2
13	14	L245892	1013	L245892	1006	18.4308	18.4311	0.26	2.1	0.5	0.3	0.14	0.46	1980	1-2
14	15	L245892	1006	L245892	1012	8.6621	8.6621	0.15	1.5	0.6	0.0	0.00	0.0	1980	1-2
14	16	L245892	1006	L245892	1007	0.5781	0.5782	0.04	0.8	0.2	0.1	0.18	0.68	1980	1-2
16	17	L245892	1007	L245892	1009	-1.0155	-1.0156	0.02	0.5	0.2	-0.1	0.18	0.80	1980	1-2
17	18	L245892	1009	L245892	1010	0.4857	0.4855	0.02	0.6	0.2	-0.1	0.20	0.00	1980	1-2
18	16	L245892	1010	L245892	1007	0.5301	0.5301	0.01	0.5	0.2	-0.1	0.16	0.80	1980	1-2
16	19	L245892	1007	L245892	1008	0.0799	0.0800	0.04	0.8	0.2	0.1	0.18	0.68	1980	1-2
19	20	L245892	1008	L245892	1011	-4.7768	-4.7768	0.06	1.0	0.4	0.0	0.00	0.0	1980	1-2
19	14	L245892	1008	L245892	1006	-0.6579	-0.6582	0.01	0.4	0.1	-0.3	0.67	2.35	1980	1-2
14	21	L245892	1006	L245892	1017	1.3878	1.3878	0.02	0.6	0.2	0.0	0.00	0.0	1980	1-2
22	23	L245893	1022	L245893	1019	0.5403	0.5403	0.02	0.5	0.1	-0.0	0.07	0.23	1980	1-2
23	24	L245893	1019	L245893	1020	-2.4906	-2.4905	0.05	0.8	0.2	0.0	0.04	0.14	1980	1-2
24	25	L245893	1020	L245893	1023	2.6573	2.6575	0.05	0.8	0.2	0.1	0.17	0.65	1980	1-2
25	26	L245893	1023	L245893	1024	0.2096	0.2097	0.02	0.6	0.2	0.1	0.11	0.65	1980	1-2
24	26	L245893	1020	L245893	1024	2.8673	2.8671	0.05	0.9	0.2	-0.2	0.17	0.60	1980	1-2
26	27	L245893	1024	L245893	1018	3.6328	3.6328	0.07	1.1	0.3	0.0	0.01	0.03	1980	1-2
27	28	L245893	1018	L245893	1021	-1.0336	-1.0335	0.01	0.5	0.1	0.1	0.20	0.68	1980	1-2
28	22	L245893	1021	L245893	1022	-3.5158	-3.5162	0.06	1.0	0.2	-0.4	0.40	1.29	1980	1-2
29	30	L24157	21	L24157	20	-45.7821	-45.7821	1.37	3.5	1.4	0.0	0.00	0.0	1977	1-1
30	31	L24157	20	L24157	19	-17.9654	-17.9654	0.93	2.9	1.1	0.0	0.00	0.0	1977	1-1
31	32	L24157	19	L24157	18	-0.3979	-0.3979	0.94	2.9	1.1	0.0	0.00	0.0	1977	1-1
32	33	L24157	18	L24157	17	-11.4833	-11.4833	0.49	2.1	0.8	0.0	0.00	0.0	1977	1-1
33	34	L24157	17	L24157	16	20.3241	20.3241	1.50	3.7	1.4	0.0	0.00	0.0	1977	1-1
34	35	L24157	16	L24157	15	-22.8193	-22.8193	1.07	3.1	1.2	0.0	0.00	0.0	1977	1-1
35	36	L24157	15	L24157	14	-65.9925	-65.9925	1.21	3.3	1.3	0.0	0.00	0.0	1977	1-1
36	37	L24157	14	L24157	13	-46.1597	-46.1597	1.33	3.5	1.3	0.0	0.00	0.0	1977	1-1
37	38	L24157	13	L24157	12	-26.7448	-26.7448	1.86	4.1	1.6	0.0	0.00	0.0	1977	1-1
38	39	L24157	12	L24157	11	-19.8618	-19.8618	1.54	3.7	1.4	0.0	0.00	0.0	1977	1-1
39	40	L24157	11	L24157	10	-12.9323	-12.9323	1.09	3.1	1.2	0.0	0.00	0.0	1977	1-1
40	41	L24157	10	L24157	9	-8.0720	-8.0720	1.44	3.6	1.4	0.0	0.00	0.0	1977	1-1
41	42	L24157	9	L24157	8	-18.1162	-18.1162	0.76	2.6	1.0	0.0	0.00	0.0	1977	1-1
42	43	L24157	8	L24157	4	14.5139	14.5139	0.70	2.5	1.0	0.0	0.00	0.0	1977	1-1
43	44	L24157	4	L24157	5	17.0997	17.0997	0.37	1.8	0.7	0.0	0.00	0.0	1977	1-1
44	45	L24157	5	L24157	6	10.7026	10.7026	0.39	1.9	0.7	0.0	0.00	0.0	1977	1-1
45	46	L24157	6	L24157	7	-6.2193	-6.2193	0.12	1.0	0.4	0.0	0.00	0.0	1977	1-1
42	47	L24157	8	L24157	1	0.8771	0.8771	0.66	2.4	0.9	0.0	0.00	0.0	1977	1-1
47	48	L24157	1	L24157	3	-1.8024	-1.8024	0.41	1.9	0.7	0.0	0.00	0.0	1977	1-1
48	49	L24157	3	L24157	2	12.1071	12.1071	1.44	3.6	1.4	0.0	0.00	0.0	1977	1-1

FROM XREF	TO XREF	FROM LINE#	FROM SPSN	TO LINE#	TO SPSN	HEIGHT DIFFERENCE(M) OBSERVED	HEIGHT DIFFERENCE(M) ADJUSTED	LENGTH (KM)	SIGMA(MM) PRIOR	SIGMA(MM) POST	RESIDUAL (MM)	RESIDUAL NORM	TAU	YEAR	O-C
49	50	L24157	2	L24157	124	14.7799	14.7799	1.54	3.7	1.4	-0.0	0.00	0.0	1977	1-1
48	51	L24157	3	L24157	59	-8.2464	-8.2464	1.63	3.8	1.5	0.0	0.00	0.0	1977	1-1
51	52	L24157	59	L24157	58	-3.0699	-3.0699	1.39	3.5	1.4	0.0	0.00	0.0	1977	1-1
52	53	L24157	58	L24157	57	0.0496	0.0496	0.30	1.7	0.6	0.0	0.00	0.0	1977	1-1
53	54	L24157	57	L24157	56	-1.1305	-1.1305	0.13	1.1	0.4	0.0	0.00	0.0	1977	1-1
54	55	L24157	56	L24157	60	-5.9578	-5.9578	1.15	3.2	1.2	0.0	0.00	0.0	1977	1-1
55	56	L24157	60	L24157	61	-10.7143	-10.7143	1.59	3.8	1.5	0.0	0.00	0.0	1977	1-1
56	57	L24157	61	L24157	7401	0.8612	0.8612	0.05	0.7	0.3	0.0	0.00	0.0	1977	1-1
57	58	L24157	7401	L24157	62	-14.5472	-14.5472	1.53	3.7	1.4	0.0	0.00	0.0	1977	1-1
58	59	L24157	62	L24157	63	-15.1724	-15.1724	1.59	3.8	1.5	0.0	0.00	0.0	1977	1-1
53	60	L24157	57	L24157	54	0.0913	0.0913	0.38	1.8	0.7	0.0	0.00	0.0	1977	1-1
60	61	L24157	54	L24157	55	0.6503	0.6503	0.07	0.8	0.3	0.0	0.00	0.0	1977	1-1
60	62	L24157	54	L24157	53	-3.9466	-3.9466	1.31	3.4	1.3	0.0	0.00	0.0	1977	1-1
62	63	L24157	53	L24157	52	-1.1744	-1.1744	1.80	4.0	1.6	0.0	0.00	0.0	1977	1-1
63	64	L24157	52	L24157	51	-8.7937	-8.7937	1.57	3.8	1.5	0.0	0.00	0.0	1977	1-1
64	65	L24157	51	L24157	50	1.7603	1.7603	1.60	3.8	1.5	0.0	0.00	0.0	1977	1-1
65	66	L24157	50	L24157	49	10.5332	10.5332	1.38	3.5	1.4	0.0	0.00	0.0	1977	1-1
66	67	L24157	49	L24157	48	-5.8861	-5.8861	1.48	3.7	1.4	0.0	0.00	0.0	1977	1-1
67	68	L24157	48	L24157	47	6.0635	6.0635	1.51	3.7	1.4	0.0	0.00	0.0	1977	1-1
68	69	L24157	47	L24157	46	8.6109	8.6109	0.88	2.8	1.1	0.0	0.00	0.0	1977	1-1
69	70	L24157	46	L24157	45	-18.1356	-18.1356	0.71	2.5	1.0	0.0	0.00	0.0	1977	1-1
70	71	L24157	45	L24157	44	0.7465	0.7465	1.13	3.2	1.2	0.0	0.00	0.0	1977	1-1
71	72	L24157	44	L24157	43	11.6849	11.6849	1.15	3.2	1.2	0.0	0.00	0.0	1977	1-1
72	73	L24157	43	L24157	42	1.1740	1.1740	1.26	3.4	1.3	0.0	0.00	0.0	1977	1-1
73	74	L24157	42	L24157	41	10.6644	10.6644	1.20	3.3	1.3	0.0	0.00	0.0	1977	1-1
74	75	L24157	41	L24157	40	5.9469	5.9469	0.93	2.9	1.1	0.0	0.00	0.0	1977	1-1
75	76	L24157	40	L24157	39	6.4303	6.4303	1.37	3.5	1.4	0.0	0.00	0.0	1977	1-1
76	77	L24157	39	L24157	38	19.9747	19.9747	0.41	1.9	0.7	0.0	0.00	0.0	1977	1-1
77	78	L24157	38	L24157	37	-2.6859	-2.6859	1.06	3.1	1.2	0.0	0.00	0.0	1977	1-1
78	79	L24157	37	L24157	36	42.3788	42.3788	0.71	2.5	1.0	0.0	0.00	0.0	1977	1-1
79	80	L24157	36	L24157	35	-23.6041	-23.6041	1.23	3.3	1.3	0.0	0.00	0.0	1977	1-1
80	81	L24157	35	L24157	34	9.4956	9.4956	1.07	3.1	1.2	0.0	0.00	0.0	1977	1-1
81	82	L24157	34	L24157	33	14.5718	14.5718	1.32	3.4	1.3	0.0	0.00	0.0	1977	1-1
82	83	L24157	33	L24157	32	3.5279	3.5279	0.98	3.0	1.1	0.0	0.00	0.0	1977	1-1
83	84	L24157	32	L24157	31	7.7100	7.7100	0.80	2.7	1.0	0.0	0.00	0.0	1977	1-1
84	85	L24157	31	L24157	30	55.5014	55.5014	1.12	3.2	1.2	0.0	0.00	0.0	1977	1-1
85	86	L24157	30	L24157	29	2.2673	2.2673	1.05	3.1	1.2	0.0	0.00	0.0	1977	1-1
86	87	L24157	29	L24157	28	-19.3752	-19.3752	0.62	2.4	0.9	0.0	0.00	0.0	1977	1-1
87	88	L24157	28	L24157	27	-15.2283	-15.2283	0.78	2.6	1.0	0.0	0.00	0.0	1977	1-1
88	89	L24157	27	L24157	26	13.5659	13.5659	1.50	3.7	1.4	0.0	0.00	0.0	1977	1-1
89	90	L24157	26	L24157	24	18.4915	18.4915	1.28	3.4	1.3	0.0	0.00	0.0	1977	1-1
90	91	L24157	24	L24157	25	1.6607	1.6607	0.78	2.7	1.0	0.0	0.00	0.0	1977	1-1
90	92	L24157	24	L24157	23	-4.5603	-4.5603	0.51	2.2	0.8	0.0	0.00	0.0	1977	1-1
92	93	L24157	23	L24157	66	-10.2485	-10.2485	1.64	3.8	1.5	0.0	0.00	0.0	1977	1-1
93	94	L24157	66	L24157	22	-0.9101	-0.9101	0.07	0.8	0.3	0.0	0.00	0.0	1977	1-1
93	95	L24157	66	L24157	67	-6.4739	-6.4739	1.01	3.0	1.2	0.0	0.00	0.0	1977	1-1
95	96	L24157	67	L24157	68	-13.3219	-13.3219	1.17	3.3	1.3	0.0	0.00	0.0	1977	1-1
96	97	L24157	68	L24157	69	-12.1153	-12.1153	1.36	3.5	1.4	0.0	0.00	0.0	1977	1-1
97	98	L24157	69	L24157	70	-8.0231	-8.0231	1.64	3.8	1.5	0.0	0.00	0.0	1977	1-1
98	99	L24157	70	L24157	71	-13.7397	-13.7397	1.58	3.9	1.5	0.0	0.00	0.0	1977	1-1

FROM	TO	FROM		TO		HEIGHT DIFFERENCE(M)		LENGTH	SIGMA(MM)		RESIDUAL				
XREF	XREF	LINE#	SPSN	LINE#	SPSN	OBSERVED	ADJUSTED	(KM)	PRIOR	POST	(MM)	NORM	TAU	YEAR	O-C
96	100	L24157	68	L24157	72	10.7826	10.7826	1.09	3.1	1.2	0.0	0.00	0.0	1977	1-1
100	101	L24157	72	L24157	73	8.2186	8.2186	1.07	3.1	1.2	0.0	0.00	0.0	1977	1-1
101	102	L24157	73	L24157	74	5.4585	5.4585	1.05	3.1	1.2	0.0	0.00	0.0	1977	1-1
102	103	L24157	74	L24157	75	10.4348	10.4348	0.89	2.8	1.1	0.0	0.00	0.0	1977	1-1
103	104	L24157	75	L24157	76	12.7449	12.7449	0.88	2.8	1.1	0.0	0.00	0.0	1977	1-1
104	105	L24157	76	L24157	77	-2.1208	-2.1208	0.88	2.8	1.1	0.0	0.00	0.0	1977	1-1
105	106	L24157	77	L24157	78	9.1671	9.1671	1.10	3.1	1.2	0.0	0.00	0.0	1977	1-1
106	107	L24157	78	L24157	79	16.3264	16.3264	1.50	3.7	1.4	0.0	0.00	0.0	1977	1-1
107	108	L24157	79	L24157	80	27.4071	27.4071	0.47	2.0	0.8	0.0	0.00	0.0	1977	1-1
108	109	L24157	80	L24157	81	21.3327	21.3327	0.33	1.7	0.7	0.0	0.00	0.0	1977	1-1
109	110	L24157	81	L24157	82	15.8578	15.8578	0.49	2.1	0.8	0.0	0.00	0.0	1977	1-1
110	1	L24157	82	L24157	83	-9.3529	-9.3529	0.91	2.9	1.1	0.0	0.00	0.0	1977	1-1
1	4	L24157	83	L24157	84	-0.3450	-0.3450	0.02	0.5	0.1	0.0	0.05	0.19	1977	1-1
4	2	L24157	84	L24157	85	0.3580	0.3581	0.04	0.6	0.2	0.2	0.28	1.00	1977	1-1
106	111	L24157	78	L24157	86	26.3832	26.3832	1.37	3.5	1.4	0.0	0.00	0.0	1977	1-1
111	112	L24157	86	L24157	87	12.2866	12.2866	1.01	3.0	1.2	0.0	0.00	0.0	1977	1-1
112	113	L24157	87	L24157	88	24.9905	24.9905	0.59	2.3	0.9	0.0	0.00	0.0	1977	1-1
113	114	L24157	88	L24157	89	-26.3066	-26.3066	1.22	3.3	1.3	0.0	0.00	0.0	1977	1-1
114	115	L24157	89	L24157	90	13.1257	13.1257	1.26	3.4	1.3	0.0	0.00	0.0	1977	1-1
115	116	L24157	90	L24157	91	12.9731	12.9731	1.42	3.6	1.4	0.0	0.00	0.0	1977	1-1
116	117	L24157	91	L24157	92	19.0522	19.0522	1.46	3.6	1.4	0.0	0.00	0.0	1977	1-1
117	118	L24157	92	L24157	93	31.9453	31.9453	1.06	3.1	1.2	0.0	0.00	0.0	1977	1-1
118	119	L24157	93	L24157	94	54.1543	54.1543	0.89	2.8	1.1	0.0	0.00	0.0	1977	1-1
119	120	L24157	94	L24157	95	21.3231	21.3231	0.36	1.8	0.7	0.0	0.00	0.0	1977	1-1
120	121	L24157	95	L24157	96	-10.3537	-10.3537	0.65	2.4	0.9	0.0	0.00	0.0	1977	1-1
121	122	L24157	96	L24157	97	28.7733	28.7733	0.43	2.0	0.8	0.0	0.00	0.0	1977	1-1
122	123	L24157	97	L24157	98	25.7189	25.7189	0.55	2.2	0.9	0.0	0.00	0.0	1977	1-1
123	124	L24157	98	L24157	99	33.7279	33.7279	0.55	2.2	0.9	0.0	0.00	0.0	1977	1-1
124	125	L24157	99	L24157	100	45.4113	45.4113	0.56	2.2	0.9	0.0	0.00	0.0	1977	1-1
125	126	L24157	100	L24157	101	6.5946	6.5946	0.35	1.8	0.7	0.0	0.00	0.0	1977	1-1
126	127	L24157	101	L24157	102	-1.1602	-1.1602	0.61	2.3	0.9	0.0	0.00	0.0	1977	1-1
127	128	L24157	102	L24157	103	9.6613	9.6613	0.75	2.6	1.0	0.0	0.00	0.0	1977	1-1
128	129	L24157	103	L24157	104	18.3111	18.3111	0.63	2.4	0.9	0.0	0.00	0.0	1977	1-1
129	130	L24157	104	L24157	105	29.6410	29.6410	0.87	2.8	1.1	0.0	0.00	0.0	1977	1-1
130	131	L24157	105	L24157	106	29.6395	29.6395	0.35	1.8	0.7	0.0	0.00	0.0	1977	1-1
131	132	L24157	106	L24157	107	23.2243	23.2243	0.28	1.6	0.6	0.0	0.00	0.0	1977	1-1
132	28	L24157	107	L24157	108	17.0910	17.0910	0.18	1.3	0.5	0.0	0.00	0.0	1977	1-1
28	27	L24157	108	L24157	109	1.0333	1.0335	0.02	0.4	0.1	0.2	0.37	1.34	1977	1-1
27	22	L24157	109	L24157	110	-4.5499	-4.5497	0.06	0.7	0.2	0.2	0.30	1.20	1977	1-1
22	23	L24157	110	L24157	111	0.5403	0.5403	0.02	0.4	0.1	0.0	0.06	0.23	1977	1-1
23	24	L24157	111	L24157	112	-2.4905	-2.4905	0.05	0.6	0.2	-0.0	0.03	0.11	1977	1-1
24	133	L24157	112	L24157	113	5.9591	5.9591	0.12	1.0	0.4	0.0	0.00	0.0	1977	1-1
132	134	L24157	107	L24157	114	27.6252	27.6252	0.31	1.7	0.7	0.0	0.00	0.0	1977	1-1
134	135	L24157	114	L24157	115	26.6380	26.6380	0.24	1.5	0.6	0.0	0.00	0.0	1977	1-1
135	13	L24157	115	L24157	116	22.5225	22.5225	0.23	1.4	0.6	0.0	0.00	0.0	1977	1-1
13	10	L24157	116	L24157	117	3.7387	3.7385	0.12	1.0	0.3	-0.2	0.24	0.90	1977	1-1
10	14	L24157	117	L24157	119	14.6928	14.6926	0.24	1.5	0.5	-0.1	0.10	0.46	1977	1-1
14	19	L24157	119	L24157	118	0.6585	0.6582	0.02	0.4	0.1	-0.3	0.77	2.71	1977	1-1

ADJUSTMENT OF OCTOBER 21, 1980

XREF	LINE	SPSN	DESIGNATION	CONSTRAINED HT(M)	ADJUSTED HT(M)	RESIDUAL (M)	APRIORI SIG(MM)
29	L24157	21	S 706	1614.0344	1614.0344	0.0	0.001

```
LEVEL  1.06      29 OCT 80      ADJUSTMENT OF LEVELING      11:02:36     PAGE   5
                           ADJUSTMENT OF OCTOBER 21, 1980
---------------------------------------------------------------------------------

               0.15 VARIANCE OF UNIT WEIGHT
              14.00 DEGREES OF FREEDOM
             106.94 KILOMETERS OF LEVELING
               1    NUMBER OF CONSTRAINTS
               1    NUMBER OF TEMPORARY BENCHMARKS
             134    NUMBER OF BENCHMARKS
             135    TOTAL NUMBER OF BMS & TBMS
             148    NUMBER OF OBSERVATIONS
              29    NON-SPUR OBSERVATIONS
               0    OBSERVATIONS FLAGGED BY MAGNITUDE
               0    OBSERVATIONS FLAGGED BY NORMALIZED RESIDUAL
               0    OBSERVATIONS FLAGGED BY TAU
               2.75 CRITICAL VALUE OF TAU


               0.11 CPU SECONDS TO FORM NEIGHBOR LIST
               0.12 CPU SECONDS TO REORDER USING THE C-M  ALGORITHM
               0.17 CPU SECONDS TO FORM NORMALS
               0.02 CPU SECONDS TO SOLVE NORMALS
               0.05 CPU SECONDS TO COMPUTE INVERSE
             470.76K BYTES ALLOCATED FOR WORK SPACE
              93.18 PER CENT COMPRESSION OF NORMALS
```

APPENDIX C.--GRAVITY STATION DESCRIPTIONS AND ADJUSTMENTS

The descriptions for absolute gravity stations McDONALD AA and McDONALD AB follow. Also included are copies of the output of the gravity adjustment program.

GRAVITY STATION DESCRIPTION	STATION TYPE: Absolute Site	STATION DESIGNATION: McDonald AA
COUNTRY: U.S.A.	STATE/PROVINCE: Texas	CITY: Ft. Davis
LATITUDE: 30° 40.'2 N	LONGITUDE: 104° 01.'5 W	ELEVATION: 2028 Meters
GRAVITY STATION MARK: Brass Disk	AGENCY/SOURCE: DMA	INSCRIPTION:
POSITION REFERENCE: Esimated from Trig Sta.	POSITION SOURCE: NGS	SOURCE DESIGNATION: McDonald, 1942
ELEVATION REFERENCE: Engineer's Map	ELEVATION SOURCE: Univ. of Texas	SOURCE DESIGNATION: McDonald Observatory

POSITION/ELEVATION REMARKS

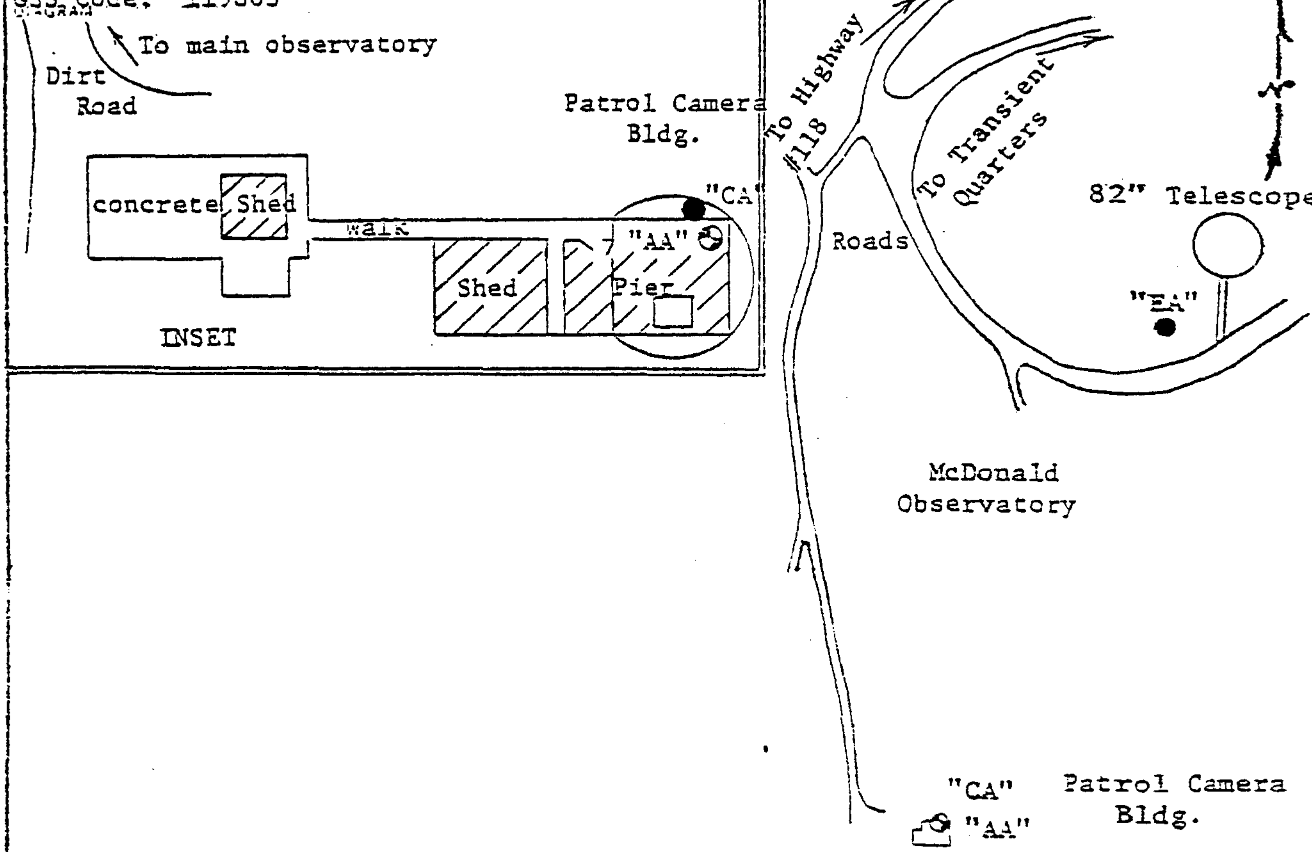
CI=2 Feet. Station is 200 meters SW of Trig Station

DESCRIPTION

The station is 17 miles northwest of Ft. Davis on Mt. Locke at the McDonald Observatory. To reach from the courthouse in Ft. Davis go 15 miles northwest along Texas Highway 118, then turn right and go southeast 2 miles along Spur Road 78 to the observatory area. The station is about 200 meters southwest of the main telescope area (which is on top of the mountain), in the Patrol Camera Building (corrugated metal bldg). Observations were made 0.9 meters west of the east side of the building and 0.5 meters south of the north side on the concrete floor. The disk is at the NE corner of the building one meter NE of the station.

GSS Code: 119S03

DIAGRAM



DESCRIBED	AGENCY	DATE
W.G. Spita	DMAHTC/GSS	July 1979

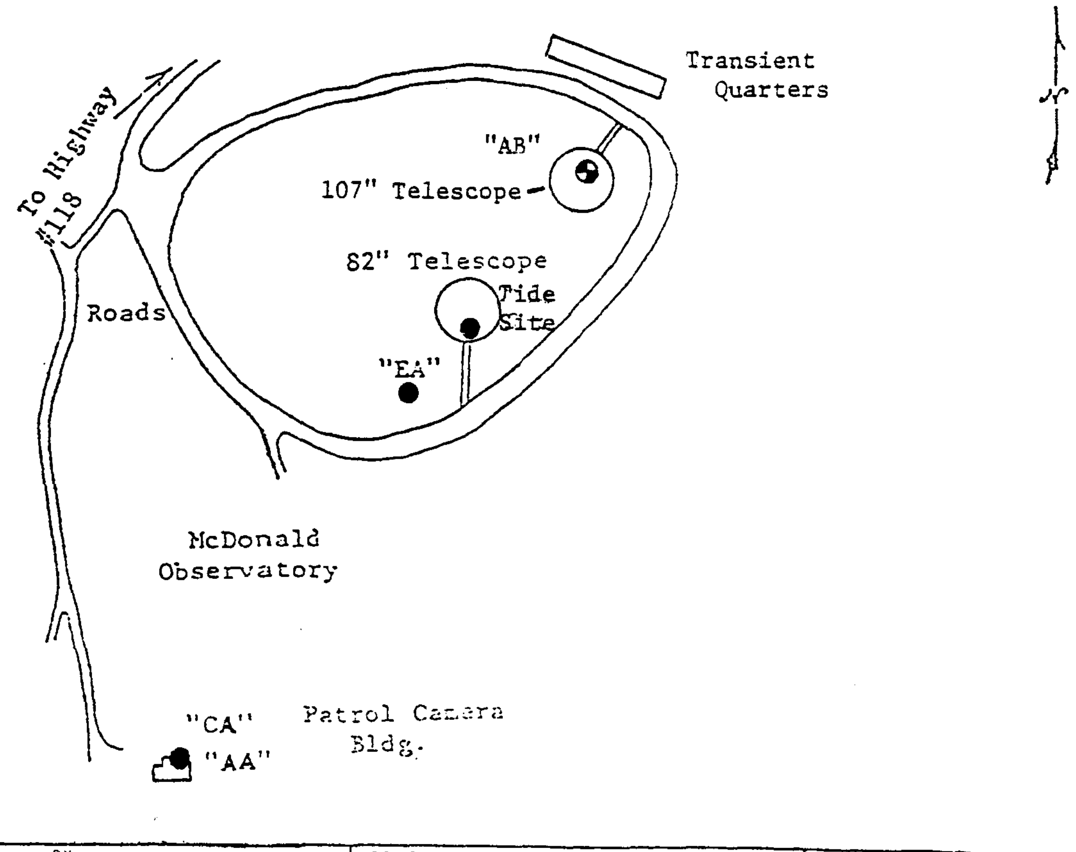
GRAVITY STATION DESCRIPTION	STATION TYPE: Absolute Site	STATION DESIGNATION: McDonald AB
COUNTRY: U.S.A.	STATE/PROVINCE: Texas	CITY: Ft. Davis
LATITUDE: 30° 40.'3 N	LONGITUDE: 104° 01.'4 W	ELEVATION: 2065 Meters
GRAVITY STATION MARK	AGENCY/SOURCE	INSCRIPTION
POSITION REFERENCE	POSITION SOURCE: NGS	SOURCE DESIGNATION: McDonald, 1942
ELEVATION REFERENCE	ELEVATION SOURCE: NGS	SOURCE DESIGNATION: McDonald No. 1, 1942

POSITION/ELEVATION REMARKS

DESCRIPTION

The station is 17 miles northwest of Ft. Davis on Mt. Locke at the McDonald Observatory. To reach from the courthouse in Ft. Davis go 15 miles northwest along Texas Highway 118, then turn right and go southeast 2 miles along Spur Road 78 to the McDonald Observatory 107 inch telescope (near the top of the mountain). The station is located in the 107 inch telescope building, on ground level on the NE side in Room 103, 1.8 meters east of the west wall and door, and 1.1 meters south of the north wall, on the tile floor.

DIAGRAM



DESCRIBED BY	AGENCY	DATE
W.G. Spita	DMAHTC/GSS	July 1979

GRAVITY STATION DESCRIPTION	STATION TYPE Absolute Site	STATION DESIGNATION McDonald AB
COUNTRY USA	STATE/PROVINCE Texas	CITY Ft Davis
LATITUDE 30° 40.'3 N	LONGITUDE 104° 01.'3 W	ELEVATION 2065.6 meters
GRAVITY STATION MARK None	AGENCY/SOURCE	INSCRIPTION
POSITION REFERENCE Estimated from Trig. Sta	POSITION SOURCE NGS	SOURCE DESIGNATION McDonald, 1942
ELEVATION REFERENCE Spot elev, Engineer's Map	ELEVATION SOURCE Univ. of Texas	SOURCE DESIGNATION McDonald Observatory

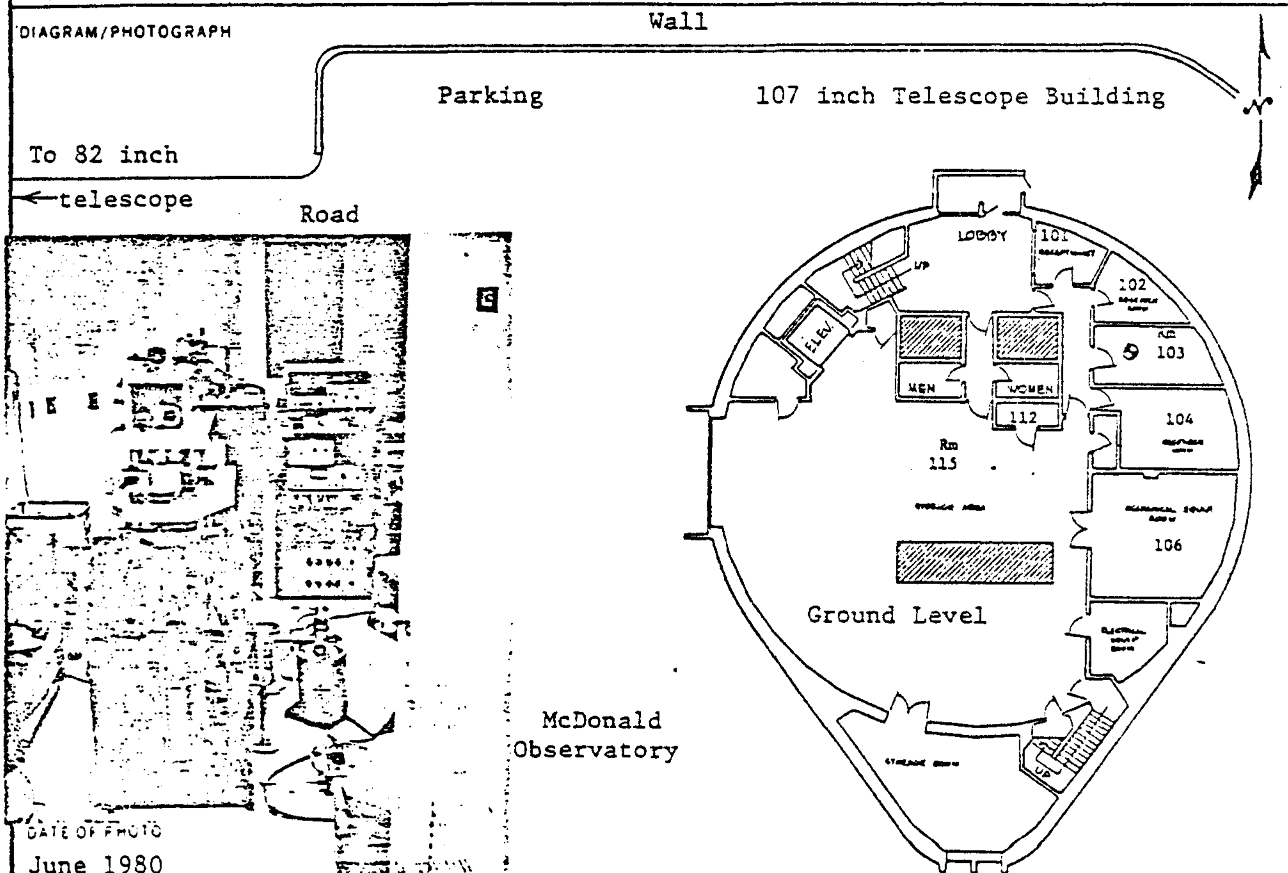
POSITION/ELEVATION REMARKS

CI=2 feet, station is 100 meters NE of Trig. Station

DESCRIPTION The station is 17 miles northwest of Ft. Davis on Mt. Locke at the McDonald Observatory. To reach from the courthouse in Ft. Davis go 15 miles northwest along Texas Highway 118, then turn right and go southeast 2 miles along Spur Road 78 to McDonald Observatory. The station is east of the top of the mountain, at the end of the road, in the 107 inch Telescope Building, ground level. Observations were made in the northeast side, in Room 103, 1.8 meter east of the west wall and door of the room and 1.1 meter south of the north wall, on the tile floor.

GSS Code: 119S04

DIAGRAM/PHOTOGRAPH



DATE OF PHOTO
June 1980

DESCRIBED BY	AGENCY	DATE
W.G. Spita	DMAHTC/GSS	June 1980

ADJUSTED VALUES OF GRAVITY

STATION	LATITUDE DEG	LATITUDE MIN	LONGITUDE DEG	LONGITUDE MIN	ELEVATION (M) PRI	ELEVATION (M) SEC	GRAVITY MGAL	GRAVITY SIG	FREE-AIR ANOM. MGAL	FREE-AIR ANOM. SIG	BOUGUER ANOM. MGAL	BOUGUER ANOM. SIG
MCDONALD RM1	30	40.30	104	01.40	2065.94	0.01	978819.145	0.000	79.785	0.500	-151.394	0.500
ALPINE	30	21.30	103	34.80	1371.60	0.0	978975.762	0.009	47.151	0.500	-106.331	0.500
SAN ANTONIO L	29	31.70	98	28.40	243.80	0.0	979182.567	0.012	-29.502	0.500	- 56.783	0.500
AUSTIN B	30	18.00	97	42.00	192.00	0.0	979270.245	0.019	-18.055	0.500	- 39.540	0.500
V 912 1945	31	49.20	106	23.10	1195.36	0.0	979069.819	0.024	-30.190	0.500	-163.951	0.500
EL PASO M	31	50.00	106	22.90	1204.00	0.0	979070.327	0.024	-28.095	0.500	-162.823	0.500
BEARD 2 1977	30	49.70	103	31.20	1530.00	-0.01	978957.996	0.013	40.811	0.500	-130.396	0.500
J 1096 1977	30	16.20	103	35.20	1583.38	0.0	978920.292	0.011	63.724	0.500	-113.455	0.500
N 469 1934	30	35.30	103	53.70	1493.68	0.0	978956.082	0.009	46.725	0.500	-120.418	0.500
W 1114 1958	30	34.70	103	52.90	1505.08	0.0	978953.737	0.016	48.689	0.500	-119.730	0.500
DAVIS 1942	30	34.50	103	52.70	1509.74	0.0	978953.075	0.012	49.727	0.500	-119.212	0.500
M 469 1934	30	33.90	103	52.30	1490.85	0.0	978955.671	0.016	47.286	0.500	-119.541	0.500
K 1096 1977	30	33.10	103	51.90	1476.99	0.0	978957.763	0.016	46.156	0.500	-119.120	0.500
L 1096 1977	30	32.80	103	51.70	1492.55	0.02	978954.506	0.016	48.095	0.500	-118.921	0.500
M 1096 1977	30	32.60	103	51.40	1512.34	0.02	978950.651	0.012	50.611	0.500	-118.620	0.500
N 1096 1977	30	32.30	103	50.90	1510.02	0.02	978951.562	0.016	51.202	0.500	-117.769	0.500
U 1114 1958	30	31.80	103	50.70	1439.79	0.02	978962.937	0.016	41.561	0.500	-119.551	0.500
K 469 1934	30	31.60	103	50.40	1445.46	0.0	978965.223	0.011	45.860	0.500	-115.887	0.500
E 1096 1977	30	20.50	103	38.60	1393.31	0.0	978968.558	0.009	47.699	0.500	-108.213	0.500
SUMMIT 1968	31	3.30	104	56.50	1402.00	0.0	978989.977	0.013	15.236	0.500	-141.648	0.500
17 RCN 1973	30	41.00	104	19.50	1893.30	0.0	978854.904	0.013	61.344	0.500	-150.517	0.500
T 1105 1957	30	9.50	102	38.30	1024.45	0.0	979027.895	0.013	7.618	0.500	-107.019	0.500
E 1115	30	42.90	103	46.90	1386.30	-0.04	978999.382	0.012	46.853	0.500	-108.275	0.500
Y 1114 1958	30	38.10	103	51.30	1439.79	0.02	978976.804	0.012	47.121	0.500	-113.992	0.500
P 1096 1977	30	31.60	103	49.80	1441.85	0.01	978967.560	0.017	47.085	0.500	-114.258	0.500
T 1114 1958	30	31.60	103	49.00	1426.97	0.01	978973.260	0.013	48.191	0.500	-111.487	0.500
Q 1096 1977	30	31.90	103	48.40	1417.27	0.02	978976.162	0.017	47.705	0.500	-110.887	0.500
S 1114 1958	30	32.20	103	47.70	1441.38	0.02	978972.973	0.017	51.562	0.500	-109.729	0.500
R 1096 1977	30	32.20	103	47.40	1398.09	0.0	978982.283	0.010	47.512	0.500	-108.934	0.500
H 469 1934	30	31.70	103	47.00	1400.83	0.0	978982.852	0.018	49.587	0.500	-107.167	0.500
R 1114 1958	30	31.70	103	46.70	1380.43	0.01	978988.138	0.018	48.577	0.500	-105.894	0.500
Q 1114 1958	30	31.20	103	46.10	1373.86	0.0	978988.704	0.017	47.774	0.500	-105.961	0.500
S 1096 1977	30	30.60	103	45.20	1356.90	0.0	978991.988	0.013	46.612	0.500	-105.224	0.500

ADJUSTED VALUES OF GRAVITY (CONT'D.)

STATION	LATITUDE DEG	LATITUDE MIN	LONGITUDE DEG	LONGITUDE MIN	ELEVATION (M) PRI	ELEVATION (M) SEC	GRAVITY MGAL	GRAVITY SIG	FREE-AIR ANOM. MGAL	FREE-AIR ANOM. SIG	BOUGUER ANOM. MGAL	BOUGUER ANOM. SIG
P 1114 1958	30	29.90	103	45.10	1355.70	0.0	978993.621	0.014	48.797	0.500	-102.906	0.500
T 1096 1977	30	29.30	103	44.80	1343.76	0.02	978996.740	0.017	49.023	0.500	-101.344	0.500
N 1114 1958	30	29.00	103	44.30	1343.00	0.01	978997.031	0.017	49.473	0.500	-100.809	0.500
U 1096 1977	30	28.70	103	44.00	1361.52	0.02	978993.109	0.017	51.663	0.500	-100.692	0.500
K 1114 1958	30	28.40	103	43.60	1352.73	0.0	978994.849	0.011	51.083	0.500	-100.288	0.500
J 1114 1958	30	27.70	103	43.20	1346.53	0.0	978994.786	0.018	50.030	0.500	-100.647	0.500
H 1114 1958	30	26.90	103	42.70	1352.55	0.0	978992.003	0.017	50.155	0.500	-101.195	0.500
D 469 R52	30	26.30	103	42.30	1341.79	0.0	978991.877	0.017	47.497	0.500	-102.649	0.500
G 1114 1958	30	25.50	103	41.80	1339.99	0.0	978990.502	0.013	46.619	0.500	-103.326	0.500
C 469 R52	30	24.80	103	41.40	1348.97	0.0	978986.752	0.017	46.561	0.500	-104.389	0.500
F 1114 1958	30	23.90	103	40.80	1350.17	0.0	978985.694	0.017	47.057	0.500	-104.028	0.500
B 469 R52	30	23.20	103	40.40	1352.95	0.0	978982.722	0.013	45.862	0.500	-105.533	0.500
A 469 R52	30	23.00	103	40.30	1354.06	0.0	978982.049	0.017	45.793	0.500	-105.726	0.500
E 1114 1958	30	22.30	103	40.00	1357.19	0.01	978978.938	0.017	44.569	0.500	-107.301	0.500
J 25 USGS	30	21.50	103	39.80	1365.62	0.0	978975.855	0.013	45.136	0.500	-107.677	0.500
E 1105 1957	30	21.70	103	38.90	1381.39	0.0	978973.109	0.017	46.995	0.500	-107.583	0.500
C 1096 1977	30	21.50	103	39.20	1366.56	0.0	978975.766	0.017	45.339	0.500	-107.580	0.500
D 1096 1977	30	21.20	103	39.10	1385.07	0.01	978971.457	0.017	47.134	0.500	-107.855	0.500
H 454 1935	30	2.20	104	11.80	1641.01	0.0	978853.933	0.013	33.457	0.500	-150.172	0.500
K 706 1943	30	19.40	103	37.70	1426.81	0.0	978959.066	0.017	49.986	0.500	-109.673	0.500
F 1096 1977	30	18.00	103	36.00	1568.69	0.01	978925.113	0.017	61.654	0.500	-113.883	0.500
G 1096 1977	30	17.50	103	35.70	1592.00	0.0	978919.790	0.017	64.179	0.500	-113.966	0.500
H 1096 1977	30	16.90	103	35.10	1571.24	0.02	978923.547	0.017	62.316	0.500	-113.505	0.500
Q 706 1943	30	16.60	103	35.10	1582.97	0.02	978920.865	0.017	63.648	0.500	-113.486	0.500
D 1097 1977	30	35.70	103	53.30	1488.00	0.01	978958.763	0.017	47.124	0.500	-119.383	0.500
E 1097 1977	30	36.30	103	53.20	1474.39	0.01	978962.764	0.017	46.134	0.500	-118.850	0.500
F 1097 1977	30	36.30	103	53.70	1485.41	0.0	978958.636	0.017	45.405	0.500	-120.812	0.500
G 1097 1977	30	36.20	103	54.40	1493.80	0.0	978954.974	0.011	44.466	0.500	-122.690	0.500
H 1097 1977	30	36.00	103	55.00	1499.38	0.02	978951.181	0.017	42.658	0.500	-125.122	0.500
J 1097 1977	30	36.00	103	55.50	1510.04	0.0	978947.375	0.017	42.141	0.500	-126.832	0.500
K 1097 1977	30	36.00	103	56.00	1523.05	0.02	978943.211	0.017	41.995	0.500	-128.435	0.500
L 1097 1977	30	36.40	103	56.40	1520.09	0.0	978942.762	0.017	40.102	0.500	-129.996	0.500

ADJUSTED VALUES OF GRAVITY (CONT'D.)

STATION	LATITUDE DEG	LATITUDE MIN	LONGITUDE DEG	LONGITUDE MIN	ELEVATION (M) PRI	ELEVATION (M) SEC	GRAVITY MGAL	GRAVITY SIG	FREE-AIR ANOM. MGAL	FREE-AIR ANOM. SIG	BOUGUER ANOM. MGAL	BOUGUER ANOM. SIG
M 1097 1977	30	36.30	103	56.80	1530.25	0.0	978938.893	0.011	39.501	0.500	-131.734	0.500
N 1097 1977	30	37.10	103	56.90	1546.93	0.02	978936.556	0.016	41.255	0.500	-131.846	0.500
P 1097 1977	30	37.30	103	56.80	1574.93	0.02	978931.418	0.016	44.494	0.500	-131.740	0.500
Q 1097 1977	30	37.40	103	57.00	1596.72	0.02	978927.249	0.016	46.917	0.500	-131.756	0.500
R 1097 1977	30	37.70	103	56.90	1612.92	0.02	978924.284	0.016	48.555	0.500	-131.930	0.500
HARVARD 1977	30	38.20	103	56.80	1603.36	0.0	978927.341	0.016	48.004	0.500	-131.412	0.500
S 1097 1977	30	36.60	103	57.70	1557.20	0.02	978932.348	0.016	40.877	0.500	-133.374	0.500
T 1097 1977	30	36.40	103	58.30	1569.75	0.0	978928.922	0.016	41.588	0.500	-134.067	0.500
U 1097 1977	30	36.40	103	58.60	1595.28	0.0	978922.839	0.016	43.384	0.500	-135.128	0.500
V 1097 1977	30	36.50	103	59.30	1568.41	0.0	978927.341	0.013	39.460	0.500	-136.045	0.500
W 1097 1977	30	36.80	104	0.00	1581.82	0.0	978924.313	0.016	40.175	0.500	-136.830	0.500
X 1097 1977	30	37.50	104	0.50	1595.07	0.0	978922.104	0.016	41.131	0.500	-137.357	0.500
Y 1097 1977	30	38.20	104	1.00	1614.53	0.0	978918.431	0.013	42.540	0.500	-138.126	0.500
Z 1097 1977	30	38.80	104	1.10	1647.16	0.02	978912.130	0.016	45.518	0.500	-138.800	0.500
A 1098 1977	30	39.20	104	1.20	1702.48	-0.08	978901.112	0.017	51.043	0.500	-139.465	0.500
B 1098 1977	30	39.40	104	1.10	1724.27	0.02	978897.192	0.017	53.580	0.500	-139.365	0.500
C 1098 1977	30	39.20	104	1.20	1713.69	-0.06	978899.605	0.017	52.994	0.500	-138.768	0.500
D 1098 1977	30	39.20	104	1.40	1743.08	0.02	978893.586	0.017	56.046	0.500	-139.005	0.500
E 1098 1977	30	39.20	104	1.70	1769.36	-0.01	978887.243	0.017	57.810	0.500	-140.181	0.500
F 1098 1977	30	39.90	104	2.00	1803.81	0.02	978879.923	0.017	60.199	0.500	-141.648	0.500
L 1098 1977	30	40.80	104	1.50	1884.33	0.0	978865.845	0.010	69.780	0.500	-141.077	0.500
G 1098 1977	30	40.10	104	2.10	1850.20	-0.12	978871.844	0.017	66.172	0.500	-140.866	0.500
H 1098 1977	30	40.30	104	2.00	1856.94	0.02	978871.294	0.017	67.437	0.500	-140.355	0.500
J 1098 1977	30	40.30	104	1.70	1855.75	0.02	978870.462	0.017	66.239	0.500	-141.420	0.500
K 1098 1977	30	40.70	104	1.70	1865.62	0.02	978870.063	0.017	68.357	0.500	-140.406	0.500
M 1098 1977	30	40.60	104	1.20	1914.61	0.0	978858.164	0.017	71.708	0.500	-142.537	0.500
N 1098 1977	30	40.50	104	1.10	1944.89	0.02	978850.828	0.017	73.848	0.500	-143.785	0.500
P 1098 1977	30	40.40	104	1.10	1968.57	0.02	978844.639	0.011	75.098	0.500	-145.185	0.500
A 1097 1977	30	40.40	104	1.10	1986.08	0.02	978839.750	0.016	75.612	0.500	-146.630	0.500
VALIDATION 1	30	40.40	104	1.00	1987.13	0.02	978839.613	0.016	75.801	0.500	-146.559	0.500

ADJUSTED VALUES OF GRAVITY (CONT'D.)

STATION	LATITUDE DEG	LATITUDE MIN	LONGITUDE DEG	LONGITUDE MIN	ELEVATION (M) PRI	ELEVATION (M) SEC	GRAVITY MGAL	GRAVITY SIG	FREE-AIR ANOM. MGAL	FREE-AIR ANOM. SIG	BOUGUER ANOM. MGAL	BOUGUER ANOM. SIG
B 1097 1977	30	40.40	104	1.00	1982.48	0.02	978841.338	0.016	76.092	0.500	-145.748	0.500
VALIDATION 2	30	40.40	104	1.00	1983.04	0.01	978841.141	0.016	76.065	0.500	-145.837	0.500
VALIDATION 3	30	40.40	104	1.00	1980.49	0.02	978842.006	0.016	76.144	0.500	-145.473	0.500
C 1097 1977	30	40.50	104	1.00	1986.58	0.02	978840.913	0.016	76.798	0.500	-145.500	0.500
Q 1098 1977	30	40.40	104	1.20	1996.84	-0.09	978837.507	0.016	76.690	0.500	-146.757	0.500
R 1098 1977	30	40.40	104	1.30	2024.05	0.02	978830.725	0.016	78.306	0.500	-148.185	0.500
S 1098 1977	30	40.40	104	1.40	2047.06	0.02	978824.632	0.016	79.314	0.500	-149.753	0.500
T 1098 1977	30	40.30	104	1.50	2050.88	0.02	978823.383	0.016	79.375	0.500	-150.118	0.500
MCDONALD RM3	30	40.30	104	1.30	2066.57	0.0	978818.965	0.016	79.797	0.500	-151.451	0.500
MCDONALD RM4	30	40.30	104	1.30	2065.89	0.0	978819.096	0.016	79.721	0.500	-151.452	0.500
MCDONALD RM2	30	40.30	104	1.40	2065.45	0.0	978819.141	0.016	79.628	0.500	-151.495	0.500
MCDONALD	30	40.30	104	1.40	2066.48	0.01	978818.918	0.016	79.726	0.500	-151.514	0.500
TIDE SITE	30	40.30	104	1.30	2066.00	0.0	978818.780	0.016	79.438	0.500	-151.748	0.500
YY 1101 1957	30	18.10	103	48.30	1513.53	0.02	978930.566	0.013	49.952	0.500	-119.411	0.500
MCIVOR RM2	30	38.10	103	57.70	1750.00	0.0	978893.879	0.013	59.926	0.500	-135.899	0.500
L 731 1943	30	16.00	104	33.50	1380.68	0.0	978936.091	0.017	17.236	0.500	-137.263	0.500
Z 1095 1977	30	21.90	103	38.90	1398.85	0.0	978969.507	0.013	48.520	0.500	-108.012	0.500
28 WR 3968	31	7.50	104	12.30	1209.30	0.0	979059.591	0.013	19.792	0.500	-115.529	0.500
S 1108 1957	30	57.00	104	51.50	1239.01	0.0	979019.372	0.013	2.707	0.500	-135.938	0.500

APPENDIX D.--INPUT AND OUTPUT SECTIONS OF PROGRAM HAVAGO

Using a run of the "best available" data, the input and output sections of program HAVAGO are reproduced in this section.

STATION DATA

STATION NUMBER	GEODETIC LAT. / ASTRONOMIC LAT.	GEODETIC LON. / ASTRONOMIC LON.	GEOD.HT.	GEOD. / ASTR.	ST. ERRORS (M) / ST. ERRORS		STATION NAME (X Y Z)	CODES
1	30 40 16.79375	104 1 19.37460	2068.730	0.001	0.001	0.001	MCDONALD RM 4 1977	1 1 1
1	30 40 16.43	104 1 20.11		0.30	0.30			
2	30 38 10.42700	103 56 48.68300	1606.200	0.0	0.0	0.0	HARVARD 1977	0 0 0
2	30 38 11.34	103 56 51.30		0.30	0.30			
3	30 38 4.62900	103 57 44.37000	1741.200	0.0	0.0	0.0	MCIVOR 1977	0 0 0
3	30 38 5.74	103 57 45.82		0.30	0.30			
4	30 40 36.75200	104 0 55.60500	1986.000	0.0	0.0	0.0	MOBLAS 1979	0 0 0
4	30 40 36.56	104 0 55.72		0.30	0.30			
5	30 38 11.64000	103 56 48.38400	1605.500	0.0	0.0	0.0	HRAS 85	0 0 0
5	0 0 0.0	0 0 0.0		10.00	15.00			
6	30 38 11.64000	103 56 48.38400	1619.800	0.0	0.0	0.0	HRAS VLBI REF. POINT	0 0 0
6	0 0 0.0	0 0 0.0		10.00	15.00			
7	30 40 17.82600	104 1 17.42100	2077.600	0.0	0.0	0.0	MCDONALD OBSERVATORY 107	0 0 0
7	0 0 0.0	0 0 0.0		10.00	15.00			
8	30 40 36.75200	104 0 55.60500	1989.600	0.0	0.0	0.0	MOBLAS 7086 REF. POINT 8/79	0 0 0
8	0 0 0.0	0 0 0.0		10.00	15.00			
9	30 40 17.80800	104 1 17.42500	2082.900	0.0	0.0	0.0	MCDONALD LURE 107 REF. POINT	0 0 0
9	0 0 0.0	0 0 0.0		10.00	15.00			
10	30 40 18.40500	104 1 18.41400	2064.500	0.0	0.0	0.0	TLRS 7897	0 0 0
10	0 0 0.0	0 0 0.0		10.00	15.00			
11	30 38 7.61900	104 10 23.61100	2556.800	0.0	0.0	0.0	BALDY 1917	0 0 0
11	0 0 0.0	0 0 0.0		10.00	15.00			
12	30 33 54.61000	104 1 20.68000	2231.500	0.0	0.0	0.0	BLUE 1942 RM 3	0 0 0
12	0 0 0.0	0 0 0.0		10.00	15.00			
13	30 40 18.40400	104 1 18.41420	2067.719	0.0	0.0	0.0	TLRS 7897 (0101) REF PT 2/80	0 0 0
13	0 0 0.0	0 0 0.0		10.00	15.00			
14	30 40 18.40400	104 1 18.41420	2067.855	0.0	0.0	0.0	TLRS 7897 (0102) REF PT 2/80	0 0 0
14	0 0 0.0	0 0 0.0		10.00	15.00			
100	30 40 16.23500	104 1 20.60900	2069.300	0.0	0.0	0.0	MCDONALD 1942	0 0 0
100	0 0 0.0	0 0 0.0		10.00	15.00			
101	30 40 16.00600	104 1 21.12500	2068.300	0.0	0.0	0.0	MCDONALD RM 1 1942	0 0 0
101	0 0 0.0	0 0 0.0		10.00	15.00			
102	30 40 16.44200	104 1 20.98800	2068.800	0.0	0.0	0.0	MCDONALD RM 2 1942	0 0 0
102	0 0 0.0	0 0 0.0		10.00	15.00			

STATION DATA

STATION NUMBER	GEODETIC LAT. / ASTRONOMIC LAT.	GEODETIC LON. / ASTRONOMIC LON.	GEOD.HT.	GEOD. / ASTR.	ST. / ST. ERRORS	ERRORS (M)	STATION NAME / X	Y	Z	CODES
103	30 40 16.94200	104 1 19.46500	2069.400	0.0	0.0	0.0	MCDONALD RM 3 1942	1971		0 0 0
103	0 0 0.0	0 0 0.0		10.00	15.00					
203	30 38 8.33200	103 56 47.70100	1608.500	0.0	0.0	0.0	HARVARD RM 3 1979			0 0 0
203	0 0 0.0	0 0 0.0		10.00	15.00					
204	30 38 9.03100	103 56 47.36000	1608.200	0.0	0.0	0.0	HARVARD RM 4 1980			0 0 0
204	0 0 0.0	0 0 0.0		10.00	15.00					
205	30 38 8.26800	103 56 48.64100	1608.000	0.0	0.0	0.0	HARVARD RM 5 1980			0 0 0
205	0 0 0.0	0 0 0.0		10.00	15.00					
206	30 38 9.07700	103 56 48.38300	1607.500	0.0	0.0	0.0	HARVARD RM 6 1980			0 0 0
206	0 0 0.0	0 0 0.0		10.00	15.00					

DIRECTIONS

	FROM	TO	LIST	OBSERVED	MM	SEC.	
1	3	1	1	0 0 0.0	1.0	1.5	BENDIX CORP 8/25/79
2	3	4	1	7 12 7.95	1.0	1.5	T-3 NO. 74588
3	3	2	1	137 42 11.01	1.0	1.5	V. NELSON OBSERVER
4	4	1	2	0 0 0.0	1.0	1.5	ALL OBSERVATIONS
5	4	3	2	266 46 5.16	1.0	1.5	THRU LIST NO. 5
6	4	3	3	0 0 0.0	1.0	1.5	
7	4	1	3	93 13 55.15	1.0	1.5	
8	1	3	4	0 0 0.0	1.0	1.5	
9	1	4	4	280 26 6.40	1.0	1.5	
10	1	4	5	0 0 0.0	1.0	1.5	
11	1	3	5	79 33 53.56	1.0	1.5	
12	2	3	9	0 0 0.0	1.0	1.5	NGS T-3 1/23/80
13	2	5	9	108 54 3.90	1.0	1.5	
14	2	204	9	237 24 44.60	1.0	10.0	
15	2	203	9	254 47 25.40	1.0	10.0	
16	2	206	9	265 59 16.70	1.0	10.0	
17	2	205	9	275 54 6.50	1.0	10.0	
18	5	3	10	0 0 0.0	1.0	1.5	NGS T-3 1/23/80
19	5	205	10	282 0 43.40	1.0	10.0	
20	5	2	10	290 16 36.00	1.0	1.5	
21	100	101	11	0 0 0.0	1.0	20.0	NGS T-3 1/20/71
22	100	102	11	59 23 36.90	1.0	20.0	
23	100	103	11	171 38 46.20	1.0	20.0	
24	100	103	13	0 0 0.0	1.0	20.0	NGS T-3 6/22/77
25	100	1	13	7 55 4.40	1.0	20.0	
26	100	101	13	188 20 41.90	1.0	20.0	
27	100	102	13	247 45 3.90	1.0	20.0	
28	100	101	14	0 0 0.0	1.0	20.0	NGS 1941
29	100	102	14	59 23 19.00	1.0	20.0	
30	100	103	15	0 0 0.0	1.0	10.0	DMA 1975
31	100	101	15	188 20 4.20	1.0	10.0	
32	100	102	15	247 44 49.80	1.0	10.0	
33	102	100	16	0 0 0.0	1.0	10.0	DMA 1975
34	102	101	16	72 58 30.00	1.0	10.0	
35	101	102	17	0 0 0.0	1.0	10.0	DMA 1975
36	101	100	17	47 36 24.80	1.0	10.0	
37	103	100	18	0 0 0.0	1.0	10.0	NASA 2/80 WILD T3
38	103	10	18	157 22 36.30	1.0	10.0	
39	10	1	19	0 0 0.0	1.0	1.0	NGS 5/80
40	10	103	19	4 33 53.14	1.0	1.0	NGS 5/80
41	10	4	19	199 47 49.04	1.0	1.0	NGS 5/80
42	7	1	20	0 0 0.0	1.0	1.0	NGS 5/80
43	7	103	20	4 51 15.94	1.0	1.0	NGS 5/80
44	1	2	21	0 0 0.0	1.0	1.0	NGS 5/80
45	1	3	21	7 2 57.24	1.0	1.0	NGS 5/80
46	1	10	21	268 54 53.09	1.0	1.0	NGS 5/80
47	1	4	21	287 29 1.54	1.0	1.0	NGS 5/80
48	4	1	22	0 0 0.0	1.0	1.0	NGS 5/80
49	4	10	22	1 13 42.09	1.0	1.0	NGS 5/80
50	2	12	6	0 0 0.0	1.0	1.0	5/27/77 T-3 NGS

DIRECTIONS

	FROM	TO	LIST	OBSERVED	MM	SEC.	
51	2	3	6	40 31 14.48	1.0	1.0	
52	2	1	6	75 45 57.98	1.0	1.0	
53	1	2	7	0 0 0.0	1.0	1.0	5/26/77 NGS
54	1	3	7	7 2 57.08	1.0	1.0	
55	1	12	7	61 48 46.80	1.0	1.0	
56	1	11	7	136 20 19.14	1.0	1.0	
57	1	7	7	300 11 34.50	1.0	1.0	
58	1	11	23	0 0 0.0	1.0	9.0	6/22/77 T-3 NGS
59	1	100	23	347 41 20.20	1.0	9.0	
60	3	12	8	0 0 0.0	1.0	1.0	5/25/77 T-3 NGS
61	3	11	8	53 29 44.42	1.0	1.0	
62	3	1	8	88 36 27.68	1.0	1.0	
63	3	2	8	226 18 48.43	1.0	1.0	
64	11	1	24	0 0 0.0	1.0	1.0	5/21/77 T-3 NGS
65	11	3	24	15 35 51.83	1.0	1.0	
66	11	12	24	43 39 46.63	1.0	1.0	
67	12	11	25	0 0 0.0	1.0	1.0	5/24/77 T-3 NGS
68	12	1	25	61 48 38.71	1.0	1.0	
69	12	3	25	98 26 19.59	1.0	1.0	
70	12	2	25	104 13 52.32	1.0	1.0	

ASTRONOMIC AZIMUTHS

	FROM	TO	OBSERVED	MM	SEC.			
71	1	3	125 23 46.78	1.0	1.5	RM	5/30/78	DKM 3A
72	1	3	125 23 46.60	1.0	1.5	BEK	5/30/78	DKM 3A
73	1	3	125 23 45.88	1.0	1.5	BEK	6/05/78	DKM 3A
74	1	3	125 23 46.80	1.0	1.5	RM	6/05/78	DKM 3A
75	2	3	263 8 20.85	1.0	1.5	RM	5/31/78	DKM 3A
76	2	3	263 8 20.05	1.0	1.5	BEK	5/31/78	DKM 3A
77	2	3	263 8 19.48	1.0	1.5	BEK	6/06/78	DKM 3A
78	2	3	263 8 19.96	1.0	1.5	RM	6/06/78	DKM 3A
79	1	2	118 20 50.22	1.0	1.5	RM	5/30/78	DKM 3A
80	1	2	118 20 48.51	1.0	1.5	BEK	5/30/78	DKM 3A
81	1	2	118 20 48.77	1.0	1.5	BEK	6/05/78	DKM 3A
82	1	2	118 20 49.30	1.0	1.5	RM	6/05/78	DKM 3A
83	2	1	298 23 6.20	1.0	1.5	RM	5/31/78	DKM 3A
84	2	1	298 23 5.29	1.0	1.5	BEK	5/31/78	DKM 3A
85	2	1	298 23 5.73	1.0	1.5	BEK	6/06/78	DKM 3A
86	2	1	298 23 6.10	1.0	1.5	RM	6/06/78	DKM 3A
87	3	1	305 25 34.42	1.0	1.5	BEK	5/07/79	DKM 3A
88	3	2	83 7 50.15	1.0	1.5	BEK	5/07/79	DKM 3A
89	3	1	305 25 35.98	1.0	1.5	RM	5/08/79	DKM 3A
90	3	2	83 7 49.86	1.0	1.5	RM	5/08/79	DKM 3A
91	3	1	305 25 33.61	1.0	1.5	BEK	5/09/79	DKM 3A
92	3	2	83 7 50.75	1.0	1.5	BEK	5/09/79	DKM 3A
93	3	1	305 25 35.88	1.0	1.5	RM	5/14/79	DKM 3A
94	3	2	83 7 53.00	1.0	1.5	RM	5/14/79	DKM 3A

RECIPROCAL VERTICAL ANGLES

	FROM	TO	OBSERVED	MM	SEC.	H.I.	H.T.	OBSERVED	SEC.	MM	H.I.	H.T.	
96	1	2	93 18 15.10	2.0	1.0	6.844	1.022	86 45 51.53	2.0	1.0	1.908	7.240	
98	1	2	93 18 17.74	2.0	1.0	6.844	1.022	86 45 54.45	2.0	1.0	1.908	7.240	
100	1	2	93 18 16.81	2.0	1.0	6.844	1.022	86 45 55.82	2.0	1.0	1.908	7.240	
102	1	2	93 18 17.09	2.0	1.0	6.844	1.022	86 45 53.39	2.0	1.0	1.908	7.240	
104	1	2	93 18 15.93	2.0	1.0	6.844	1.022	86 45 49.33	2.0	1.0	1.908	7.240	
106	1	2	93 18 14.67	2.0	1.0	6.844	1.022	86 45 49.92	2.0	1.0	1.908	7.240	
108	11	12	91 12 11.40	7.0	5.0	0.0	0.0	88 55 59.90	7.0	5.0	0.400	0.0	
110	11	1	91 54 15.50	7.0	5.0	-4.870	0.0	88 13 12.70	7.0	5.0	5.050	0.0	
112	11	3	92 23 37.00	7.0	5.0	-0.070	0.0	87 46 14.40	7.0	5.0	-0.070	0.0	
114	12	2	93 23 25.20	7.0	5.0	0.550	0.0	86 42 5.80	7.0	5.0	-0.230	0.0	
116	12	1	90 48 58.50	7.0	5.0	-4.790	0.0	89 16 59.20	7.0	5.0	5.350	0.0	
118	12	3	92 57 21.30	7.0	5.0	-0.040	0.0	87 7 16.90	7.0	5.0	-0.260	0.0	
120	12	3	92 57 40.50	7.0	5.0	0.860	0.0	87 7 9.60	7.0	5.0	0.370	0.0	
122	12	2	93 23 20.80	7.0	5.0	0.350	0.0	86 42 10.20	7.0	5.0	-0.120	0.0	
124	12	1	90 48 55.90	7.0	5.0	-4.890	0.0	89 16 49.50	7.0	5.0	4.860	0.0	
-124	103	10	95 24 31.40	2.0	5.0	1.849	1.726	85 3 6.60	2.0	5.0	1.927	1.640	*
-124	103	7	82 4 5.00	2.0	5.0	1.849	2.118	97 48 0.40	2.0	5.0	2.224	2.070	*
-124	1	10	98 59 16.20	2.0	5.0	6.828	1.783	80 39 40.20	2.0	5.0	1.927	6.906	*
-124	1	7	86 14 4.00	2.0	5.0	6.828	1.976	94 11 49.50	2.0	5.0	2.224	6.612	*
-124	4	1	84 19 41.60	2.0	5.0	1.825	6.906	95 41 34.50	2.0	5.0	6.825	1.629	*
-124	4	10	84 34 53.80	2.0	5.0	1.825	1.924	95 25 46.80	2.0	5.0	1.927	1.580	*

GROUPED VERTICAL ANGLES

	FROM	TO	LIST	OBSERVED	MM	SEC.	H.I.	H.T.	K1	K2	
125	1	2	1	93 18 1.82	2.0	1.0	6.845	1.545	0.0	0.0	RM 5/30/78 DKM 3A
126	1	2	1	93 17 59.31	2.0	1.0	6.845	1.545	0.0	0.0	BEK 5/31/78 DKM 3A
127	2	1	1	86 45 53.24	2.0	1.0	1.749	6.793	0.0	0.0	RM 5/31/78 DKM 3A
128	2	1	1	86 45 51.79	2.0	1.0	1.749	6.793	0.0	0.0	BEK 6/01/78 DKM 3A
129	1	2	2	93 17 58.75	2.0	1.0	6.845	1.545	0.0	0.0	BEK 6/05/78 DKM 3A
130	1	2	2	93 18 0.93	2.0	1.0	6.845	1.545	0.0	0.0	RM 6/05/78 DKM 3A
131	2	1	2	86 45 52.07	2.0	1.0	1.749	6.793	0.0	0.0	BEK 6/06/78 DKM 3A
132	2	1	2	86 45 50.91	2.0	1.0	1.749	6.793	0.0	0.0	RM 6/06/78 DKM 3A
133	1	3	11	92 44 20.51	2.0	1.0	6.844	1.508	0.0	0.0	BEK 5/10/79 DKM 3A
134	2	3	11	84 51 10.39	2.0	1.0	1.919	1.661	0.0	0.0	RM 5/10/79 T-4
135	1	3	4	92 44 24.99	2.0	1.0	6.844	1.508	0.0	0.0	RM 5/11/79 DKM 3A
136	2	3	4	84 51 11.57	2.0	1.0	1.919	1.661	0.0	0.0	BEK 5/11/79 T-4
137	1	3	12	92 44 27.27	2.0	1.0	6.844	1.508	0.0	0.0	BEK 5/10/79 DKM 3A
138	2	3	12	84 51 10.36	2.0	1.0	1.919	1.661	0.0	0.0	RM 5/10/79 T-4
139	1	3	5	92 44 26.20	2.0	1.0	6.844	1.508	0.0	0.0	RM 5/11/79 DKM 3A
140	2	3	5	84 51 8.22	2.0	1.0	1.919	1.661	0.0	0.0	BEK 5/11/79 T-4
141	1	3	3	92 44 25.68	2.0	1.0	6.844	1.508	0.0	0.0	BEK 5/10/79 DKM 3A
142	2	3	3	84 51 9.40	2.0	1.0	1.919	1.661	0.0	0.0	RM 5/10/79 T-4
143	1	3	6	92 44 25.03	2.0	1.0	6.844	1.508	0.0	0.0	RM 5/11/79 DKM 3A
144	2	3	6	84 51 7.80	2.0	1.0	1.919	1.661	0.0	0.0	BEK 5/11/79 T-4
145	3	1	7	87 18 56.59	2.0	1.0	1.717	6.788	0.0	0.0	BEK 5/07/79
146	3	2	7	95 10 24.61	2.0	1.0	1.717	1.540	0.0	0.0	BEK 5/07/79
147	3	1	8	87 18 59.89	2.0	1.0	1.717	6.788	0.0	0.0	RM 5/08/79
148	3	2	8	95 10 31.31	2.0	1.0	1.717	1.540	0.0	0.0	RM 5/08/79
149	3	1	9	87 18 58.21	2.0	1.0	1.717	6.788	0.0	0.0	BEK 5/09/79
150	3	2	9	95 10 28.56	2.0	1.0	1.717	1.540	0.0	0.0	BEK 5/09/79
151	3	1	10	87 18 59.61	2.0	1.0	1.717	6.788	0.0	0.0	RM 5/14/79
152	3	2	10	95 10 31.80	2.0	1.0	1.717	1.540	0.0	0.0	RM 5/14/79
153	2	1	13	86 45 58.87	2.0	1.0	1.740	6.757	0.0	0.0	NGS 1/24/80 T-3
154	1	2	13	93 17 59.94	2.0	1.0	6.815	1.539	0.0	0.0	NGS 1/24/80 T-3

ABSOLUTE DISTANCES

	FROM	TO	OBSERVED	MM	PPM	H.I.	H.T.	
155	1	2	8206.2590	10.0	2.00	6.730	1.580	5/26/77 AGA MOD8
156	1	2	8206.2730	10.0	2.00	6.730	1.580	5/26/77 AGA MOD8
157	1	2	8206.2510	10.0	2.00	6.730	1.580	5/26/77 AGA MOD8
158	2	1	8206.2640	10.0	2.00	1.730	6.720	6/18/77 RMASTER II
159	2	1	8206.2580	10.0	2.00	1.650	6.710	5/27/77 AGA MOD8
160	2	1	8206.2800	10.0	2.00	1.650	6.710	5/27/77 AGA MOD8
161	2	1	8206.2660	10.0	2.00	1.650	6.710	5/27/77 AGA MOD8
162	1	3	7033.7940	10.0	2.00	6.730	1.590	5/26/77 AGA MOD8
163	1	3	7033.8160	10.0	2.00	6.730	1.590	5/26/77 AGA MOD8
164	1	3	7033.7960	10.0	2.00	6.730	1.590	5/26/77 AGA MOD8
165	3	1	7033.7860	10.0	2.00	1.690	6.720	6/18/77 RMASTER II
166	2	3	1500.1170	5.0	2.00	1.650	1.590	6/20/77 HP3800 NGS
167	2	3	1500.1390	10.0	2.00	1.650	1.520	5/27/77 AGA MOD8
-167	2	3	1500.1530	10.0	2.00	1.650	1.520	5/27/77 AGA MOD8 *
168	2	3	1500.1440	10.0	2.00	1.650	1.520	5/27/77 AGA MOD8
169	3	2	1500.1350	10.0	2.00	1.690	1.600	6/18/77 RMASTER II
170	3	2	1500.1230	5.0	2.00	1.610	1.610	6/20/77 HP3800 NGS
171	3	4	6925.1460	10.0	2.00	1.706	4.323	1/23/80 RANGER IV
172	4	3	6925.0020	10.0	3.00	1.765	1.660	BENDIX CORP 8/25/79
-172	4	1	886.5760	10.0	3.00	1.765	5.257	BENDIX CORP 8/25/79*
173	5	3	1512.9460	10.0	2.00	1.555	1.546	1/24/80 RANGER IV
174	5	3	1512.9530	10.0	2.00	1.555	1.563	1/23/80 RANGER IV
175	3	5	1512.9910	10.0	2.00	1.706	1.407	1/23/80 RANGER IV
176	2	206	42.3450	5.0	2.00	1.705	1.430	1/18/80 HP3800
177	2	205	66.5220	5.0	2.00	1.705	1.450	1/18/80 HP3800
178	2	204	55.7060	5.0	2.00	1.705	1.550	1/18/80 HP3800
179	2	203	69.6520	5.0	2.00	1.705	1.514	1/18/80 HP3800
180	2	203	69.6560	5.0	2.00	1.705	1.514	1/18/80 HP3800
181	203	2	69.6520	5.0	2.00	1.624	1.595	1/18/80 HP3800
182	203	2	69.6550	5.0	2.00	1.624	1.595	1/18/80 HP3800
183	205	5	104.1110	5.0	2.00	1.450	1.403	1/21/80 HP3800
184	5	205	104.1090	5.0	2.00	1.513	1.340	1/21/80 HP3800
185	7	1	61.0720	5.0	2.00	1.550	6.680	6/22/77 HP3800
186	7	1	61.0810	5.0	2.00	1.730	6.680	6/22/77 MA100
187	7	1	61.0790	5.0	2.00	1.730	6.680	6/22/77 MA100
188	103	10	53.2280	5.0	1.00	1.410	1.655	NASA 2/80 AGA 76
189	103	10	53.2260	5.0	1.00	1.410	1.655	NASA 2/80 AGA 76
190	103	10	53.2270	5.0	1.00	1.410	1.655	NASA 2/80 AGA 76
191	2	5	38.2050	1.0	0.0	0.0	0.0	NGS TRAV. 1/80
192	204	203	23.4150	1.0	0.0	0.0	0.0	NGS TRAV. 1/80
193	205	203	25.1270	1.0	0.0	0.0	0.0	NGS TRAV. 1/80
194	203	206	29.2900	1.0	0.0	0.0	0.0	NGS TRAV. 1/80
195	204	206	27.4330	1.0	0.0	0.0	0.0	NGS TRAV. 1/80
196	206	205	25.8590	1.0	0.0	0.0	0.0	NGS TRAV. 1/80
197	100	101	15.4810	3.0	0.0	0.0	0.0	DMA TAPED 3/75
198	100	102	11.9440	3.0	0.0	0.0	0.0	DMA TAPED 3/75
199	101	102	13.9140	3.0	0.0	0.0	0.0	DMA TAPED 3/75
200	103	100	37.4680	3.0	0.0	0.0	0.0	DMA TAPED 3/75
201	103	1	5.2020	3.0	0.0	0.0	0.0	NGS TRAV. 6/77
202	100	101	15.4800	3.0	0.0	0.0	0.0	NGS TRAV. 6/77
203	1	100	37.1160	3.0	0.0	0.0	0.0	NGS TRAV. 6/77
204	103	100	37.4640	3.0	0.0	0.0	0.0	NGS TRAV. 6/77

ABSOLUTE DISTANCES

	FROM	TO	OBSERVED	MM	PPM	H.I.	H.T.	
205	100	103	37.4620	3.0	0.0	0.0	0.0	NGS 1/71 TRAVERSE
206	100	101	15.4780	3.0	0.0	0.0	0.0	NGS 1/71 TAPED
207	100	102	11.9410	3.0	0.0	0.0	0.0	NGS 1/71 TAPED
208	10	103	53.2400	5.0	2.00	1.930	1.624	NGS HP3800 5/80
209	10	103	53.2530	5.0	2.00	1.909	1.640	NGS HP3800 5/80
210	10	1	56.5960	5.0	2.00	1.909	6.906	NGS HP3800 5/80
211	103	10	53.2800	5.0	2.00	1.844	1.712	NGS HP3800 5/80
212	4	10	833.2440	5.0	2.00	1.790	2.154	NGS HP3800 5/80
213	4	1	886.5950	5.0	2.00	1.790	6.906	NGS HP3800 5/80
214	103	1	5.2010	1.0	0.0	0.0	0.0	NGS TRAVERSE 5/80
215	7	103	61.4050	5.0	2.00	2.216	2.070	NGS HP3800 5/80
216	7	1	61.1220	5.0	2.00	2.216	6.612	NGS HP3800 5/80
217	2	12	10723.4790	10.0	1.00	1.730	1.750	6/18/77 RMASTER II
218	3	12	9631.1220	10.0	1.00	1.690	1.750	6/18/77 RMASTER II
219	12	1	11774.2180	10.0	1.00	1.850	6.720	6/18/77 RMASTER II
220	12	3	9631.1300	10.0	1.00	1.850	1.590	6/18/77 RMASTER II
221	12	2	10723.4690	10.0	1.00	1.850	1.620	6/18/77 RMASTER II
222	11	3	20240.2520	10.0	1.00	1.570	1.570	5/21/77 AGA MOD8
223	11	3	20240.2490	10.0	1.00	1.570	1.570	5/21/77 AGA MOD8
224	11	3	20240.2380	10.0	1.00	1.570	1.570	5/21/77 AGA MOD8
225	11	1	15037.9070	10.0	1.00	1.570	6.710	5/21/77 AGA MOD8
226	11	1	15037.9130	10.0	1.00	1.570	6.710	5/21/77 AGA MOD8
227	11	1	15037.9160	10.0	1.00	1.570	6.710	5/21/77 AGA MOD8
228	11	12	16437.9590	10.0	1.00	1.570	1.760	5/21/77 AGA MOD8
229	11	12	16437.9590	10.0	1.00	1.570	1.760	5/21/77 AGA MOD8
230	11	12	16437.9690	10.0	1.00	1.570	1.760	5/21/77 AGA MOD8
231	12	3	9631.1460	10.0	1.00	1.760	1.590	5/24/77 AGA MOD8
232	12	3	9631.1360	10.0	1.00	1.760	1.590	5/24/77 AGA MOD8
233	12	3	9631.1320	10.0	1.00	1.760	1.590	5/24/77 AGA MOD8
234	12	11	16437.9960	10.0	1.00	1.760	1.550	5/24/77 AGA MOD8
235	12	11	16437.9740	10.0	1.00	1.760	1.550	5/24/77 AGA MOD8
236	12	11	16437.9860	10.0	1.00	1.760	1.550	5/24/77 AGA MOD8
237	12	2	10723.4610	10.0	1.00	1.760	1.600	5/24/77 AGA MOD8
238	12	2	10723.4410	10.0	1.00	1.760	1.600	5/24/77 AGA MOD8
239	12	2	10723.4640	10.0	1.00	1.760	1.600	5/24/77 AGA MOD8
240	12	1	11774.2220	10.0	1.00	1.760	6.700	5/24/77 AGA MOD8
241	12	1	11774.2170	10.0	1.00	1.760	6.700	5/24/77 AGA MOD8
242	12	1	11774.2100	10.0	1.00	1.760	6.700	5/24/77 AGA MOD8
243	3	12	9631.1240	10.0	1.00	1.610	1.720	5/25/77 AGA MOD8
244	3	12	9631.1300	10.0	1.00	1.610	1.720	5/25/77 AGA MOD8
245	3	12	9631.1220	10.0	1.00	1.610	1.720	5/25/77 AGA MOD8
246	3	11	20240.2980	10.0	1.00	1.610	1.770	5/25/77 AGA MOD8
247	3	11	20240.2810	10.0	1.00	1.610	1.770	5/25/77 AGA MOD8
248	3	11	20240.2790	10.0	1.00	1.610	1.770	5/25/77 AGA MOD8
249	1	11	15037.9350	10.0	1.00	6.730	1.520	5/26/77 AGA MOD8
250	1	11	15037.9370	10.0	1.00	6.730	1.520	5/26/77 AGA MOD8
251	1	11	15037.9250	10.0	1.00	6.730	1.520	5/26/77 AGA MOD8
252	1	12	11774.2100	10.0	1.00	6.730	1.720	5/26/77 AGA MOD8
253	1	12	11774.2150	10.0	1.00	6.730	1.720	5/26/77 AGA MOD8
254	1	12	11774.2070	10.0	1.00	6.730	1.720	5/26/77 AGA MOD8

ABSOLUTE DISTANCES

	FROM	TO	OBSERVED	MM	PPM	H.I.	H.T.	
255	2	12	10723.4650	10.0	1.00	1.650	1.720	5/27/77 AGA MOD8
256	2	12	10723.4500	10.0	1.00	1.650	1.720	5/27/77 AGA MOD8
257	2	12	10723.4650	10.0	1.00	1.650	1.720	5/27/77 AGA MOD8

ELEVATION DIFFERENCES

	FROM	TO	OBSERVED	S.E.	
258	1	4	-82.682	0.010	BENDIX CORP 8/25/79
259	2	1	462.551	0.015	NGS VERTICAL ADJ.
260	2	3	134.972	0.010	NGS VERTICAL ADJ.
261	2	4	379.859	0.015	NGS VERTICAL ADJ.
262	2	203	2.306	0.001	NGS 1/16/80
263	203	206	-0.998	0.001	NGS 1/16/80
264	206	2	-1.308	0.001	NGS 1/16/80
265	203	205	-0.516	0.001	NGS 1/18/80
266	205	206	-0.482	0.001	NGS 1/18/80
267	206	204	0.666	0.001	NGS 1/18/80
268	204	203	0.331	0.001	NGS 1/18/80
269	2	5	-0.774	0.001	NGS 1/18/80
270	100	10	-4.798	0.002	NASA 2/80 WILD N3
271	100	101	-1.037	0.001	NGS 5/80
272	101	102	0.498	0.001	NGS 5/80
273	102	100	0.541	0.001	NGS 5/80
274	100	103	0.081	0.001	NGS 5/80
275	103	1	-0.672	0.001	NGS 5/80
276	1	7	8.849	0.001	NGS 5/80
277	103	10	-4.880	0.001	NGS 5/80

POSITION DIFFERENCES (METERS)

	FROM	TO	LAT.	S.E.	LON.	S.E.	HEIGHT	S.E.	
278	5	6	0.0	0.0005	0.0	0.0005	14.3040	0.0010	1980 VERTICAL TAPED
279	7	9	-0.7390	0.0020	0.1430	0.0020	5.3040	0.0020	UN TEX MEMO 2/80
280	4	8	0.0070	0.0020	0.0070	0.0020	3.7880	0.0020	NASA CAL REPORT 79
281	10	13	-1.5830	0.0010	-0.1020	0.0010	3.1970	0.0010	TL0101 2/80
282	10	14	-1.5490	0.0010	-0.1260	0.0010	3.3330	0.0010	TL0102 2/80

ASTRONOMIC POSITION DIFFERENCES TO BE THE SAME AS GEODETIC

	FROM	TO
283	1	9
284	1	10
285	1	13
286	1	14
287	1	100
288	1	101
289	1	102
290	1	103
291	1	7
292	2	5
293	2	6
294	2	203
295	2	204
296	2	205
297	2	206
298	4	8

```
A PRIORI STANDARD ERRORS (UNLESS OVERRIDEN BY INPUT ON OBSERVATION CARD)

                                      VECTOR SUM OF

DIRECTIONS                           0.0 MM     0.0 SEC.
AZIMUTHS                             0.0 MM     0.0 SEC.
RECIPROCAL VERTICAL ANGLES           0.0 MM     0.0 SEC.
GROUPED VERTICAL ANGLES              0.0 MM     0.0 SEC.
ABSOLUTE DISTANCES                   0.0 MM     0.0 PPM
RELATIVE DISTANCES                   0.0 MM     0.0 PPM

ITER.  0, LINE  195, C-O   138.1 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  217, C-O    84.9 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  218, C-O    80.2 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  220, C-O    80.3 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  221, C-O    86.4 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  222, C-O    79.2 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  223, C-O    79.3 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  224, C-O    79.8 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  225, C-O    92.0 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  226, C-O    91.7 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  227, C-O    91.5 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  231, C-O    78.8 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  232, C-O    79.5 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  233, C-O    79.8 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  237, C-O    86.7 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  238, C-O    88.1 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  239, C-O    86.5 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  243, C-O    80.2 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  244, C-O    79.8 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  245, C-O    80.3 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  246, C-O    77.5 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  247, C-O    78.2 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  248, C-O    78.3 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  249, C-O    90.3 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  250, C-O    90.2 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  251, C-O    90.9 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  255, C-O    86.1 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  256, C-O    87.1 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  257, C-O    86.1 TIMES ASSIGNED STANDARD ERROR
ITER.  0, LINE  269, C-O    74.0 TIMES ASSIGNED STANDARD ERROR
```

```
NATIONAL GEODETIC SURVEY, ROCKVILLE, MD       HAVAGO VERSION 79.04.27     WEDNESDAY         APRIL  8,1981    PAGE   13

JOB STATISTICS

ELLIPSOID:  CLARKE 1866      A = 6378206.400    1/F = 294.9786982

FORT DAVIS CENTRAL SCHEME

STANDARD ERROR OF UNIT WEIGHT =  1.18, VARIANCE =  1.40, 177 DEGREES OF FREEDOM.

  339 OBSERVATIONS                                           1 ITERATIONS
   70 DIRECTIONS                                            22 STATIONS
   24 ASTR. AZIMUTHS                                       162 UNKNOWNS
   30 REC. VERTICAL ANGLES                                  24 LISTS OF DIRECTIONS
   30 GROUPED VERTICAL ANGLES                               28 REFRACTION UNKNOWNS
  103 ABSOLUTE DISTANCES                                     0 SCALE UNKNOWNS
    0 RELATIVE DISTANCES
   20 ELEVATION DIFFERENCES
    5 LAT., LON., HEIGHT DIFFERENCES
    0 PLANE DISTANCES
    4 OBSERVED ASTR. LATITUDES
    4 OBSERVED ASTR. LONGITUDES
    1 CONSTRAINED GEOD. LATITUDES
    1 CONSTRAINED GEOD. LONGITUDES
    1 CONSTRAINED GEOD. HEIGHTS
   16 ASTR. POSITION DIFFERENCES

DK/DH ASSUMED AS  -0.010/1000 IF K VALUES NOT INPUT.


SELECTED OPTIONS:

CC  FLAG   OPTION

27   1     MODIFIED GROUPING OF VERTICAL ANGLES
```

ADJUSTED DATA: STATIONS

STATION		LATITUDE	SIGMA	LONGITUDE	SIGMA	HEIGHT	SIGMA
1	MCDONALD RM 4 1977	30 40 16.79375	0.00004	104 1 19.37460	0.00004	2068.730	0.001
2	HARVARD 1977	30 38 10.42724	0.00046	103 56 48.68332	0.00036	1606.238	0.011
3	MCIVOR 1977	30 38 4.62970	0.00042	103 57 44.37059	0.00036	1741.214	0.012
4	MOBLAS 1979	30 40 36.74907	0.00015	104 0 55.60860	0.00018	1986.050	0.010
5	HRAS 85	30 38 11.64004	0.00046	103 56 48.38416	0.00036	1605.464	0.011
6	HRAS VLBI REF. POINT	30 38 11.64004	0.00046	103 56 48.38416	0.00036	1619.768	0.012
7	MCDONALD OBSERVATORY 107	30 40 17.82653	0.00007	104 1 17.42191	0.00010	2077.579	0.002
8	MOBLAS 7086 REF. POINT 8/79	30 40 36.74930	0.00017	104 0 55.60886	0.00020	1989.838	0.011
9	MCDONALD LURE 107 REF. POINT	30 40 17.80253	0.00010	104 1 17.42728	0.00013	2082.883	0.003
10	TLRS 7897	30 40 18.40493	0.00008	104 1 18.41417	0.00007	2064.522	0.002
11	BALDY 1917	30 38 7.61452	0.00123	104 10 23.54532	0.00084	2556.754	0.551
12	BLUE 1942 RM 3	30 33 54.60718	0.00025	104 1 20.60590	0.00114	2231.500	0.253
13	TLRS 7897 (0101) REF PT 2/80	30 40 18.35353	0.00009	104 1 18.41034	0.00009	2067.719	0.002
14	TLRS 7897 (0102) REF PT 2/80	30 40 18.35463	0.00009	104 1 18.40943	0.00009	2067.855	0.002
100	MCDONALD 1942	30 40 16.23506	0.00008	104 1 20.60930	0.00010	2069.320	0.002
101	MCDONALD RM 1 1942	30 40 16.00585	0.00011	104 1 21.12516	0.00013	2068.283	0.002
102	MCDONALD RM 2 1942	30 40 16.44145	0.00010	104 1 20.98840	0.00011	2068.780	0.002
103	MCDONALD RM 3 1942 1971	30 40 16.94208	0.00006	104 1 19.46452	0.00008	2069.402	0.002
203	HARVARD RM 3 1979	30 38 8.33266	0.00047	103 56 47.70125	0.00037	1608.544	0.011
204	HARVARD RM 4 1980	30 38 9.03143	0.00047	103 56 47.35534	0.00037	1608.213	0.012
205	HARVARD RM 5 1980	30 38 8.26845	0.00047	103 56 48.64146	0.00038	1608.028	0.012
206	HARVARD RM 6 1980	30 38 9.07766	0.00047	103 56 48.38355	0.00037	1607.546	0.011

ADJUSTED DATA: DIRECTIONS

	FROM	TO	LIST	OBSERVED	V	N.V	ADJUSTED	DIST.	AZ.	V.A.	
1	3	1	1	0 0 0.0	-1.55	-1.03	0 0 0.0	7033.549	305 25 35.31	87 21 43.93	BENDIX CORP 8/25/79
2	3	4	1	7 12 7.95	-2.44	-1.62	7 12 7.06	6925.024	312 37 42.38	88 0 16.36	T-3 NO. 74588
3	3	2	1	137 42 11.01	4.02	2.67	137 42 16.58	1500.131	83 7 51.89	95 10 9.13	V. NELSON OBSERVER
4	4	1	2	0 0 0.0	1.20	0.79	0 0 0.0	886.106	225 50 2.67	84 39 0.14	ALL OBSERVATIONS
5	4	3	2	266 46 5.16	-1.17	-0.78	266 46 2.79	6925.024	132 36 5.46	92 3 26.06	THRU LIST NO. 5
6	4	3	3	0 0 0.0	-1.02	-0.68	0 0 0.0	6925.024	132 36 5.46	92 3 26.06	
7	4	1	3	93 13 55.15	1.04	0.69	93 13 57.21	886.106	225 50 2.67	84 39 0.14	
8	1	3	4	0 0 0.0	1.08	0.72	0 0 0.0	7033.549	125 23 46.02	92 42 2.13	
9	1	4	4	280 26 6.40	-1.10	-0.73	280 26 4.22	886.106	45 49 50.24	95 21 28.89	
10	1	4	5	0 0 0.0	-1.12	-0.74	0 0 0.0	886.106	45 49 50.24	95 21 28.89	
11	1	3	5	79 33 53.56	1.10	0.73	79 33 55.78	7033.549	125 23 46.02	92 42 2.13	
12	2	3	9	0 0 0.0	-0.24	-0.16	0 0 0.0	1500.131	263 8 19.52	84 50 37.84	NGS T-3 1/23/80
13	2	5	9	108 54 3.90	2.26	0.40	108 54 6.40	38.205	12 2 25.92	91 9 39.61	
14	2	204	9	237 24 44.60	9.94	0.93	237 24 54.78	55.710	140 33 14.30	87 58 8.81	
15	2	203	9	254 47 25.40	0.03	0.00	254 47 25.67	69.657	157 55 45.19	88 6 11.75	
16	2	206	9	265 59 16.70	-0.08	-0.01	265 59 16.86	42.350	169 7 36.38	88 13 48.57	
17	2	205	9	275 54 6.50	-5.89	-0.56	275 54 0.85	66.529	179 2 20.37	88 27 30.68	
18	5	3	10	0 0 0.0	0.26	0.17	0 0 0.0	1512.956	261 45 52.47	84 51 30.08	NGS T-3 1/23/80
19	5	205	10	282 0 43.40	-4.76	-0.47	282 0 38.38	104.109	183 46 30.86	88 35 21.30	
20	5	2	10	290 16 36.00	-2.14	-0.38	290 16 33.60	38.205	192 2 26.07	88 50 21.63	
21	100	101	11	0 0 0.0	-30.40	-1.26	0 0 0.0	15.480	242 47 49.39	93 50 37.07	NGS T-3 1/20/71
22	100	102	11	59 23 36.90	12.93	0.49	59 24 20.23	11.943	302 12 9.62	92 35 35.64	
23	100	103	11	171 38 46.20	14.68	0.71	171 39 31.28	37.465	54 27 20.67	89 52 33.72	
24	100	103	13	0 0 0.0	9.58	0.46	0 0 0.0	37.465	54 27 20.67	89 52 33.72	NGS T-3 6/22/77
25	100	1	13	7 55 4.40	-3.61	-0.17	7 54 51.20	37.115	62 22 11.87	90 54 43.06	
26	100	101	13	188 20 41.90	-3.59	-0.15	188 20 28.72	15.480	242 47 49.39	93 50 37.07	
27	100	102	13	247 45 3.90	-5.36	-0.20	247 44 48.96	11.943	302 12 9.62	92 35 35.64	
28	100	101	14	0 0 0.0	-27.72	-1.15	0 0 0.0	15.480	242 47 49.39	93 50 37.07	NGS 1941
29	100	102	14	59 23 19.00	33.51	1.27	59 24 20.23	11.943	302 12 9.62	92 35 35.64	
30	100	103	15	0 0 0.0	-6.26	-0.55	0 0 0.0	37.465	54 27 20.67	89 52 33.72	DMA 1975
31	100	101	15	188 20 4.20	18.27	1.10	188 20 28.72	15.480	242 47 49.39	93 50 37.07	
32	100	102	15	247 44 49.80	-7.10	-0.36	247 44 48.96	11.943	302 12 9.62	92 35 35.64	
33	102	100	16	0 0 0.0	-13.24	-0.66	0 0 0.0	11.943	122 12 9.43	87 24 24.75	DMA 1975
34	102	101	16	72 58 30.00	10.63	0.59	72 58 53.88	13.913	195 11 3.30	92 2 55.03	
35	101	102	17	0 0 0.0	-11.29	-0.63	0 0 0.0	13.913	15 11 3.23	87 57 5.42	DMA 1975
36	101	100	17	47 36 24.80	9.80	0.59	47 36 45.89	15.480	62 47 49.13	86 9 23.43	
37	103	100	18	0 0 0.0	10.89	0.95	0 0 0.0	37.465	234 27 21.25	90 7 27.49	NASA 2/80 WILD T3

ADJUSTED DATA: DIRECTIONS

	FROM	TO	LIST	OBSERVED	V	N.V	ADJUSTED	DIST.	AZ.	V.A.	
38	103	10	18	157 22 36.30	-9.61	-0.90	157 22 15.80	53.261	31 49 37.05	95 15 25.68	
39	10	1	19	0 0 0.0	-0.61	-0.16	0 0 0.0	55.992	207 15 42.58	85 41 24.44	NGS 5/80
40	10	103	19	4 33 53.14	1.25	0.31	4 33 55.00	53.261	211 49 37.58	84 44 36.04	NGS 5/80
41	10	4	19	199 47 49.04	-0.04	-0.04	199 47 49.61	833.207	47 3 32.19	95 24 29.02	NGS 5/80
42	7	1	20	0 0 0.0	1.48	0.42	0 0 0.0	61.597	238 32 24.18	98 15 35.84	NGS 5/80
43	7	103	20	4 51 15.94	-1.49	-0.43	4 51 12.96	61.381	243 23 37.15	97 39 21.57	NGS 5/80
44	1	2	21	0 0 0.0	0.11	0.11	0 0 0.0	8205.970	118 20 48.91	93 16 4.18	NGS 5/80
45	1	3	21	7 2 57.24	-0.02	-0.02	7 2 57.10	7033.549	125 23 46.02	92 42 2.13	NGS 5/80
46	1	10	21	268 54 53.09	0.20	0.05	268 54 53.18	55.992	27 15 42.09	94 18 37.37	NGS 5/80
47	1	4	21	287 29 1.54	-0.11	-0.10	287 29 1.32	886.106	45 49 50.24	95 21 28.89	NGS 5/80
48	4	1	22	0 0 0.0	0.31	0.30	0 0 0.0	886.106	225 50 2.67	84 39 0.14	NGS 5/80
49	4	10	22	1 13 42.09	-0.31	-0.30	1 13 41.47	833.207	227 3 44.14	84 35 58.30	NGS 5/80
50	2	12	6	0 0 0.0	-0.31	-0.31	0 0 0.0	10723.447	222 37 6.02	86 42 18.69	5/27/77 T-3 NGS
51	2	3	6	40 31 14.48	-1.29	-1.28	40 31 13.50	1500.131	263 8 19.52	84 50 37.84	
52	2	1	6	75 45 57.98	1.58	1.58	75 45 59.87	8205.970	298 23 5.88	86 48 18.61	
53	1	2	7	0 0 0.0	0.27	0.27	0 0 0.0	8205.970	118 20 48.91	93 16 4.18	5/26/77 NGS
54	1	3	7	7 2 57.08	0.30	0.30	7 2 57.10	7033.549	125 23 46.02	92 42 2.13	
55	1	12	7	61 48 46.80	-0.72	-0.72	61 48 45.80	11774.276	180 9 34.72	89 15 39.23	
56	1	11	7	136 20 19.14	0.15	0.15	136 20 19.01	15038.074	254 41 7.93	88 12 27.16	
57	1	7	7	300 11 34.50	0.05	0.01	300 11 34.27	61.597	58 32 23.19	81 44 26.13	
58	1	11	23	0 0 0.0	6.56	0.73	0 0 0.0	15038.074	254 41 7.93	88 12 27.16	6/22/77 T-3 NGS
59	1	100	23	347 41 20.20	-9.07	-0.86	347 41 4.57	37.115	242 22 12.50	89 5 18.14	
60	3	12	8	0 0 0.0	0.03	0.03	0 0 0.0	9631.124	216 49 5.78	87 7 31.33	5/25/77 T-3 NGS
61	3	11	8	53 29 44.42	0.32	0.32	53 29 44.71	20240.268	270 18 50.49	87 46 52.23	
62	3	1	8	88 36 27.68	1.89	1.89	88 36 29.54	7033.549	305 25 35.31	87 21 43.93	
63	3	2	8	226 18 48.43	-2.28	-2.26	226 18 46.12	1500.131	83 7 51.89	95 10 9.13	
64	11	1	24	0 0 0.0	-0.80	-0.80	0 0 0.0	15038.074	74 36 25.37	91 55 46.46	5/21/77 T-3 NGS
65	11	3	24	15 35 51.83	0.93	0.93	15 35 53.57	20240.268	90 12 18.93	92 24 8.98	
66	11	12	24	43 39 46.63	-0.13	-0.13	43 39 47.31	16437.972	118 16 12.68	91 12 35.51	
67	12	11	25	0 0 0.0	-1.44	-1.44	0 0 0.0	16437.972	298 20 52.15	88 56 18.09	5/24/77 T-3 NGS
68	12	1	25	61 48 38.71	-0.08	-0.08	61 48 40.07	11774.276	0 9 32.22	90 50 36.75	
69	12	3	25	98 26 19.59	0.79	0.79	98 26 21.82	9631.124	36 47 13.97	92 57 38.09	
70	12	2	25	104 13 52.32	0.72	0.72	104 13 54.48	10723.447	42 34 46.62	93 23 25.23	

ADJUSTED DATA: ASTRONOMIC AZIMUTHS

	FROM	TO	OBSERVED	V	N.V	ADJUSTED	DIST.	V.A.			
71	1	3	125 23 46.78	-0.76	-0.51	125 23 46.02	7033.549	92 42 2.13	RM	5/30/78	DKM 3A
72	1	3	125 23 46.60	-0.58	-0.39	125 23 46.02	7033.549	92 42 2.13	BEK	5/30/78	DKM 3A
73	1	3	125 23 45.88	0.14	0.09	125 23 46.02	7033.549	92 42 2.13	BEK	6/05/78	DKM 3A
74	1	3	125 23 46.80	-0.78	-0.52	125 23 46.02	7033.549	92 42 2.13	RM	6/05/78	DKM 3A
75	2	3	263 8 20.85	-1.33	-0.88	263 8 19.52	1500.131	84 50 37.84	RM	5/31/78	DKM 3A
76	2	3	263 8 20.05	-0.53	-0.35	263 8 19.52	1500.131	84 50 37.84	BEK	5/31/78	DKM 3A
77	2	3	263 8 19.48	0.04	0.03	263 8 19.52	1500.131	84 50 37.84	BEK	6/06/78	DKM 3A
78	2	3	263 8 19.96	-0.44	-0.29	263 8 19.52	1500.131	84 50 37.84	RM	6/06/78	DKM 3A
79	1	2	118 20 50.22	-1.31	-0.87	118 20 48.91	8205.970	93 16 4.18	RM	5/30/78	DKM 3A
80	1	2	118 20 48.51	0.40	0.27	118 20 48.91	8205.970	93 16 4.18	BEK	5/30/78	DKM 3A
81	1	2	118 20 48.77	0.14	0.10	118 20 48.91	8205.970	93 16 4.18	BEK	6/05/78	DKM 3A
82	1	2	118 20 49.30	-0.39	-0.26	118 20 48.91	8205.970	93 16 4.18	RM	6/05/78	DKM 3A
83	2	1	298 23 6.20	-0.32	-0.21	298 23 5.88	8205.970	86 48 18.61	RM	5/31/78	DKM 3A
84	2	1	298 23 5.29	0.59	0.40	298 23 5.88	8205.970	86 48 18.61	BEK	5/31/78	DKM 3A
85	2	1	298 23 5.73	0.15	0.10	298 23 5.88	8205.970	86 48 18.61	BEK	6/06/78	DKM 3A
86	2	1	298 23 6.10	-0.22	-0.14	298 23 5.88	8205.970	86 48 18.61	RM	6/06/78	DKM 3A
87	3	1	305 25 34.42	0.89	0.60	305 25 35.31	7033.549	87 21 43.93	BEK	5/07/79	DKM 3A
88	3	2	83 7 50.15	1.74	1.16	83 7 51.89	1500.131	95 10 9.13	BEK	5/07/79	DKM 3A
89	3	1	305 25 35.98	-0.67	-0.44	305 25 35.31	7033.549	87 21 43.93	RM	5/08/79	DKM 3A
90	3	2	83 7 49.86	2.03	1.35	83 7 51.89	1500.131	95 10 9.13	RM	5/08/79	DKM 3A
91	3	1	305 25 33.61	1.70	1.14	305 25 35.31	7033.549	87 21 43.93	BEK	5/09/79	DKM 3A
92	3	2	83 7 50.75	1.14	0.76	83 7 51.89	1500.131	95 10 9.13	BEK	5/09/79	DKM 3A
93	3	1	305 25 35.88	-0.57	-0.38	305 25 35.31	7033.549	87 21 43.93	RM	5/14/79	DKM 3A
94	3	2	83 7 53.00	-1.11	-0.74	83 7 51.89	1500.131	95 10 9.13	RM	5/14/79	DKM 3A

ADJUSTED DATA: RECIPROCAL VERTICAL ANGLES

	FROM	TO	OBSERVED	REF/KM	V	N.V	ADJUSTED	DIST.	AZ.
95	1	2	93 15 48.90	1.74	1.05	1.05	93 16 4.18	8205.970	118 20 48.91
96	2	1	86 48 5.43	1.74	-1.05	-1.05	86 48 18.61	8205.970	298 23 5.88
97	1	2	93 15 51.54	1.40	1.19	1.19	93 16 4.18	8205.970	118 20 48.91
98	2	1	86 48 8.35	1.40	-1.19	-1.19	86 48 18.61	8205.970	298 23 5.88
99	1	2	93 15 50.61	1.37	2.34	2.34	93 16 4.18	8205.970	118 20 48.91
100	2	1	86 48 9.72	1.37	-2.34	-2.34	86 48 18.61	8205.970	298 23 5.88
101	1	2	93 15 50.89	1.50	0.98	0.98	93 16 4.18	8205.970	118 20 48.91
102	2	1	86 48 7.29	1.50	-0.98	-0.98	86 48 18.61	8205.970	298 23 5.88
103	1	2	93 15 49.73	1.82	-0.47	-0.46	93 16 4.18	8205.970	118 20 48.91
104	2	1	86 48 3.23	1.82	0.47	0.46	86 48 18.61	8205.970	298 23 5.88
105	1	2	93 15 48.47	1.86	0.46	0.46	93 16 4.18	8205.970	118 20 48.91
106	2	1	86 48 3.82	1.86	-0.46	-0.46	86 48 18.61	8205.970	298 23 5.88
107	11	12	91 12 11.26	1.44	0.60	0.12	91 12 35.51	16437.972	118 16 12.68
108	12	11	88 55 55.03	1.44	-0.60	-0.12	88 56 18.09	16437.972	298 20 52.15
109	11	1	91 55 22.06	1.59	0.45	0.09	91 55 46.46	15038.074	74 36 25.37
110	1	11	88 12 3.66	1.59	-0.45	-0.09	88 12 27.16	15038.074	254 41 7.93
111	11	3	92 23 37.27	1.69	-2.48	-0.50	92 24 8.98	20240.268	90 12 18.93
112	3	11	87 46 15.56	1.69	2.48	0.50	87 46 52.23	20240.268	270 18 50.49
113	12	2	93 23 14.46	0.89	1.24	0.25	93 23 25.23	10723.447	42 34 46.62
114	2	12	86 42 10.40	0.89	-1.24	-0.25	86 42 18.69	10723.447	222 37 6.02
115	12	1	90 50 22.35	1.19	0.35	0.07	90 50 36.75	11774.276	0 9 32.22
116	1	12	89 15 25.54	1.19	-0.35	-0.07	89 15 39.23	11774.276	180 9 34.72
117	12	3	92 57 22.03	1.29	3.66	0.73	92 57 38.09	9631.124	36 47 13.97
118	3	12	87 7 22.59	1.29	-3.66	-0.73	87 7 31.33	9631.124	216 49 5.78
119	12	3	92 57 21.98	2.37	-6.71	-1.34	92 57 38.09	9631.124	36 47 13.97
120	3	12	87 7 1.81	2.37	6.70	1.34	87 7 31.33	9631.124	216 49 5.78
121	12	2	93 23 13.90	0.81	2.66	0.53	93 23 25.23	10723.447	42 34 46.62
122	2	12	86 42 12.68	0.81	-2.66	-0.53	86 42 18.69	10723.447	222 37 6.02
123	12	1	90 50 21.50	1.28	0.22	0.04	90 50 36.75	11774.276	0 9 32.22
124	1	12	89 15 24.42	1.28	-0.22	-0.04	89 15 39.23	11774.276	180 9 34.72

ADJUSTED DATA: GROUPED VERTICAL ANGLES

	FROM	TO	LIST	OBSERVED	REF/KM	V	N.V	ADJUSTED	DIST.	AZ.			
125	1	2	1	93 15 48.93	2.21	-2.81	-2.81	93 16 4.18	8205.970	118 20 48.91	RM	5/30/78	DKM 3A
126	1	2	1	93 15 46.42	2.21	-0.30	-0.30	93 16 4.18	8205.970	118 20 48.91	BEK	5/31/78	DKM 3A
127	2	1	1	86 47 59.71	2.21	0.83	0.83	86 48 18.61	8205.970	298 23 5.88	RM	5/31/78	DKM 3A
128	2	1	1	86 47 58.26	2.21	2.28	2.28	86 48 18.61	8205.970	298 23 5.88	BEK	6/01/78	DKM 3A
129	1	2	2	93 15 45.86	2.31	-0.62	-0.62	93 16 4.18	8205.970	118 20 48.91	BEK	6/05/78	DKM 3A
130	1	2	2	93 15 48.04	2.31	-2.80	-2.79	93 16 4.18	8205.970	118 20 48.91	RM	6/05/78	DKM 3A
131	2	1	2	86 47 58.54	2.31	1.13	1.13	86 48 18.61	8205.970	298 23 5.88	BEK	6/06/78	DKM 3A
132	2	1	2	86 47 57.38	2.31	2.29	2.28	86 48 18.61	8205.970	298 23 5.88	RM	6/06/78	DKM 3A
133	1	3	11	92 41 44.27	2.52	0.19	0.19	92 42 2.13	7033.549	125 23 46.02	BEK	5/10/79	DKM 3A
134	2	3	11	84 50 35.05	2.52	-0.97	-0.93	84 50 37.84	1500.131	263 8 19.52	RM	5/10/79	T-4
135	1	3	4	92 41 48.75	1.87	0.23	0.23	92 42 2.13	7033.549	125 23 46.02	RM	5/11/79	DKM 3A
136	2	3	4	84 50 36.23	1.87	-1.18	-1.14	84 50 37.84	1500.131	263 8 19.52	BEK	5/11/79	T-4
137	1	3	12	92 41 51.03	1.59	-0.09	-0.09	92 42 2.13	7033.549	125 23 46.02	BEK	5/10/79	DKM 3A
138	2	3	12	84 50 35.02	1.59	0.44	0.43	84 50 37.84	1500.131	263 8 19.52	RM	5/10/79	T-4
139	1	3	5	92 41 49.96	1.80	-0.45	-0.45	92 42 2.13	7033.549	125 23 46.02	RM	5/11/79	DKM 3A
140	2	3	5	84 50 32.88	1.80	2.28	2.20	84 50 37.84	1500.131	263 8 19.52	BEK	5/11/79	T-4
141	1	3	3	92 41 49.44	1.84	-0.21	-0.21	92 42 2.13	7033.549	125 23 46.02	BEK	5/10/79	DKM 3A
142	2	3	3	84 50 34.06	1.84	1.04	1.00	84 50 37.84	1500.131	263 8 19.52	RM	5/10/79	T-4
143	1	3	6	92 41 48.79	1.97	-0.48	-0.48	92 42 2.13	7033.549	125 23 46.02	RM	5/11/79	DKM 3A
144	2	3	6	84 50 32.46	1.97	2.44	2.35	84 50 37.84	1500.131	263 8 19.52	BEK	5/11/79	T-4
145	3	1	7	87 21 25.07	2.81	-0.90	-0.90	87 21 43.93	7033.549	305 25 35.31	BEK	5/07/79	
146	3	2	7	95 10 0.38	2.81	4.54	4.38	95 10 9.13	1500.131	83 7 51.89	BEK	5/07/79	
147	3	1	8	87 21 28.37	2.18	0.24	0.24	87 21 43.93	7033.549	305 25 35.31	RM	5/08/79	
148	3	2	8	95 10 7.08	2.18	-1.22	-1.17	95 10 9.13	1500.131	83 7 51.89	RM	5/08/79	
149	3	1	9	87 21 26.69	2.48	-0.21	-0.21	87 21 43.93	7033.549	305 25 35.31	BEK	5/09/79	
150	3	2	9	95 10 4.33	2.48	1.08	1.04	95 10 9.13	1500.131	83 7 51.89	BEK	5/09/79	
151	3	1	10	87 21 28.09	2.21	0.35	0.35	87 21 43.93	7033.549	305 25 35.31	RM	5/14/79	
152	3	2	10	95 10 7.57	2.21	-1.74	-1.68	95 10 9.13	1500.131	83 7 51.89	RM	5/14/79	
153	2	1	13	86 48 4.66	1.86	-1.29	-1.29	86 48 18.61	8205.970	298 23 5.88	NGS	1/24/80	T-3
154	1	2	13	93 15 47.65	1.86	1.29	1.29	93 16 4.18	8205.970	118 20 48.91	NGS	1/24/80	T-3

ADJUSTED DATA: ABSOLUTE DISTANCES

	FROM	TO	OBSERVED	V	N.V	ADJUSTED	AZ.	V.A	
155	1	2	8205.9618	0.0077	0.40	8205.9695	118 20 48.91	93 16 4.18	5/26/77 AGA MOD8
156	1	2	8205.9758	-0.0063	-0.33	8205.9695	118 20 48.91	93 16 4.18	5/26/77 AGA MOD8
157	1	2	8205.9538	0.0157	0.82	8205.9695	118 20 48.91	93 16 4.18	5/26/77 AGA MOD8
158	2	1	8205.9758	-0.0063	-0.33	8205.9695	298 23 5.88	86 48 18.61	6/18/77 RMASTER II
159	2	1	8205.9659	0.0036	0.19	8205.9695	298 23 5.88	86 48 18.61	5/27/77 AGA MOD8
160	2	1	8205.9879	-0.0184	-0.96	8205.9695	298 23 5.88	86 48 18.61	5/27/77 AGA MOD8
161	2	1	8205.9739	-0.0044	-0.23	8205.9695	298 23 5.88	86 48 18.61	5/27/77 AGA MOD8
162	1	3	7033.5482	0.0003	0.02	7033.5485	125 23 46.02	92 42 2.13	5/26/77 AGA MOD8
163	1	3	7033.5702	-0.0217	-1.26	7033.5485	125 23 46.02	92 42 2.13	5/26/77 AGA MOD8
164	1	3	7033.5502	-0.0017	-0.10	7033.5485	125 23 46.02	92 42 2.13	5/26/77 AGA MOD8
165	3	1	7033.5454	0.0031	0.18	7033.5485	305 25 35.31	87 21 43.93	6/18/77 RMASTER II
166	2	3	1500.1220	0.0086	1.47	1500.1306	263 8 19.52	84 50 37.84	6/20/77 HP3800 NGS
167	2	3	1500.1503	-0.0197	-1.89	1500.1306	263 8 19.52	84 50 37.84	5/27/77 AGA MOD8
168	2	3	1500.1553	-0.0247	-2.37	1500.1306	263 8 19.52	84 50 37.84	5/27/77 AGA MOD8
169	3	2	1500.1265	0.0041	0.39	1500.1306	83 7 51.89	95 10 9.13	6/18/77 RMASTER II
170	3	2	1500.1226	0.0080	1.37	1500.1306	83 7 51.89	95 10 9.13	6/20/77 HP3800 NGS
171	3	4	6925.0497	-0.0253	-1.48	6925.0244	312 37 42.38	88 0 16.36	1/23/80 RANGER IV
172	4	3	6924.9964	0.0280	1.22	6925.0244	132 36 5.46	92 3 26.06	BENDIX CORP 8/25/79
173	5	3	1512.9464	0.0092	0.88	1512.9557	261 45 52.47	84 51 30.08	1/24/80 RANGER IV
174	5	3	1512.9519	0.0038	0.36	1512.9557	261 45 52.47	84 51 30.08	1/23/80 RANGER IV
175	3	5	1512.9638	-0.0081	-0.77	1512.9557	81 45 24.69	95 9 17.30	1/23/80 RANGER IV
176	2	206	42.3526	-0.0027	-0.54	42.3499	169 7 36.38	88 13 48.57	1/18/80 HP3800
177	2	205	66.5284	0.0002	0.03	66.5285	179 2 20.37	88 27 30.68	1/18/80 HP3800
178	2	204	55.7113	-0.0014	-0.29	55.7098	140 33 14.30	87 58 8.81	1/18/80 HP3800
179	2	203	69.6580	-0.0011	-0.23	69.6569	157 55 45.19	88 6 11.75	1/18/80 HP3800
180	2	203	69.6620	-0.0051	-1.03	69.6569	157 55 45.19	88 6 11.75	1/18/80 HP3800
181	203	2	69.6510	0.0059	1.18	69.6569	337 55 45.69	91 53 50.51	1/18/80 HP3800
182	203	2	69.6540	0.0029	0.58	69.6569	337 55 45.69	91 53 50.51	1/18/80 HP3800
183	205	5	104.1098	-0.0003	-0.06	104.1095	3 46 30.73	91 24 42.08	1/21/80 HP3800
184	5	205	104.1131	-0.0036	-0.72	104.1095	183 46 30.86	88 35 21.30	1/21/80 HP3800
185	7	1	61.5976	-0.0006	-0.12	61.5970	238 32 24.18	98 15 35.84	6/22/77 HP3800
186	7	1	61.5953	0.0016	0.33	61.5970	238 32 24.18	98 15 35.84	6/22/77 MA100
187	7	1	61.5933	0.0036	0.73	61.5970	238 32 24.18	98 15 35.84	6/22/77 MA100
188	103	10	53.2499	0.0112	2.23	53.2610	31 49 37.05	95 15 25.68	NASA 2/80 AGA 76
189	103	10	53.2479	0.0132	2.63	53.2610	31 49 37.05	95 15 25.68	NASA 2/80 AGA 76
190	103	10	53.2489	0.0122	2.43	53.2610	31 49 37.05	95 15 25.68	NASA 2/80 AGA 76
191	2	5	38.2050	0.0002	0.17	38.2052	12 2 25.92	91 9 39.61	NGS TRAV. 1/80
192	204	203	23.4150	0.0002	0.19	23.4152	203 10 28.82	89 11 20.97	NGS TRAV. 1/80
193	205	203	25.1270	0.0002	0.23	25.1272	85 29 2.77	88 49 25.20	NGS TRAV. 1/80
194	203	206	29.2900	-0.0003	-0.31	29.2897	321 37 14.55	91 57 8.57	NGS TRAV. 1/80
195	204	206	27.4330	0.0002	0.21	27.4332	272 58 32.89	91 23 31.46	NGS TRAV. 1/80
196	206	205	25.8590	0.0001	0.13	25.8591	195 24 30.44	88 55 56.31	NGS TRAV. 1/80
197	100	101	15.4810	-0.0010	-0.33	15.4800	242 47 49.39	93 50 37.07	DMA TAPED 3/75
198	100	102	11.9440	-0.0015	-0.49	11.9425	302 12 9.62	92 35 35.64	DMA TAPED 3/75
199	101	102	13.9140	-0.0012	-0.39	13.9128	15 11 3.23	87 57 5.42	DMA TAPED 3/75
200	103	100	37.4680	-0.0032	-1.08	37.4648	234 27 21.25	90 7 27.49	DMA TAPED 3/75
201	103	1	5.2020	0.0001	0.03	5.2021	152 20 30.60	97 25 11.30	NGS TRAV. 6/77
202	100	101	15.4800	0.0000	0.00	15.4800	242 47 49.39	93 50 37.07	NGS TRAV. 6/77
203	1	100	37.1160	-0.0009	-0.31	37.1151	242 22 12.50	89 5 18.14	NGS TRAV. 6/77
204	103	100	37.4640	0.0008	0.25	37.4648	234 27 21.25	90 7 27.49	NGS TRAV. 6/77

ADJUSTED DATA: ABSOLUTE DISTANCES

	FROM	TO	OBSERVED	V	N.V	ADJUSTED	AZ.	V.A	
205	100	103	37.4620	0.0028	0.92	37.4648	54 27 20.67	89 52 33.72	NGS 1/71 TRAVERSE
206	100	101	15.4780	0.0020	0.67	15.4800	242 47 49.39	93 50 37.07	NGS 1/71 TAPED
207	100	102	11.9410	0.0015	0.51	11.9425	302 12 9.62	92 35 35.64	NGS 1/71 TAPED
208	10	103	53.2671	-0.0061	-1.22	53.2610	211 49 37.58	84 44 36.04	NGS HP3800 5/80
209	10	103	53.2770	-0.0159	-3.18	53.2610	211 49 37.58	84 44 36.04	NGS HP3800 5/80
210	10	1	56.0006	-0.0088	-1.76	55.9918	207 15 42.58	85 41 24.44	NGS HP3800 5/80
211	103	10	53.2677	-0.0067	-1.34	53.2610	31 49 37.05	95 15 25.68	NGS HP3800 5/80
212	4	10	833.2094	-0.0019	-0.36	833.2075	227 3 44.14	84 35 58.30	NGS HP3800 5/80
213	4	1	886.1024	0.0035	0.67	886.1060	225 50 2.67	84 39 0.14	NGS HP3800 5/80
214	103	1	5.2010	0.0011	1.09	5.2021	152 20 30.60	97 25 11.30	NGS TRAVERSE 5/80
215	7	103	61.3854	-0.0041	-0.82	61.3813	243 23 37.15	97 39 21.57	NGS HP3800 5/80
216	7	1	61.5985	-0.0015	-0.30	61.5970	238 32 24.18	98 15 35.84	NGS HP3800 5/80
217	2	12	10723.4749	-0.0279	-1.90	10723.4471	222 37 6.02	86 42 18.69	6/18/77 RMASTER II
218	3	12	9631.1163	0.0080	0.58	9631.1244	216 49 5.78	87 7 31.33	6/18/77 RMASTER II
219	12	1	11774.2764	-0.0008	-0.05	11774.2755	0 9 32.22	90 50 36.75	6/18/77 RMASTER II
220	12	3	9631.1142	0.0102	0.74	9631.1244	36 47 13.97	92 57 38.09	6/18/77 RMASTER II
221	12	2	10723.4527	-0.0056	-0.38	10723.4471	42 34 46.62	93 23 25.23	6/18/77 RMASTER II
222	11	3	20240.2470	0.0208	0.92	20240.2679	90 12 18.93	92 24 8.98	5/21/77 AGA MOD8
223	11	3	20240.2440	0.0238	1.06	20240.2679	90 12 18.93	92 24 8.98	5/21/77 AGA MOD8
224	11	3	20240.2330	0.0348	1.54	20240.2679	90 12 18.93	92 24 8.98	5/21/77 AGA MOD8
225	11	1	15038.0632	0.0108	0.60	15038.0740	74 36 25.37	91 55 46.46	5/21/77 AGA MOD8
226	11	1	15038.0692	0.0048	0.27	15038.0740	74 36 25.37	91 55 46.46	5/21/77 AGA MOD8
227	11	1	15038.0722	0.0018	0.10	15038.0740	74 36 25.37	91 55 46.46	5/21/77 AGA MOD8
228	11	12	16437.9585	0.0131	0.68	16437.9715	118 16 12.68	91 12 35.51	5/21/77 AGA MOD8
229	11	12	16437.9585	0.0131	0.68	16437.9715	118 16 12.68	91 12 35.51	5/21/77 AGA MOD8
230	11	12	16437.9685	0.0031	0.16	16437.9715	118 16 12.68	91 12 35.51	5/21/77 AGA MOD8
231	12	3	9631.1348	-0.0104	-0.75	9631.1244	36 47 13.97	92 57 38.09	5/24/77 AGA MOD8
232	12	3	9631.1248	-0.0004	-0.03	9631.1244	36 47 13.97	92 57 38.09	5/24/77 AGA MOD8
233	12	3	9631.1208	0.0036	0.26	9631.1244	36 47 13.97	92 57 38.09	5/24/77 AGA MOD8
234	12	11	16437.9959	-0.0244	-1.27	16437.9715	298 20 52.15	88 56 18.09	5/24/77 AGA MOD8
235	12	11	16437.9739	-0.0024	-0.12	16437.9715	298 20 52.15	88 56 18.09	5/24/77 AGA MOD8
236	12	11	16437.9859	-0.0144	-0.75	16437.9715	298 20 52.15	88 56 18.09	5/24/77 AGA MOD8
237	12	2	10723.4489	-0.0018	-0.12	10723.4471	42 34 46.62	93 23 25,23	5/24/77 AGA MOD8
238	12	2	10723.4289	0.0182	1.24	10723.4471	42 34 46.62	93 23 25.23	5/24/77 AGA MOD8
239	12	2	10723.4519	-0.0048	-0.33	10723.4471	42 34 46.62	93 23 25.23	5/24/77 AGA MOD8
240	12	1	11774.2814	-0.0059	-0.38	11774.2755	0 9 32.22	90 50 36.75	5/24/77 AGA MOD8
241	12	1	11774.2764	-0.0009	-0.06	11774.2755	0 9 32.22	90 50 36.75	5/24/77 AGA MOD8
242	12	1	11774.2694	0.0061	0.40	11774.2755	0 9 32.22	90 50 36.75	5/24/77 AGA MOD8
243	3	12	9631.1159	0.0085	0.61	9631.1244	216 49 5.78	87 7 31.33	5/25/77 AGA MOD8
244	3	12	9631.1219	0.0025	0.18	9631.1244	216 49 5.78	87 7 31.33	5/25/77 AGA MOD8
245	3	12	9631.1139	0.0105	0.76	9631.1244	216 49 5.78	87 7 31.33	5/25/77 AGA MOD8
246	3	11	20240.2862	-0.0183	-0.81	20240.2679	270 18 50.49	87 46 52.23	5/25/77 AGA MOD8
247	3	11	20240.2692	-0.0013	-0.06	20240.2679	270 18 50.49	87 46 52.23	5/25/77 AGA MOD8
248	3	11	20240.2672	0.0007	0.03	20240.2679	270 18 50.49	87 46 52.23	5/25/77 AGA MOD8
249	1	11	15038.0935	-0.0195	-1.08	15038.0740	254 41 7.93	88 12 27.16	5/26/77 AGA MOD8
250	1	11	15038.0955	-0.0215	-1.19	15038.0740	254 41 7.93	88 12 27.16	5/26/77 AGA MOD8
251	1	11	15038.0835	-0.0095	-0.52	15038.0740	254 41 7.93	88 12 27.16	5/26/77 AGA MOD8
252	1	12	11774.2704	0.0052	0.33	11774.2755	180 9 34.72	89 15 39.23	5/26/77 AGA MOD8
253	1	12	11774.2754	0.0002	0.01	11774.2755	180 9 34.72	89 15 39.23	5/26/77 AGA MOD8
254	1	12	11774.2674	0.0082	0.53	11774.2755	180 9 34.72	89 15 39.23	5/26/77 AGA MOD8

ADJUSTED DATA: ABSOLUTE DISTANCES

	FROM	TO	OBSERVED	V	N.V	ADJUSTED	AZ.	V.A	
255	2	12	10723.4581	-0.0110	-0.75	10723.4471	222 37 6.02	86 42 18.69	5/27/77 AGA MOD8
256	2	12	10723.4431	0.0040	0.27	10723.4471	222 37 6.02	86 42 18.69	5/27/77 AGA MOD8
257	2	12	10723.4581	-0.0110	-0.75	10723.4471	222 37 6.02	86 42 18.69	5/27/77 AGA MOD8

ADJUSTED ELEVATION DIFFERENCES

	FROM	TO	MEASURED	V	N.V	ADJUSTED	
258	1	4	-82.6820	0.0004	0.04	-82.6816	BENDIX CORP 8/25/79
259	2	1	462.5510	-0.0014	-0.09	462.5496	NGS VERTICAL ADJ.
260	2	3	134.9720	0.0155	1.55	134.9875	NGS VERTICAL ADJ.
261	2	4	379.8590	0.0006	0.04	379.8596	NGS VERTICAL ADJ.
262	2	203	2.3060	-0.0001	-0.10	2.3059	NGS 1/16/80
263	203	206	-0.9980	0.0002	0.20	-0.9978	NGS 1/16/80
264	206	2	-1.3080	-0.0001	-0.10	-1.3081	NGS 1/16/80
265	203	205	-0.5160	0.0001	0.10	-0.5159	NGS 1/18/80
266	205	206	-0.4820	0.0001	0.10	-0.4819	NGS 1/18/80
267	206	204	0.6660	0.0004	0.40	0.6664	NGS 1/18/80
268	204	203	0.3310	0.0004	0.40	0.3314	NGS 1/18/80
269	2	5	-0.7740	0.0000	0.00	-0.7740	NGS 1/18/80
270	100	10	-4.7980	-0.0007	-0.34	-4.7987	NASA 2/80 WILD N3
271	100	101	-1.0370	-0.0007	-0.66	-1.0377	NGS 5/80
272	101	102	0.4980	-0.0007	-0.67	0.4973	NGS 5/80
273	102	100	0.5410	-0.0007	-0.67	0.5403	NGS 5/80
274	100	103	0.0810	0.0002	0.17	0.0812	NGS 5/80
275	103	1	-0.6720	0.0002	0.21	-0.6718	NGS 5/80
276	1	7	8.8490	0.0000	0.01	8.8490	NGS 5/80
277	103	10	-4.8800	0.0001	0.15	-4.8799	NGS 5/80

ADJUSTED POSITION DIFFERENCES (METERS)

	FROM	TO	LAT.	V	LON.	V	H	V	
278	5	6	-0.0000	-0.0000	0.0000	0.0000	14.3040	0.0000	1980 VERTICAL TAPED
279	7	9	-0.7390	0.0000	0.1430	0.0000	5.3040	-0.0000	UN TEX MEMO 2/80
280	4	8	0.0070	0.0000	0.0070	0.0000	3.7880	0.0000	NASA CAL REPORT 79
281	10	13	-1.5830	0.0000	-0.1020	0.0000	3.1970	0.0000	TL0101 2/80
282	10	14	-1.5490	0.0000	-0.1260	0.0000	3.3330	0.0000	TL0102 2/80

ADJUSTED ASTRONOMIC LATITUDES AND LONGITUDES

	STATION			OBSERVED	V	N.V	ADJUSTED	SIGMA	
299	1	MCDONALD RM 4 1977	LAT	30 40 16.43	0.03	0.11	30 40 16.46	0.35	
300	1	MCDONALD RM 4 1977	LON	104 1 20.11	-0.04	-0.12	104 1 20.07	0.34	
301	2	HARVARD 1977	LAT	30 38 11.34	-0.05	-0.17	30 38 11.29	0.35	
302	2	HARVARD 1977	LON	103 56 51.30	0.17	0.56	103 56 51.47	0.33	
303	3	MCIVOR 1977	LAT	30 38 5.74	0.01	0.04	30 38 5.75	0.35	
304	3	MCIVOR 1977	LON	103 57 45.82	-0.15	-0.50	103 57 45.67	0.32	
305	4	MOBLAS 1979	LAT	30 40 36.56	0.00	0.00	30 40 36.56	0.35	
306	4	MOBLAS 1979	LON	104 0 55.72	0.00	0.01	104 0 55.72	0.35	
307	5	HRAS 85	LAT	30 38 11.64	0.86	0.09	30 38 12.50	0.37	NOT OBS.
308	5	HRAS 85	LON	103 56 48.38	2.78	0.19	103 56 51.17	0.35	NOT OBS.
309	6	HRAS VLBI REF. POINT	LAT	30 38 11.64	0.86	0.09	30 38 12.50	0.37	NOT OBS.
310	6	HRAS VLBI REF. POINT	LON	103 56 48.38	2.78	0.19	103 56 51.17	0.35	NOT OBS.
311	7	MCDONALD OBSERVATORY 107	LAT	30 40 17.83	-0.33	-0.03	30 40 17.50	0.37	NOT OBS.
312	7	MCDONALD OBSERVATORY 107	LON	104 1 17.42	0.70	0.05	104 1 18.12	0.36	NOT OBS.
313	8	MOBLAS 7086 REF. POINT 8/79	LAT	30 40 36.75	-0.19	-0.02	30 40 36.56	0.37	NOT OBS.
314	8	MOBLAS 7086 REF. POINT 8/79	LON	104 0 55.61	0.12	0.01	104 0 55.72	0.36	NOT OBS.
315	9	MCDONALD LURE 107 REF. POINT	LAT	30 40 17.80	-0.33	-0.03	30 40 17.47	0.37	NOT OBS.
316	9	MCDONALD LURE 107 REF. POINT	LON	104 1 17.43	0.70	0.05	104 1 18.13	0.36	NOT OBS.
317	10	TLRS 7897	LAT	30 40 18.40	-0.33	-0.03	30 40 18.07	0.37	NOT OBS.
318	10	TLRS 7897	LON	104 1 18.41	0.70	0.05	104 1 19.11	0.36	NOT OBS.
319	11	BALDY 1917	LAT	30 38 7.61	0.45	0.04	30 38 8.06	10.38	NOT OBS.
320	11	BALDY 1917	LON	104 10 23.55	10.58	0.71	104 10 34.13	15.05	NOT OBS.
321	12	BLUE 1942 RM 3	LAT	30 33 54.61	5.88	0.59	30 34 0.49	9.86	NOT OBS.
322	12	BLUE 1942 RM 3	LON	104 1 20.61	4.29	0.29	104 1 24.89	8.49	NOT OBS.
323	13	TLRS 7897 (0101) REF PT 2/80	LAT	30 40 18.35	-0.33	-0.03	30 40 18.02	0.37	NOT OBS.
324	13	TLRS 7897 (0101) REF PT 2/80	LON	104 1 18.41	0.70	0.05	104 1 19.11	0.36	NOT OBS.
325	14	TLRS 7897 (0102) REF PT 2/80	LAT	30 40 18.35	-0.33	-0.03	30 40 18.02	0.37	NOT OBS.
326	14	TLRS 7897 (0102) REF PT 2/80	LON	104 1 18.41	0.70	0.05	104 1 19.11	0.36	NOT OBS.
327	100	MCDONALD 1942	LAT	30 40 16.24	-0.33	-0.03	30 40 15.90	0.37	NOT OBS.
328	100	MCDONALD 1942	LON	104 1 20.61	0.70	0.05	104 1 21.31	0.36	NOT OBS.
329	101	MCDONALD RM 1 1942	LAT	30 40 16.01	-0.33	-0.03	30 40 15.68	0.37	NOT OBS.
330	101	MCDONALD RM 1 1942	LON	104 1 21.13	0.70	0.05	104 1 21.82	0.36	NOT OBS.
331	102	MCDONALD RM 2 1942	LAT	30 40 16.44	-0.33	-0.03	30 40 16.11	0.37	NOT OBS.
332	102	MCDONALD RM 2 1942	LON	104 1 20.99	0:70	0.05	104 1 21.69	0.36	NOT OBS.

ADJUSTED ASTRONOMIC LATITUDES AND LONGITUDES

STATION				OBSERVED	V	N.V	ADJUSTED	SIGMA	
333	103	MCDONALD RM 3 1942 1971	LAT	30 40 16.94	-0.33	-0.03	30 40 16.61	0.37	NOT OBS.
334	103	MCDONALD RM 3 1942 1971	LON	104 1 19.46	0.70	0.05	104 1 20.16	0.36	NOT OBS.
335	203	HARVARD RM 3 1979	LAT	30 38 8.33	0.86	0.09	30 38 9.19	0.37	NOT OBS.
336	203	HARVARD RM 3 1979	LON	103 56 47.70	2.78	0.19	103 56 50.48	0.35	NOT OBS.
337	204	HARVARD RM 4 1980	LAT	30 38 9.03	0.86	0.09	30 38 9.89	0.37	NOT OBS.
338	204	HARVARD RM 4 1980	LON	103 56 47.36	2.78	0.19	103 56 50.14	0.35	NOT OBS.
339	205	HARVARD RM 5 1980	LAT	30 38 8.27	0.86	0.09	30 38 9.13	0.37	NOT OBS.
340	205	HARVARD RM 5 1980	LON	103 56 48.64	2.78	0.19	103 56 51.43	0.35	NOT OBS.
341	206	HARVARD RM 6 1980	LAT	30 38 9.08	0.86	0.09	30 38 9.94	0.37	NOT OBS.
342	206	HARVARD RM 6 1980	LON	103 56 48.38	2.78	0.19	103 56 51.17	0.35	NOT OBS.

GEODETIC LATITUDE CONSTRAINTS

	STATION	CONSTRAINED	V	N.V	ADJUSTED	SIGMA
343	1	30 40 16.79375	0.00000	0.00001	30 40 16.79375	0.00004

GEODETIC LONGITUDE CONSTRAINTS

	STATION	CONSTRAINED	V	N.V	ADJUSTED	SIGMA
344	1	104 1 19.37460	-0.00000	-0.00003	104 1 19.37460	0.00004

GEODETIC HEIGHT CONSTRAINTS

	STATION	CONSTRAINED	V	N.V	ADJUSTED	SIGMA
345	1	2068.7300	-0.0000	-0.0	2068.7300	0.001

ADJUSTED CARTESIAN COORDINATES

DX	DY	DZ	EPSILON	PSI	OMEGA	SCALE
-10.720	147.910	175.260	0.0	0.0	0.0	0.0

STATION		X	Y	Z	TRANSFORMED COORDINATES X	Y	Z
1	MCDONALD RM 4 1977	-1330821.491	-5328896.587	3235485.999	-1330832.211	-5328748.677	3235661.259
2	HARVARD 1977	-1324209.413	-5332178.445	3231901.620	-1324220.133	-5332030.535	3232076.880
3	MCIVOR 1977	-1325698.922	-5332021.756	3231816.747	-1325709.642	-5331873.846	3231992.007
4	MOBLAS 1979	-1330114.312	-5328676.635	3235972.521	-1330125.032	-5328528.725	3236147.781
5	HRAS 85	-1324196.931	-5332161.243	3231933.368	-1324207.651	-5332013.333	3232108.628
6	HRAS VLBI REF. POINT	-1324199.897	-5332173.188	3231940.658	-1324210.617	-5332025.278	3232115.918
7	MCDONALD OBSERVATORY 107	-1330768.955	-5328900.825	3235517.877	-1330779.675	-5328752.915	3235693.137
8	MOBLAS 7086 REF. POINT 8/79	-1330115.107	-5328679.790	3235974.459	-1330125.827	-5328531.880	3236149.719
9	MCDONALD LURE 107 REF. POINT	-1330770.290	-5328905.582	3235519.947	-1330781.010	-5328757.672	3235695.207
10	TLRS 7897	-1330789.667	-5328874.709	3235526.541	-1330800.387	-5328726.799	3235701.801
11	BALDY 1917	-1345475.192	-5327741.236	3232311.434	-1345485.912	-5327593.326	3232486.694
12	BLUE 1942 RM 3	-1332340.134	-5334842.089	3225437.204	-1332350.854	-5334694.179	3225612.464
13	TLRS 7897 (0101) REF PT 2/80	-1330790.430	-5328878.185	3235526.810	-1330801.150	-5328730.275	3235702.070
14	TLRS 7897 (0102) REF PT 2/80	-1330790.431	-5328878.287	3235526.908	-1330801.151	-5328730.377	3235702.168
100	MCDONALD 1942	-1330855.640	-5328897.631	3235471.498	-1330866.360	-5328749.721	3235646.758
101	MCDONALD RM 1 1942	-1330869.624	-5328896.931	3235464.895	-1330880.344	-5328749.021	3235640.155
102	MCDONALD RM 2 1942	-1330864.536	-5328891.587	3235476.690	-1330875.256	-5328743.677	3235651.950
103	MCDONALD RM 3 1942 1971	-1330823.389	-5328894.306	3235490.272	-1330834.109	-5328746.396	3235665.532
203	HARVARD RM 3 1979	-1324192.428	-5332218.583	3231847.284	-1324203.148	-5332070.673	3232022.544
204	HARVARD RM 4 1980	-1324180.773	-5332209.882	3231865.634	-1324191.493	-5332061.972	3232040.894
205	HARVARD RM 5 1980	-1324216.869	-5332213.094	3231845.319	-1324227.589	-5332065.184	3232020.579
206	HARVARD RM 6 1980	-1324207.041	-5332202.020	3231866.519	-1324217.761	-5332054.110	3232041.779

MISCELLANEOUS DATA FOR SELECTED LINES, PART 1

FROM	TO		STANDARD ERRORS	CORRELATION COEFF. AZ.	DIST.	V.A.		STANDARD ERRORS	CORRELATION COEFF. DX	DY	DZ	DX,DY,DZ	AZ.,DIST.,V.A.	AZ.,DIST.,B.AZ. (GEODETIC)
1	2	AZ.	0.41	1.00	-0.07	0.18	DX	0.011	1.00	0.51	0.61	6612.078	118 20 48.91	118 20 49.13
		DIST.	0.006	-0.07	1.00	0.02	DY	0.012	0.51	1.00	0.16	-3281.858	8205.970	8190.566
		V.A.	0.31	0.18	0.02	1.00	DZ	0.013	0.61	0.16	1.00	-3584.379	93 16 4.18	298 23 7.14
1	3	AZ.	0.44	1.00	0.06	0.10	DX	0.011	1.00	0.46	0.56	5122.569	125 23 46.02	125 23 46.21
		DIST.	0.006	0.06	1.00	-0.00	DY	0.011	0.46	1.00	0.02	-3125.169	7033.549	7023.820
		V.A.	0.35	0.10	-0.00	1.00	DZ	0.012	0.56	0.02	1.00	-3669.252	92 42 2.13	305 25 35.83
1	4	AZ.	1.02	1.00	0.02	0.00	DX	0.005	1.00	0.19	-0.15	707.179	45 49 50.24	45 49 50.77
		DIST.	0.005	0.02	1.00	0.05	DY	0.009	0.19	1.00	-0.67	219.952	886.106	881.959
		V.A.	2.44	0.00	0.05	1.00	DZ	0.007	-0.15	-0.67	1.00	486.522	95 21 28.89	225 50 2.90
1	5	AZ.	0.41	1.00	-0.07	0.17	DX	0.011	1.00	0.50	0.60	6624.560	118 5 24.88	118 5 25.10
		DIST.	0.006	-0.07	1.00	0.02	DY	0.012	0.50	1.00	0.16	-3264.656	8195.362	8179.902
		V.A.	0.31	0.17	0.02	1.00	DZ	0.013	0.60	0.16	1.00	-3552.631	93 16 38.59	298 7 43.26
1	6	AZ.	0.41	1.00	-0.07	0.17	DX	0.011	1.00	0.50	0.60	6621.594	118 5 24.88	118 5 25.10
		DIST.	0.006	-0.07	1.00	0.02	DY	0.012	0.50	1.00	0.15	-3276.601	8194.575	8179.902
		V.A.	0.31	0.17	0.02	1.00	DZ	0.013	0.60	0.15	1.00	-3545.341	93 10 39.11	298 7 43.26
1	7	AZ.	4.20	1.00	-0.01	0.00	DX	0.002	1.00	0.11	0.57	52.536	58 32 23.19	58 32 23.69
		DIST.	0.003	-0.01	1.00	-0.28	DY	0.001	0.11	1.00	0.12	-4.238	61.597	60.938
		V.A.	4.17	0.00	-0.28	1.00	DZ	0.002	0.57	0.12	1.00	31.878	81 44 26.13	238 32 24.69
1	8	AZ.	1.16	1.00	0.02	0.00	DX	0.005	1.00	0.17	-0.12	706.384	45 49 47.92	45 49 48.46
		DIST.	0.005	0.02	1.00	0.05	DY	0.009	0.17	1.00	-0.62	216.797	885.761	881.959
		V.A.	2.50	0.00	0.05	1.00	DZ	0.007	-0.12	-0.62	1.00	488.460	95 6 50.63	225 50 0.58
1	9	AZ.	9.12	1.00	-0.01	0.00	DX	0.003	1.00	0.04	0.23	51.201	59 4 0.02	59 4 0.52
		DIST.	0.004	-0.01	1.00	-0.14	DY	0.003	0.04	1.00	0.03	-8.995	62.087	60.433
		V.A.	9.00	0.00	-0.14	1.00	DZ	0.003	0.23	0.03	1.00	33.948	76 49 25.28	239 4 1.51
1	10	AZ.	3.09	1.00	0.23	0.04	DX	0.002	1.00	0.51	0.70	31.824	27 15 42.09	27 15 42.61
		DIST.	0.003	0.23	1.00	0.09	DY	0.002	0.51	1.00	0.15	21.878	55.992	55.815
		V.A.	5.92	0.04	0.09	1.00	DZ	0.002	0.70	0.15	1.00	40.542	94 18 37.37	207 15 43.10
1	11	AZ.	0.54	1.00	-0.29	-0.07	DX	0.097	1.00	0.99	-0.99	-14653.701	254 41 7.93	254 41 8.38
		DIST.	0.008	-0.29	1.00	-0.13	DY	0.464	0.99	1.00	-0.99	1155.351	15038.074	15024.711
		V.A.	7.56	-0.07	-0.13	1.00	DZ	0.285	-0.99	-0.99	1.00	-3174.565	88 12 27.16	74 36 30.94
1	12	AZ.	0.54	1.00	-0.17	-0.54	DX	0.044	1.00	0.81	-0.83	-1518.643	180 9 34.72	180 9 35.08
		DIST.	0.006	-0.17	1.00	-0.07	DY	0.213	0.81	1.00	-1.00	-5945.502	11774.276	11769.168
		V.A.	4.44	-0.54	-0.07	1.00	DZ	0.132	-0.83	-1.00	1.00	-10048.795	89 15 39.23	0 9 34.45
1	101	AZ.	13.33	1.00	0.08	-0.01	DX	0.003	1.00	-0.24	-0.08	-48.133	242 29 44.35	242 29 44.84
		DIST.	0.003	0.08	1.00	0.02	DY	0.002	-0.24	1.00	0.46	-0.344	52.557	52.538
		V.A.	7.33	-0.01	0.02	1.00	DZ	0.003	-0.08	0.46	1.00	-21.104	90 29 15.34	62 29 43.95

MISCELLANEOUS DATA FOR SELECTED LINES, PART 1

FROM	TO		STANDARD ERRORS	CORRELATION COEFF. AZ.	DIST.	V.A.		STANDARD ERRORS	CORRELATION COEFF. DX	DY	DZ	DX,DY,DZ	AZ.,DIST.,V.A.	AZ.,DIST.,B.AZ. (GEODETIC)
1	203	AZ.	0.41	1.00	-0.06	0.17	DX	0.011	1.00	0.49	0.60	6629.063	118 39 17.59	118 39 17.80
		DIST.	0.006	-0.06	1.00	0.02	DY	0.012	0.49	1.00	0.16	-3321.996	8259.564	8244.357
		V.A.	0.31	0.17	0.02	1.00	DZ	0.013	0.60	0.16	1.00	-3638.715	93 13 51.81	298 41 36.31
1	206	AZ.	0.41	1.00	-0.06	0.17	DX	0.011	1.00	0.49	0.60	6614.450	118 34 31.42	118 34 31.63
		DIST.	0.006	-0.06	1.00	0.02	DY	0.012	0.49	1.00	0.16	-3305.433	8232.708	8217.412
		V.A.	0.31	0.17	0.02	1.00	DZ	0.013	0.60	0.16	1.00	-3619.480	93 14 53.97	298 36 49.80
2	1	AZ.	0.41	1.00	-0.08	-0.19	DX	0.011	1.00	0.51	0.61	-6612.078	298 23 5.88	298 23 7.14
		DIST.	0.006	-0.08	1.00	0.01	DY	0.012	0.51	1.00	0.16	3281.858	8205.970	8190.566
		V.A.	0.29	-0.19	0.01	1.00	DZ	0.013	0.61	0.16	1.00	3584.379	86 48 18.61	118 20 49.13
2	3	AZ.	0.53	1.00	0.04	-0.08	DX	0.003	1.00	-0.01	-0.03	-1489.509	263 8 19.52	263 8 21.08
		DIST.	0.003	0.04	1.00	-0.00	DY	0.004	-0.01	1.00	0.16	156.688	1500.131	1493.654
		V.A.	0.44	-0.08	-0.00	1.00	DZ	0.004	-0.03	0.16	1.00	-84.873	84 50 37.84	83 7 52.70
2	4	AZ.	0.43	1.00	-0.12	-0.08	DX	0.013	1.00	0.38	0.53	-5904.899	304 26 36.99	304 26 38.23
		DIST.	0.007	-0.12	1.00	0.02	DY	0.013	0.38	1.00	-0.09	3501.810	7981.400	7970.112
		V.A.	0.35	-0.08	0.02	1.00	DZ	0.013	0.53	-0.09	1.00	4070.900	87 18 27.23	124 24 32.32
2	5	AZ.	4.84	1.00	-0.02	0.00	DX	0.001	1.00	0.15	0.06	12.482	12 2 25.92	12 2 27.44
		DIST.	0.001	-0.02	1.00	0.02	DY	0.001	0.15	1.00	-0.05	17.201	38.205	38.188
		V.A.	6.39	0.00	0.02	1.00	DZ	0.001	0.06	-0.05	1.00	31.748	91 9 39.61	192 2 27.59
2	6	AZ.	5.80	1.00	-0.01	0.00	DX	0.001	1.00	0.20	-0.03	9.516	12 2 26.86	12 2 27.44
		DIST.	0.001	-0.01	1.00	0.17	DY	0.002	0.20	1.00	-0.24	5.257	40.523	38.188
		V.A.	8.29	0.00	0.17	1.00	DZ	0.001	-0.03	-0.24	1.00	39.037	70 29 43.28	192 2 27.59
2	7	AZ.	0.42	1.00	-0.10	-0.18	DX	0.011	1.00	0.49	0.61	-6559.542	298 45 17.28	298 45 18.53
		DIST.	0.006	-0.10	1.00	0.01	DY	0.012	0.49	1.00	0.15	3277.620	8176.044	8160.090
		V.A.	0.29	-0.18	0.01	1.00	DZ	0.013	0.61	0.15	1.00	3616.256	86 43 51.90	118 43 · 1.52
2	10	AZ.	0.42	1.00	-0.08	-0.18	DX	0.011	1.00	0.50	0.61	-6580.254	298 46 31.04	298 46 32.30
		DIST.	0.006	-0.08	1.00	0.01	DY	0.012	0.50	1.00	0.15	3303.736	8206.976	8191.814
		V.A.	0.29	-0.18	0.01	1.00	DZ	0.013	0.61	0.15	1.00	3624.921	86 50 5.99	118 44 14.77
2	11	AZ.	0.48	1.00	0.10	0.03	DX	0.097	1.00	1.00	-0.98	-21265.779	269 49 42.85	269 49 44.30
		DIST.	0.009	0.10	1.00	0.55	DY	0.464	1.00	1.00	-0.98	4437.209	21727.636	21699.770
		V.A.	5.24	0.03	0.55	1.00	DZ	0.286	-0.98	-0.98	1.00	409.813	87 35 21.87	89 42 49.07
2	12	AZ.	0.50	1.00	0.21	-0.36	DX	0.040	1.00	0.89	-0.95	-8130.721	222 37 6.02	222 37 7.75
		DIST.	0.005	0.21	1.00	0.14	DY	0.213	0.89	1.00	-0.99	-2663.645	10723.447	10701.978
		V.A.	4.87	-0.36	0.14	1.00	DZ	0.133	-0.95	-0.99	1.00	-6464.417	86 42 18.69	42 34 49.33
3	1	AZ.	0.44	1.00	0.07	-0.19	DX	0.011	1.00	0.46	0.56	-5122.569	305 25 35.31	305 25 35.83
		DIST.	0.006	0.07	1.00	-0.01	DY	0.011	0.46	1.00	0.02	3125.169	7033.549	7023.820
		V.A.	0.46	-0.19	-0.01	1.00	DZ	0.012	0.56	0.02	1.00	3669.252	87 21 43.93	125 23 46.21

MISCELLANEOUS DATA FOR SELECTED LINES, PART 1

FROM	TO		STANDARD ERRORS	CORRELATION COEFF. AZ.	DIST.	V.A.		STANDARD ERRORS	CORRELATION COEFF. DX	DY	DZ	DX,DY,DZ	AZ.,DIST.,V.A.	AZ.,DIST.,B.AZ. (GEODETIC)
3	2	AZ.	0.53	1.00	0.04	0.08	DX	0.003	1.00	-0.01	-0.03	1489.509	83 7 51.89	83 7 52.70
		DIST.	0.003	0.04	1.00	-0.00	DY	0.004	-0.01	1.00	0.16	-156.688	1500.131	1493.654
		V.A.	0.45	0.08	-0.00	1.00	DZ	0.004	-0.03	0.16	1.00	84.873	95 10 9.13	263 8 21.08
3	4	AZ.	0.47	1.00	0.01	-0.11	DX	0.013	1.00	0.34	0.48	-4415.390	312 37 42.38	312 37 42.88
		DIST.	0.007	0.01	1.00	-0.00	DY	0.013	0.34	1.00	-0.21	3345.122	6925.024	6918.671
		V.A.	0.52	-0.11	-0.00	1.00	DZ	0.012	0.48	-0.21	1.00	4155.773	88 0 16.36	132 36 5.37
3	5	AZ.	0.55	1.00	0.04	0.07	DX	0.003	1.00	-0.01	-0.05	1501.991	81 45 24.69	81 45 25.51
		DIST.	0.003	0.04	1.00	-0.00	DY	0.004	-0.01	1.00	0.14	-139.487	1512.956	1506.458
		V.A.	0.48	0.07	-0.00	1.00	DZ	0.004	-0.05	0.14	1.00	116.621	95 9 17.30	261 45 54.04
3	7	AZ.	0.45	1.00	0.04	-0.19	DX	0.011	1.00	0.44	0.56	-5070.033	305 53 6.43	305 53 6.95
		DIST.	0.006	0.04	1.00	-0.01	DY	0.011	0.44	1.00	0.02	3120.932	7010.264	7000.093
		V.A.	0.46	-0.19	-0.01	1.00	DZ	0.012	0.56	0.02	1.00	3701.129	87 16 50.95	125 51 18.32
3	10	AZ.	0.45	1.00	0.07	-0.19	DX	0.011	1.00	0.46	0.57	-5090.745	305 52 36.07	305 52 36.58
		DIST.	0.006	0.07	1.00	-0.01	DY	0.012	0.46	1.00	0.02	3147.048	7041.460	7031.934
		V.A.	0.46	-0.19	-0.01	1.00	DZ	0.012	0.57	0.02	1.00	3709.794	87 23 58.26	125 50 47.45
3	11	AZ.	0.50	1.00	0.14	0.04	DX	0.097	1.00	1.00	-0.98	-19776.270	270 18 50.49	270 18 51.19
		DIST.	0.008	0.14	1.00	0.37	DY	0.464	1.00	1.00	-0.98	4280.521	20240.268	20217.034
		V.A.	5.63	0.04	0.37	1.00	DZ	0.286	-0.98	-0.98	1.00	494.686	87 46 52.23	90 12 24.34
3	12	AZ.	0.54	1.00	0.03	-0.41	DX	0.040	1.00	0.89	-0.94	-6641.212	216 49 5.78	216 49 6.69
		DIST.	0.004	0.03	1.00	-0.05	DY	0.213	0.89	1.00	-0.99	-2820.333	9631.124	9615.636
		V.A.	5.42	-0.41	-0.05	1.00	DZ	0.133	-0.94	-0.99	1.00	-6379.544	87 7 31.33	36 47 16.62
3	203	AZ.	0.61	1.00	-0.06	0.06	DX	0.004	1.00	0.00	0.10	1506.494	85 40 28.71	85 40 29.50
		DIST.	0.004	-0.06	1.00	0.03	DY	0.004	0.00	1.00	0.24	-196.827	1519.605	1513.405
		V.A.	0.46	0.06	0.03	1.00	DZ	0.004	0.10	0.24	1.00	30.536	95 0 56.41	265 40 58.37
3	206	AZ.	0.61	1.00	-0.02	0.06	DX	0.004	1.00	-0.02	0.06	1491.881	84 44 48.51	84 44 49.30
		DIST.	0.004	-0.02	1.00	0.02	DY	0.004	-0.02	1.00	0.24	-180.264	1503.557	1497.210
		V.A.	0.47	0.06	0.02	1.00	DZ	0.004	0.06	0.24	1.00	49.772	95 6 26.55	264 45 17.83
4	5	AZ.	0.45	1.00	-0.11	0.22	DX	0.013	1.00	0.38	0.52	5917.382	124 9 17.03	124 9 16.96
		DIST.	0.007	-0.11	1.00	0.01	DY	0.013	0.38	1.00	-0.09	-3484.609	7966.973	7955.636
		V.A.	0.42	0.22	0.01	1.00	DZ	0.013	0.52	-0.09	1.00	-4039.152	92 46 25.84	304 11 23.02
4	7	AZ.	1.15	1.00	0.07	-0.06	DX	0.005	1.00	0.18	-0.07	-654.642	224 54 0.97	224 54 1.19
		DIST.	0.005	0.07	1.00	-0.02	DY	0.009	0.18	1.00	-0.65	-224.190	827.961	822.624
		V.A.	2.63	-0.06	-0.02	1.00	DZ	0.007	-0.07	-0.65	1.00	-454.644	83 39 24.38	44 53 50.06
4	10	AZ.	1.08	1.00	-0.02	-0.05	DX	0.005	1.00	0.22	-0.14	-675.354	227 3 44.14	227 3 44.36
		DIST.	0.005	-0.02	1.00	-0.04	DY	0.009	0.22	1.00	-0.68	-198.074	833.207	829.240
		V.A.	2.63	-0.05	-0.04	1.00	DZ	0.007	-0.14	-0.68	1.00	-445.980	84 35 58.30	47 3 32.73

MISCELLANEOUS DATA FOR SELECTED LINES, PART 1

FROM	TO		STANDARD ERRORS	CORRELATION COEFF. AZ.	DIST.	V.A.		STANDARD ERRORS	CORRELATION COEFF. DX	DY	DZ	DX,DY,DZ	AZ.,DIST.,V.A.	AZ.,DIST.,B.AZ. (GEODETIC)
4	11	AZ.	0.55	1.00	-0.28	-0.09	DX	0.097	1.00	0.99	-0.99	-15360.880	253 8 44.25	253 8 44.42
		DIST.	0.009	-0.28	1.00	0.11	DY	0.464	0.99	1.00	-0.99	935.399	15818.823	15802.904
		V.A.	7.20	-0.09	0.11	1.00	DZ	0.285	-0.99	-0.99	1.00	-3661.087	88 0 12.13	73 3 54.83
4	12	AZ.	0.56	1.00	-0.16	-0.48	DX	0.045	1.00	0.79	-0.82	-2225.822	183 4 44.92	183 4 45.00
		DIST.	0.007	-0.16	1.00	0.02	DY	0.213	0.79	1.00	-1.00	-6165.455	12408.063	12401.519
		V.A.	4.22	-0.48	0.02	1.00	DZ	0.132	-0.82	-1.00	1.00	-10535.317	88 55 20.68	3 4 32.27
4	101	AZ.	1.27	1.00	0.00	-0.04	DX	0.005	1.00	0.11	-0.17	-755.311	226 45 35.81	226 45 36.04
		DIST.	0.005	0.00	1.00	-0.05	DY	0.009	0.11	1.00	-0.55	-220.296	936.327	932.413
		V.A.	2.35	-0.04	-0.05	1.00	DZ	0.008	-0.17	-0.55	1.00	-507.625	84 57 56.43	46 45 23.02
5	7	AZ.	0.42	1.00	-0.10	-0.21	DX	0.011	1.00	0.49	0.60	-6572.024	298 29 51.69	298 29 52.95
		DIST.	0.006	-0.10	1.00	0.01	DY	0.012	0.49	1.00	0.15	3260.419	8165.202	8149.189
		V.A.	0.31	-0.21	0.01	1.00	DZ	0.013	0.60	0.15	1.00	3584.508	86 43 16.32	118 27 35.78
5	10	AZ.	0.42	1.00	-0.08	-0.21	DX	0.011	1.00	0.50	0.61	-6592.736	298 31 9.14	298 31 10.40
		DIST.	0.006	-0.08	1.00	0.01	DY	0.012	0.50	1.00	0.15	3286.535	8196.119	8180.899
		V.A.	0.31	-0.21	0.01	1.00	DZ	0.013	0.61	0.15	1.00	3593.172	86 49 31.02	118 28 52.72
5	11	AZ.	0.48	1.00	0.09	0.03	DX	0.097	1.00	1.00	-0.98	-21278.262	269 43 48.36	269 43 49.81
		DIST.	0.009	0.09	1.00	0.55	DY	0.464	1.00	1.00	-0.98	4420.008	21735.773	21707.880
		V.A.	5.24	0.03	0.55	1.00	DZ	0.286	-0.98	-0.98	1.00	378.065	87 35 18.03	89 36 54.42
5	12	AZ.	0.50	1.00	0.20	-0.36	DX	0.040	1.00	0.89	-0.94	-8143.204	222 30 52.90	222 30 54.64
		DIST.	0.005	0.20	1.00	0.13	DY	0.213	0.89	1.00	-0.99	-2680.846	10756.340	10734.873
		V.A.	4.86	-0.36	0.13	1.00	DZ	0.133	-0.94	-0.99	1.00	-6496.165	86 42 41.20	42 28 36.06
6	8	AZ.	0.44	1.00	-0.11	-0.10	DX	0.013	1.00	0.37	0.50	-5915.210	304 11 21.83	304 11 23.07
		DIST.	0.008	-0.11	1.00	0.01	DY	0.013	0.37	1.00	-0.09	3493.398	7966.498	7955.646
		V.A.	0.37	-0.10	0.01	1.00	DZ	0.013	0.50	-0.09	1.00	4033.802	87 22 21.13	124 9 17.01
6	9	AZ.	0.43	1.00	-0.09	-0.20	DX	0.012	1.00	0.47	0.58	-6570.393	298 29 33.52	298 29 34.78
		DIST.	0.007	-0.09	1.00	0.01	DY	0.012	0.47	1.00	0.14	3267.606	8164.473	8148.963
		V.A.	0.31	-0.20	0.01	1.00	DZ	0.013	0.58	0.14	1.00	3579.289	86 47 2.99	118 27 17.61
6	10	AZ.	0.42	1.00	-0.08	-0.20	DX	0.011	1.00	0.50	0.61	-6589.770	298 31 9.14	298 31 10.40
		DIST.	0.006	-0.08	1.00	0.01	DY	0.012	0.50	1.00	0.15	3298.479	8195.339	8180.899
		V.A.	0.31	-0.20	0.01	1.00	DZ	0.013	0.61	0.15	1.00	3585.883	86 55 30.48	118 28 52.72
6	101	AZ.	0.42	1.00	-0.06	-0.21	DX	0.011	1.00	0.46	0.56	-6669.727	297 49 32.92	297 49 34.18
		DIST.	0.007	-0.06	1.00	0.00	DY	0.012	0.46	1.00	0.17	3276.257	8224.316	8209.703
		V.A.	0.31	-0.21	0.00	1.00	DZ	0.013	0.56	0.17	1.00	3524.238	86 54 35.97	117 47 15.12
6	203	AZ.	5.23	1.00	0.20	0.03	DX	0.003	1.00	0.02	0.23	7.469	169 52 32.72	169 52 33.85
		DIST.	0.002	0.20	1.00	0.05	DY	0.002	0.02	1.00	0.20	-45.395	104.092	103.459
		V.A.	3.79	0.03	0.05	1.00	DZ	0.002	0.23	0.20	1.00	-93.374	96 11 26.17	349 52 34.20

MISCELLANEOUS DATA FOR SELECTED LINES, PART 1

FROM	TO		STANDARD ERRORS	CORRELATION COEFF. AZ.	DIST.	V.A.		STANDARD ERRORS	CORRELATION COEFF. DX	DY	DZ	DX,DY,DZ	AZ.,DIST.,V.A.	AZ.,DIST.,B.AZ. (GEODETIC)
6	206	AZ.	6.35	1.00	0.09	0.02	DX	0.002	1.00	-0.03	0.12	-7.144	179 59 16.61	179 59 17.66
		DIST.	0.002	0.09	1.00	0.07	DY	0.002	-0.03	1.00	0.19	-28.832	79.867	78.907
		V.A.	4.96	0.02	0.07	1.00	DZ	0.002	0.12	0.19	1.00	-74.138	98 48 9.94	359 59 17.66
7	10	AZ.	22.19	1.00	-0.23	-0.09	DX	0.003	1.00	0.27	0.57	-20.712	303 59 34.76	303 59 35.21
		DIST.	0.002	-0.23	1.00	-0.08	DY	0.002	0.27	1.00	0.12	26.116	34.440	31.858
		V.A.	11.76	-0.09	-0.08	1.00	DZ	0.003	0.57	0.12	1.00	8.664	112 16 47.48	123 59 34.70
7	11	AZ.	0.54	1.00	-0.27	-0.07	DX	0.097	1.00	0.99	-0.99	-14706.238	254 37 17.19	254 37 17.65
		DIST.	0.008	-0.27	1.00	-0.16	DY	0.464	0.99	1.00	-0.99	1159.589	15096.336	15083.256
		V.A.	7.54	-0.07	-0.16	1.00	DZ	0.285	-0.99	-0.99	1.00	-3206.443	88 14 54.92	74 32 39.21
7	12	AZ.	0.54	1.00	-0.14	-0.53	DX	0.044	1.00	0.81	-0.83	-1571.179	180 24 42.69	180 24 43.05
		DIST.	0.007	-0.14	1.00	-0.11	DY	0.213	0.81	1.00	-1.00	-5941.265	11806.236	11801.231
		V.A.	4.43	-0.53	-0.11	1.00	DZ	0.132	-0.83	-1.00	1.00	-10080.673	89 18 22.09	0 24 41.43
8	9	AZ.	1.43	1.00	0.05	-0.04	DX	0.006	1.00	0.14	-0.06	-655.183	224 52 13.18	224 52 13.40
		DIST.	0.006	0.05	1.00	-0.02	DY	0.010	0.14	1.00	-0.55	-225.792	828.751	823.248
		V.A.	2.76	-0.04	-0.02	1.00	DZ	0.008	-0.06	-0.55	1.00	-454.513	83 33 26.59	44 52 2.27
8	10	AZ.	1.23	1.00	-0.02	-0.04	DX	0.005	1.00	0.19	-0.12	-674.559	227 3 41.68	227 3 41.90
		DIST.	0.005	-0.02	1.00	-0.04	DY	0.009	0.19	1.00	-0.62	-194.918	832.859	829.240
		V.A.	2.70	-0.04	-0.04	1.00	DZ	0.007	-0.12	-0.62	1.00	-447.918	84 51 32.26	47 3 30.27
9	10	AZ.	26.76	1.00	-0.09	-0.06	DX	0.004	1.00	0.14	0.32	-19.376	305 13 37.47	305 13 38.02
		DIST.	0.003	-0.09	1.00	-0.04	DY	0.003	0.14	1.00	0.06	30.873	37.042	32.160
		V.A.	17.03	-0.06	-0.04	1.00	DZ	0.003	0.32	0.06	1.00	6.594	119 42 54.67	125 13 37.52
9	101	AZ.	7.91	1.00	0.03	0.00	DX	0.004	1.00	-0.09	0.05	-99.333	240 39 41.71	240 39 42.21
		DIST.	0.004	0.03	1.00	0.10	DY	0.004	-0.09	1.00	0.24	8.651	113.897	112.921
		V.A.	5.92	0.00	0.10	1.00	DZ	0.004	0.05	0.24	1.00	-55.051	97 21 55.05	60 39 40.33
9	203	AZ.	0.42	1.00	-0.08	0.19	DX	0.012	1.00	0.46	0.58	6577.863	119 1 7.36	119 1 7.57
		DIST.	0.007	-0.08	1.00	0.01	DY	0.012	0.46	1.00	0.15	-3313.001	8229.988	8213.931
		V.A.	0.33	0.19	0.01	1.00	DZ	0.013	0.58	0.15	1.00	-3672.663	93 20 27.97	299 3 25.09
9	206	AZ.	0.42	1.00	-0.08	0.19	DX	0.012	1.00	0.46	0.57	6563.250	118 56 24.44	118 56 24.65
		DIST.	0.007	-0.08	1.00	0.01	DY	0.012	0.46	1.00	0.15	-3296.439	8203.065	8186.913
		V.A.	0.33	0.19	0.01	1.00	DZ	0.013	0.57	0.15	1.00	-3653.427	93 21 31.76	298 58 41.82
10	11	AZ.	0.54	1.00	-0.29	-0.07	DX	0.097	1.00	0.99	-0.99	-14685.526	254 31 45.58	254 31 46.04
		DIST.	0.008	-0.29	1.00	-0.11	DY	0.464	0.99	1.00	-0.99	1133.473	15076.019	15062.531
		V.A.	7.55	-0.07	-0.11	1.00	DZ	0.285	-0.99	-0.99	1.00	-3215.107	88 11 47.03	74 27 8.11
10	12	AZ.	0.54	1.00	-0.15	-0.53	DX	0.044	1.00	0.81	-0.83	-1550.468	180 16 58.98	180 16 59.35
		DIST.	0.007	-0.15	1.00	-0.06	DY	0.213	0.81	1.00	-1.00	-5967.380	11824.056	11818.882
		V.A.	4.42	-0.53	-0.06	1.00	DZ	0.132	-0.83	-1.00	1.00	-10089.337	89 14 38.63	0 16 58.23

MISCELLANEOUS DATA FOR SELECTED LINES, PART I

FROM	TO	STANDARD ERRORS		CORRELATION COEFF. AZ.	DIST.	V.A.		STANDARD ERRORS	CORRELATION COEFF. DX	DY	DZ	DX,DY,DZ	AZ.,DIST.,V.A.	AZ.,DIST.,B.AZ. (GEODETIC)
10	101	AZ.	7.21	1.00	-0.18	0.02	DX	0.003	1.00	-0.20	0.01	-79.957	224 19 42.77	224 19 43.30
		DIST.	0.003	-0.18	1.00	-0.06	DY	0.002	-0.20	1.00	0.60	-22.222	103.379	103.277
		V.A.	3.35	0.02	-0.06	1.00	DZ	0.003	0.01	0.60	1.00	-61.646	87 54 55.89	44 19 41.92
11	12	AZ.	7.67	1.00	-0.10	0.69	DX	0.098	1.00	0.98	-0.94	13135.058	118 16 12.68	118 16 17.83
		DIST.	0.009	-0.10	1.00	-0.06	DY	0.456	0.98	1.00	-0.99	-7100.853	16437.972	16428.590
		V.A.	7.68	0.69	-0.06	1.00	DZ	0.287	-0.94	-0.99	1.00	-6874.230	91 12 35.51	298 20 54.22
11	203	AZ.	7.70	1.00	0.51	0.97	DX	0.097	1.00	1.00	-0.98	21282.765	89 52 56.76	89 53 2.18
		DIST.	0.009	0.51	1.00	0.44	DY	0.464	1.00	1.00	-0.98	-4477.347	21753.578	21725.825
		V.A.	8.45	0.97	0.44	1.00	DZ	0.286	-0.98	-0.98	1.00	-464.150	92 35 53.74	269 59 57.91
11	206	AZ.	7.70	1.00	0.51	0.97	DX	0.097	1.00	1.00	-0.98	21268.152	89 49 18.77	89 49 24.18
		DIST.	0.009	0.51	1.00	0.45	DY	0.464	1.00	1.00	-0.98	-4460.785	21735.474	21707.668
		V.A.	8.45	0.97	0.45	1.00	DZ	0.286	-0.98	-0.98	1.00	-444.914	92 36 10.42	269 56 19.57
101	203	AZ.	0.42	1.00	-0.04	0.19	DX	0.012	1.00	0.46	0.56	6677.196	118 21 8.80	118 21 9.02
		DIST.	0.007	-0.04	1.00	0.02	DY	0.012	0.46	1.00	0.18	-3321.652	8288.874	8273.730
		V.A.	0.32	0.19	0.02	1.00	DZ	0.013	0.56	0.18	1.00	-3617.612	93 13 0.44	298 23 28.42
101	206	AZ.	0.42	1.00	-0.04	0.19	DX	0.012	1.00	0.46	0.56	6662.583	118 16 20.10	118 16 20.32
		DIST.	0.007	-0.04	1.00	0.02	DY	0.012	0.46	1.00	0.18	-3305.090	8262.078	8246.845
		V.A.	0.32	0.19	0.02	1.00	DZ	0.013	0.56	0.18	1.00	-3598.376	93 14 2.12	298 18 39.37
203	204	AZ.	25.80	1.00	-0.07	-0.01	DX	0.003	1.00	-0.70	-0.58	11.654	23 10 28.65	23 10 30.19
		DIST.	0.001	-0.07	1.00	0.02	DY	0.002	-0.70	1.00	0.59	8.701	23.415	23.407
		V.A.	8.07	-0.01	0.02	1.00	DZ	0.001	-0.58	0.59	1.00	18.351	90 48 39.79	203 10 30.37
203	205	AZ.	24.03	1.00	-0.03	0.01	DX	0.001	1.00	0.07	0.14	-24.442	265 29 3.25	265 29 4.67
		DIST.	0.001	-0.03	1.00	0.02	DY	0.002	0.07	1.00	0.78	5.489	25.127	25.116
		V.A.	7.53	0.01	0.02	1.00	DZ	0.003	0.14	0.78	1.00	-1.965	91 10 35.61	85 29 4.19
203	206	AZ.	23.06	1.00	0.02	0.00	DX	0.003	1.00	0.31	0.78	-14.613	321 37 14.55	321 37 15.89
		DIST.	0.001	0.02	1.00	0.05	DY	0.001	0.31	1.00	0.50	16.563	29.290	29.265
		V.A.	5.28	0.00	0.05	1.00	DZ	0.002	0.78	0.50	1.00	19.236	91 57 8.57	141 37 15.54
204	205	AZ.	22.84	1.00	0.00	0.01	DX	0.002	1.00	-0.71	-0.69	-36.096	235 32 56.49	235 32 58.02
		DIST.	0.002	0.00	1.00	0.01	DY	0.003	-0.71	1.00	0.84	-3.212	41.545	41.534
		V.A.	5.87	0.01	0.01	1.00	DZ	0.003	-0.69	0.84	1.00	-20.315	90 15 16.68	55 32 57.36
204	206	AZ.	24.53	1.00	0.09	0.01	DX	0.001	1.00	0.25	0.33	-26.268	272 58 32.89	272 58 34.28
		DIST.	0.001	0.09	1.00	0.03	DY	0.002	0.25	1.00	0.81	7.862	27.433	27.418
		V.A.	6.89	0.01	0.03	1.00	DZ	0.003	0.33	0.81	1.00	0.885	91 23 31.46	92 58 33.76
205	206	AZ.	23.55	1.00	0.00	-0.01	DX	0.003	1.00	-0.66	-0.43	9.828	15 24 30.31	15 24 31.84
		DIST.	0.001	0.00	1.00	0.02	DY	0.001	-0.66	1.00	0.46	11.074	25.859	25.848
		V.A.	7.31	-0.01	0.02	1.00	DZ	0.001	-0.43	0.46	1.00	21.201	91 4 4.53	195 24 31.97

MISCELLANEOUS DATA FOR SELECTED LINES, PART 2

FROM	TO	EQUATORIAL SYSTEM ALTITUDE	AZIMUTH	DISTANCE	HORIZON SYSTEM, ORIGIN AT THE STANDPOINT DN	SIGMA	DE	SIGMA	DU	SIGMA
1	2	25 53 59.90	333 36 10.17	8205.970	-3889.934	0.014	7210.239	0.010	-467.769	0.011
1	3	31 26 41.70	328 36 48.71	7033.549	-4069.489	0.013	5727.149	0.010	-331.398	0.012
1	4	33 18 8.12	17 16 37.78	886.106	614.725	0.004	632.812	0.005	-82.744	0.010
1	5	25 41 21.94	333 45 55.49	8195.362	-3852.571	0.014	7218.181	0.010	-468.529	0.011
1	6	25 38 7.91	333 40 19.75	8194.575	-3852.579	0.014	7218.198	0.010	-454.225	0.011
1	7	31 9 57.83	355 23 18.22	61.597	31.814	0.002	51.997	0.002	8.849	0.001
1	8	33 28 1.65	17 3 42.50	885.761	614.732	0.005	632.805	0.005	-78.956	0.011
1	9	33 8 44.41	350 2 9.39	62.087	31.075	0.003	51.854	0.003	14.153	0.003
1	10	46 23 29.10	34 30 26.87	55.992	49.632	0.002	25.575	0.002	-4.208	0.002
1	11	12 11 12.96	175 29 30.90	15038.074	-3969.861	0.038	-14496.987	0.021	470.378	0.551
1	12	58 35 21.45	255 40 17.27	11774.276	-11773.250	0.007	-32.804	0.030	151.881	0.253
1	101	23 40 27.80	180 24 33.58	52.557	-24.271	0.003	-46.615	0.003	-0.447	0.002
1	203	26 8 19.34	333 23 0.09	8259.564	-3954.435	0.014	7236.444	0.010	-465.532	0.011
1	206	26 4 52.74	333 26 50.52	8232.708	-3931.499	0.014	7218.253	0.010	-466.495	0.011
2	1	25 53 59.90	153 36 10.17	8205.970	3895.001	0.014	-7208.173	0.010	457.330	0.011
2	3	3 14 36.10	173 59 41.56	1500.131	-178.488	0.004	-1483.360	0.003	134.817	0.003
2	4	30 40 1.40	149 19 50.12	7981.400	4509.255	0.014	-6574.861	0.011	374.923	0.014
2	5	56 12 2.37	54 1 59.60	38.205	37.357	0.001	7.968	0.001	-0.774	0.001
2	6	74 26 17.87	28 55 0.50	40.523	37.357	0.001	7.968	0.001	13.530	0.002
2	7	26 15 2.38	153 26 59.93	8176.044	3926.786	0.014	-7156.164	0.010	466.218	0.011
2	10	26 12 41.81	153 20 24.83	8206.976	3944.613	0.014	-7182.560	0.010	453.120	0.011
2	11	1 4 50.67	168 12 50.60	21727.636	-64.952	0.049	-21708.311	0.020	913.872	0.551
2	12	37 4 22.29	198 8 20.13	10723.447	-7878.131	0.016	-7248.967	0.025	616.315	0.253
3	1	31 26 41.70	148 36 48.71	7033.549	4072.731	0.013	-5725.285	0.010	323.698	0.012
3	2	3 14 36.10	353 59 41.56	1500.131	178.683	0.004	1483.306	0.003	-135.158	0.003
3	4	36 52 39.88	142 51 8.10	6925.024	4687.068	0.012	-5092.073	0.012	241.131	0.014
3	5	4 25 15.03	354 41 39.37	1512.956	216.041	0.004	1491.269	0.003	-135.935	0.004
3	7	31 52 3.47	148 23 6.10	7010.264	4104.524	0.013	-5673.278	0.010	332.573	0.012
3	10	31 47 34.34	148 16 33.81	7041.460	4122.347	0.013	-5699.680	0.010	319.481	0.012
3	11	1 24 1.76	167 47 12.78	20240.268	110.849	0.048	-20224.789	0.020	783.625	0.551
3	12	41 28 56.17	203 0 34.35	9631.124	-7700.401	0.015	-5764.467	0.024	483.008	0.252
3	203	1 9 5.14	352 33 22.84	1519.605	114.170	0.004	1509.474	0.004	-132.856	0.003
3	206	1 53 49.23	353 6 37.25	1503.557	137.115	0.004	1491.297	0.004	-133.850	0.003
4	5	30 27 48.05	329 30 25.76	7966.973	-4467.655	0.014	6585.140	0.011	-385.552	0.014
4	7	33 18 22.22	198 54 15.75	827.961	-582.884	0.005	-580.859	0.005	91.477	0.010
4	10	32 21 40.68	196 20 45.03	833.207	-565.064	0.005	-607.279	0.004	78.419	0.011
4	11	13 22 54.43	176 30 55.02	15818.823	-4583.728	0.039	-15130.130	0.022	551.139	0.551
4	12	58 6 38.48	250 8 58.76	12408.063	-12387.958	0.009	-666.385	0.032	233.350	0.253
4	101	32 49 47.20	196 15 36.01	936.327	-638.963	0.005	-679.474	0.006	82.165	0.011
5	7	26 2 23.90	153 36 49.42	8165.202	3889.432	0.014	-7164.130	0.010	467.006	0.011
5	10	26 0 6.45	153 30 12.09	8196.119	3907.259	0.014	-7190.526	0.010	453.909	0.012
5	11	0 59 47.88	168 15 54.61	21735.773	-102.299	0.049	-21716.280	0.020	914.619	0.551
5	12	37 9 8.91	198 13 19.92	10756.340	-7915.486	0.016	-7256.942	0.025	617.033	0.253
6	8	30 25 14.59	149 26 5.29	7966.498	4471.911	0.014	-6582.837	0.012	365.199	0.014
6	9	26 0 6.17	153 33 28.07	8164.473	3888.696	0.014	-7164.280	0.010	458.006	0.012
6	10	25 56 51.95	153 24 35.83	8195.339	3907.259	0.014	-7190.526	0.010	439.605	0.012
6	101	25 22 23.94	153 50 20.85	8224.316	3833.406	0.015	-7262.770	0.010	443.329	0.012
6	203	63 46 13.72	279 20 38.21	104.092	-101.874	0.003	18.191	0.003	-11.225	0.002
6	206	68 9 57.43	256 5 4.12	79.867	-78.927	0.002	0.017	0.002	-12.222	0.002
7	10	14 34 14.94	128 25 1.63	34.440	17.817	0.003	-26.422	0.003	-13.057	0.002
7	11	12 15 46.67	175 29 29.57	15096.336	-4001.607	0.038	-14549.007	0.021	461.391	0.551

MISCELLANEOUS DATA FOR SELECTED LINES, PART 2

		EQUATORIAL SYSTEM			HORIZON SYSTEM, ORIGIN AT THE STANDPOINT					
FROM	TO	ALTITUDE	AZIMUTH	DISTANCE	DN	SIGMA	DE	SIGMA	DU	SIGMA
7	12	58 37 55.78	255 11 13.61	11806.236	-11805.065	0.008	-84.859	0.031	142.973	0.253
8	9	33 15 33.95	199 0 54.60	828.751	-583.631	0.006	-580.995	0.006	92.993	0.011
8	10	32 32 4.35	196 7 1.19	832.859	-565.071	0.005	-607.272	0.005	74.631	0.011
9	10	10 15 17.29	122 6 46.75	37.042	-18.557	0.004	-26.279	0.004	-18.361	0.003
9	101	28 54 13.70	175 1 21.37	113.897	-55.346	0.004	-98.470	0.004	-14.601	0.003
9	203	26 30 12.89	333 16 2.89	8229.988	-3985.542	0.015	7184.574	0.010	-479.645	0.012
9	206	26 26 50.03	333 19 53.71	8203.065	-3962.606	0.015	7166.383	0.010	-480.609	0.012
10	11	12 18 48.41	175 35 11.36	15076.019	-4019.462	0.038	-14522.573	0.021	474.497	0.551
10	12	58 34 16.41	255 26 6.86	11824.056	-11822.883	0.008	-58.407	0.030	155.997	0.253
10	101	36 36 21.74	195 31 55.17	103.379	-73.902	0.004	-72.190	0.003	3.760	0.002
11	12	24 43 13.80	331 36 15.14	16437.972	-7783.781	0.038	14474.087	0.027	-347.081	0.545
11	203	1 13 21.35	348 7 10.85	21753.578	44.590	0.049	21731.168	0.022	-986.147	0.551
11	206	1 10 22.43	348 9 16.14	21735.474	67.501	0.049	21712.944	0.022	-987.083	0.551
101	203	25 52 37.48	333 33 5.02	8288.874	-3930.134	0.015	7283.073	0.010	-465.122	0.012
101	206	25 49 8.28	333 36 55.78	8262.078	-3907.198	0.015	7264.882	0.010	-466.086	0.012
203	204	51 36 3.12	36 44 35.29	23.415	21.524	0.002	9.214	0.003	-0.331	0.001
203	205	4 29 4.97	167 20 33.77	25.127	-1.978	0.003	-25.044	0.001	-0.516	0.001
203	206	41 3 8.54	131 25 18.31	29.290	22.947	0.002	-18.174	0.003	-0.998	0.001
204	205	29 16 29.78	185 5 4.26	41.545	-23.502	0.004	-34.258	0.003	-0.185	0.001
204	206	1 50 58.39	163 20 14.52	27.433	1.424	0.003	-27.388	0.001	-0.666	0.001
205	206	55 4 13.00	48 24 33.41	25.859	24.925	0.001	6.870	0.003	-0.482	0.001

(Continued from inside front cover)

NOS NGS-10 Fronczek, C. J., Use of calibration base lines, 1977, 38 pp (PB279574).
NOS NGS-11 Snay, R. A., Applicability of array algebra, 1978, 22 pp (PB281196).
NOS NGS-12 Schwarz, C. R., The TRAV-10 horizontal network adjustment program, 1978, 52 pp (PB283087).
NOS NGS-13 Vincenty, T. and Bowring, B. R., Application of three-dimensional geodesy to adjustments of horizontal networks, 1978, 7 pp (PB286672).
NOS NGS-14 Snay, R. A., Solvability analysis of geodetic networks using logical geometry, 1978, 29 pp (PB291286).
NOS NGS-15 Carter, W. E., and Pettey, J. E., Goldstone validation survey - phase 1, 1978, 44 pp (PB292310).
NOS NGS-16 Vincenty, T., Determination of North American Datum 1983 coordinates of map corners (second prediction), 1979, 6 pp (PB297245).
NOS NGS-17 Vincenty, T., The HAVAGO three-dimensional adjustment program, 1979, 18 pp (PB297069).
NOS NGS-18 Pettey, J. E., Determination of astronomic positions for California-Nevada boundary monuments near Lake Tahoe, 1979, 22 pp (PB301264).
NOS NGS-19 Vincenty, T., HOACOS: A program for adjusting horizontal networks in three dimensions, 1979, 18 pp (PB301351).
NOS NGS-20 Balazs, E. I. and Douglas, B. C., Geodetic leveling and the sea level slope along the California coast, 1979, 23 pp (PB80 120611).
NOS NGS-21 Carter, W. E., Fronczek, C. J., and Pettey, J. E., Haystack-Westford Survey, 1979, 57 pp (PB81 108383).
NOS NGS-22 Goad, C. C., Gravimetric tidal loading computed from integrated Green's functions, 1979, 15 pp (PB80 128903).
NOS NGS-23 Bowring, B. R. and Vincenty, T., Use of auxiliary ellipsoids in height-controlled spatial adjustments, 1979, 6 pp (PB80 155104).
NOS NGS-24 Douglas, B. C., Goad, C. C., and Morrison, F. F., Determination of the geopotential from satellite-to-satellite tracking data, 1980, 32 pp (PB80 161086).
NOS NGS-25 Vincenty, T., Revisions of the HOACOS height-controlled network adjustment program, 1980, 5 pp (PB80 223324).
NOS NGS-26 Poetzschke, H., Motorized leveling at the National Geodetic Survey, 1980, 19 pp (PB81 127995).
NOS NGS-27 Balazs, E. I., The 1978 Houston-Galveston and Texas Gulf Coast vertical control surveys, 1980, 63 pp (PB81 163792).
NOS NGS-28 Agreen, R. W., Storage of satellite altimeter data, 1980, 11 pp (PB81 164360).
NOS NGS-29 Dillinger, W. H., Subroutine package for processing large, sparse, least-squares problems, 1981, 20 pp.
NOS NGS-30 Groten, E., Determination of plumb line curvature by astronomical and gravimetric methods, 1981, 20 pp.
NOS NGS-31 Holdahl, S. R., A model of temperature stratification for correction of leveling refraction, 1981, 30 pp.

NOAA Technical Reports, NOS/NGS subseries

NOS 65 NGS 1 Pope, A. J., The statistics of residuals and the detection of outliers, 1976, 133 pp (PB258428).
NOS 66 NGS 2 Moose, R. E. and Henriksen, S. W., Effect of Geoceiver observations upon the classical triangulation network, 1976, 65 pp (PB260921).
NOS 67 NGS 3 Morrison, F., Algorithms for computing the geopotential using a simple-layer density model, 1977, 41 pp (PB266967).
NOS 68 NGS 4 Whalen, C. T. and Balazs, E., Test results of first-order class III leveling, 1976, 30 pp (GPO# 003-017-00393-1) (PB265421).
NOS 70 NGS 5 Doyle, F. J., Elassal, A. A., and Lucas, J. R., Selenocentric geodetic reference system, 1977, 53 pp (PB266046).
NOS 71 NGS 6 Goad, C. C., Application of digital filtering to satellite geodesy, 1977, 73 pp (PB-270192).
NOS 72 NGS 7 Henriksen, S. W., Systems for the determination of polar motion, 1977, 55 pp (PB274698).
NOS 73 NGS 8 Whalen, C. T., Control leveling, 1978, 23 pp (GPO# 003-017-00422-8) (PB286838).
NOS 74 NGS 9 Carter, W. E. and Vincenty, T., Survey of the McDonald Observatory radial line scheme by relative lateration techniques, 1978, 33 pp (PB287427).
NOS 75 NGS 10 Schmid, E., An algorithm to compute the eigenvectors of a symmetric matrix, 1978, 5 pp (PB287923).
NOS 76 NGS 11 Hardy, R. L., The application of multiquadric equations and point mass anomaly models to crustal movement studies, 1978, 63 pp (PB293544).
NOS 79 NGS 12 Milbert, D. G., Optimization of horizontal control networks by nonlinear programing, 1979, 44 pp (PB80 117948).
NOS 82 NGS 13 Grundig, L., Feasibility study of the conjugate gradient method for solving large sparse equation sets, 1980, 22 pp (PB80 180235).
NOS 83 NGS 14 Vanicek, P., Tidal corrections to geodetic quantities, 1980, 30 pp (PB80 189376).
NOS 84 NGS 15 Bossler, J. D. and Hanson, R. H., Application of special variance estimators to geodesy, 1980, 16 pp (PB80 223332).

(Continued on inside back cover)

U.S. GOVERNMENT PRINTING OFFICE: 1981-0-340-997/1683

(Continued)

NOS 85 NGS 16	Grafarend, E. W., The Bruns transformation and a dual setup of geodetic observational equations, 1980, 73 pp (PB80 202302).
NOS 86 NGS 17	Vanicek, P. and Grafarend, E. W., On the weight estimation in leveling, 1980, 36 pp (PB81 108284).
NOS 87 NGS 18	Snay, R. A. and Cline, M. W., Crustal movement investigations at Tejon Ranch, Calif., 1980, 35 pp (PB81 119000).
NOS 88 NGS 19	Dracup, J. F., Horizontal Control, 1980, 40 pp (PB81 133050)

NOAA Manuals, NOS/NGS subseries

NOS NGS 1	Floyd, Richard P., Geodetic bench marks, 1978, 56 pp (GPO# 003-017-00442-2) (PB296427).
NOS NGS 2	Input formats and specifications of the National Geodetic Survey data base: Pfeifer, L., Vol. I--Horizontal control data, 1980, 205 pp. Pfeifer, L. and Morrison, N., Vol. II--Vertical control data, 1980, 136 pp. (Distribution of this loose-leaf manual and revisions is maintained by the National Geodetic Survey, NOS/NOAA, Rockville, MD 20852.)

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Survey
National Geodetic Survey, OA/C18x2
Rockville, Maryland 20852

OFFICIAL BUSINESS

LETTER MAIL

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF COMMERCE
COM-210

THIRD CLASS

U.S.MAIL