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Number 156

BAKER-NUNN PHOTOGRAPHY OF THE SYNCOM II FOURTH-STAGE IGNITION

by

Robert Citron and Leonard H. Solomon

and

TRACKING OF CENTAUR (AC-2)

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June 25, 1964

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CAMBRIDGE, MASSACHUSETTS 02138

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by

Robert Citron[2] and Leonard H. Solomon[3]

Abstract.--The fourth-stage ignition of Syncom II was tracked by the Smithsonian Astrophysical Observatory Baker-Nunn Camera station at South Africa. The film gave values, within ± 4 seconds, of ignition time, duration and burnout time. The unexpected brightness of the actual burn prevented greater accuracy but the fact that it was easily filmed indicates that the Baker-Nunn system is capable of recording most rocket maneuvers in cislunar space.

Introduction

The Smithsonian Astrophysical Observatory's Satellite-Tracking Program was requested by the NASA Goddard Space Flight Center and Hughes Aircraft Company to track optically the Syncom II launch vehicle during its coast phase, to record the fourth-stage ignition, and, in case the fourth-stage rocket failed, to continue to track the vehicle. The nominal flight was to approximate that of Syncom I. The plan was first to place the spacecraft in a transfer ellipse to bring it to the required distance from the earth; at apogee of this ellipse the fourth stage was to fire, placing the satellite in an orbit of approximately 24-hour period at inclination 33 degrees. The fourth stage consisted of a Thiokol TE-375 solid propellant motor. Firing was to occur above 22 degrees S, 39 degrees E (Operations Plan 13-62), a position easily visible from the Baker-Nunn camera (Henize, 1957) located at Olifantsfontein, South Africa. The passive satellite was expected to be no brighter than magnitude 15, which is below the effective limit of the camera, but the fourth-stage burn was expected to be at least four to five magnitudes brighter than this, or well within the camera's recording capacity.

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[1]This work was supported in part by grant number NsG 87/60 from the National Aeronautics and Space Administration.

[2]Station Chief, SC-2, Olifantsfontein, South Africa.

[3]Chief, Data Division.

Predictions

For the transfer ellipse, whose elements were provided by Goddard Space Flight Center, we prepared camera predictions for all Baker-Nunn stations for a period of three days for all transits where the station-to-satellite range was less than 20,000 km. At greater ranges the satellite would be fainter than magnitude 14.5, the effective limiting magnitude of the camera (Solomon, 1964) under normal conditions. This was done to prepare for the possibility of a fourth-stage misfire. For the fourth-stage firing, the SCROGE (Cherniack, 1963) prediction program was used in double-precision mode; we derived a great-circle arc fitting the transfer ellipse at the period of firing. The camera settings describing this great circle were provided, with all other available information, to the Olifantsfontein station. These were then used to orient the camera to photograph the burning.

Observational Procedures

Just before apogee motor burn the satellite was expected to be traveling at 9"arc/sec (topocentric) retrograde. Since the apogee motor would almost cancel this motion to put the satellite into a near-synchronous orbit, and since the motor would only burn for 20 seconds, we felt that no benefit would be derived from tracking at the mean velocity to integrate the light on the film during the burning time. The spacecraft would be at a range of 23,000 miles, and the circle of confusion of the image would probably be larger than the expected image. We therefore decided to keep the camera stationary during photography. In order to obtain the maximum exposure time and still have corroborating images for positive identification, we settled on the following photographic procedures: keep camera stationary; expose for 3 seconds before recording time; present time by performing third chop of shutter (Henize, 1957) by hand; expose for 3 additional seconds; transport film on 4-second cycle (Henize, 1957); repeat sequence.

Total exposure would be approximately 6 seconds per frame, which would yield approximately thirteenth-magnitude star images (Solomon, 1964). Use of the 4-second cycle would mean 1.6 second for transport of film between frames. With this sequence, the minimum number of full "burn" images would be 2. We could also determine ignition and burnout times within ± 4 seconds. Since Hughes Aircraft Company had predicted the magnitude of the burn images to be +11, we obtained thirteenth-magnitude Franklin Adams charts from the Radcliffe Observatory for image identification.

Preliminary Film Analysis

Ignition time.--The actual burn yielded images approximately 6 magnitudes brighter than predicted. A total of 18 frames containing images was recorded (see figure 1). Frame 1 contains a point image, which is motor ignition. The time of the frame, when presented manually, is $20^h\ 05^m\ 54^s.8$. This point image is approximately tenth magnitude. The second frame contains a hard image, size 3 minutes of arc. This image and that of frame number 3 are very similar. They appear to represent full 6-second exposures during "burn." These images are about fifth magnitude. Since a 6-second exposure yields images of fifth magnitude,

tenth-magnitude images would be produced by exposures of .01 of this duration (neglecting reciprocity failure), or .06 second. We therefore assume that fourth-stage ignition took place approximately .06 second before shutter close on frame number 1. Appendix 1 shows the average exposure time of all frames to be 6.5 seconds, assuming 1.6 second for film transport on the 4-second camera cycle. To get the estimated start of "burn," we add half the exposure time to frame time and subtract the estimated magnitude-correction time:

$$T_b = 20^h\ 04^m\ 54^s.8 + 3^s.25 - {}^s.06 = 20^h\ 05^m\ 58^s.0\ .$$

The result, apogee-motor ignition time, is probably accurate to ± 1 second. The position at this instant has been measured to be $\alpha\ 18^h\ 47^m\ 17^s$, $\delta\ 20^\circ\ 47'\ 20''$, which is accurate to an estimated ± 5" arc.

Burnout time.--Burning time was expected to be 20 seconds. If ignition occurred at $20^h\ 05^m\ 58^s.0$, as stated, burnout should have occurred at $20^h\ 06^m\ 18^s.6$. The fourth-frame image appears to be roughly half hard (burn) and half soft (residual gases). which seems to indicate that the burnout took place sometime during this exposure. Approximate exposure center was $20^h\ 06^m\ 18^s.6$; burnout must have occurred within 1 or 2 seconds of this time.

Residual gas particle cloud.--The 6-second, manually timed exposures were continued for approximately 2 minutes after fourth-stage burnout. The resulting 12 frames contain images of the expanding residual gas cloud. These images vary in total brightness from sixth magnitude, just after burnout, to tenth magnitude, 120 seconds later (see Appendix 2). The brightness of the cloud decreased at the nearly linear rate of 1 magnitude every 30 seconds. Images probably could have been recorded for at least another 90 seconds had photography been continued.

The approximate rate of expansion of the residual gases after burnout, along the axis of rocket motion, was 11".0/sec, or about 6400 ft/sec. This rate of expansion remained fairly constant until approximately 60 seconds after burnout, when it gradually decreased to about 9".0/sec, or about 5300 ft/sec, at 120 seconds after burnout.

The expansion of gases transverse to rocket motion remains approximately constant during the 120 seconds after burnout, at a rate of 8".7/sec or about 5100 ft/sec (see Appendix 3).

Conclusions

The Baker-Nunn camera at South Africa was used to provide confirmation of deep-space rocket ignition and burning. In addition, the film provided approximate values of ignition time, duration of burn, and burnout time. The burning was some 250 times brighter than anticipated. Had the actual brightness been expected, camera operation could have been modified to yield estimated ignition, burn, and burnout times to an accuracy of 0.4 second or better. In addition, the approximate metric and photometric results quoted here yield information about the expansion of the rocket exhaust in vacuum. This small rocket yielded images of fifth magnitude at 23,000 miles. At the distance of the moon, then, tenth magnitude images would have been produced. As these are well within the capability of the Baker-Nunn camera to record, all rocket maneuvers in cislunar space are within the recording range of the Baker-Nunn system.

Acknowledgments

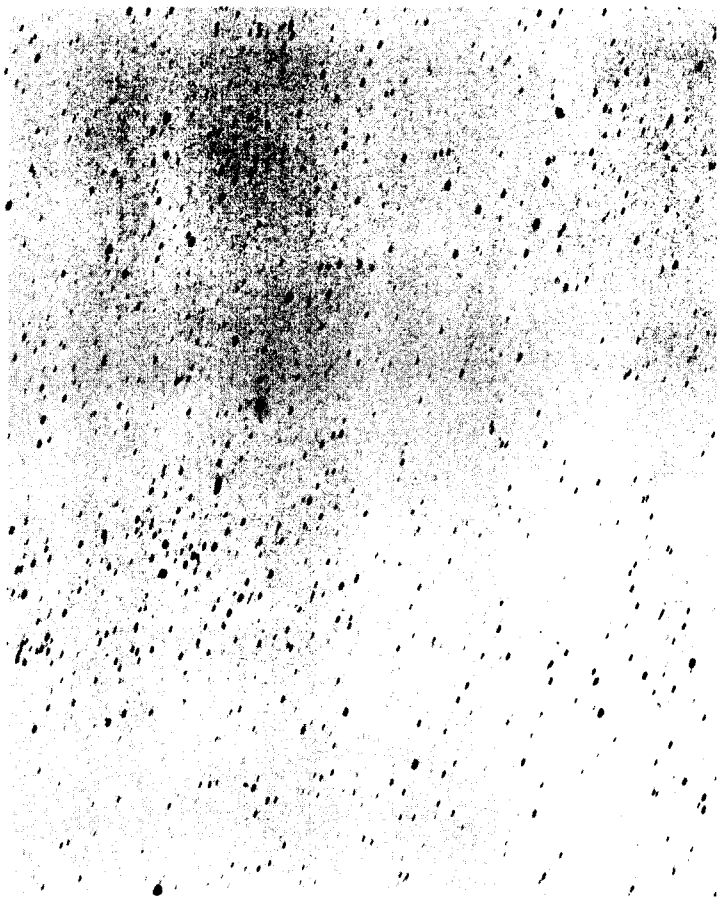
We thank Robert Pumfrey for the magnitude estimates and gas-cloud measurements, and Duane Gingerich for aiding in film measurement.

References

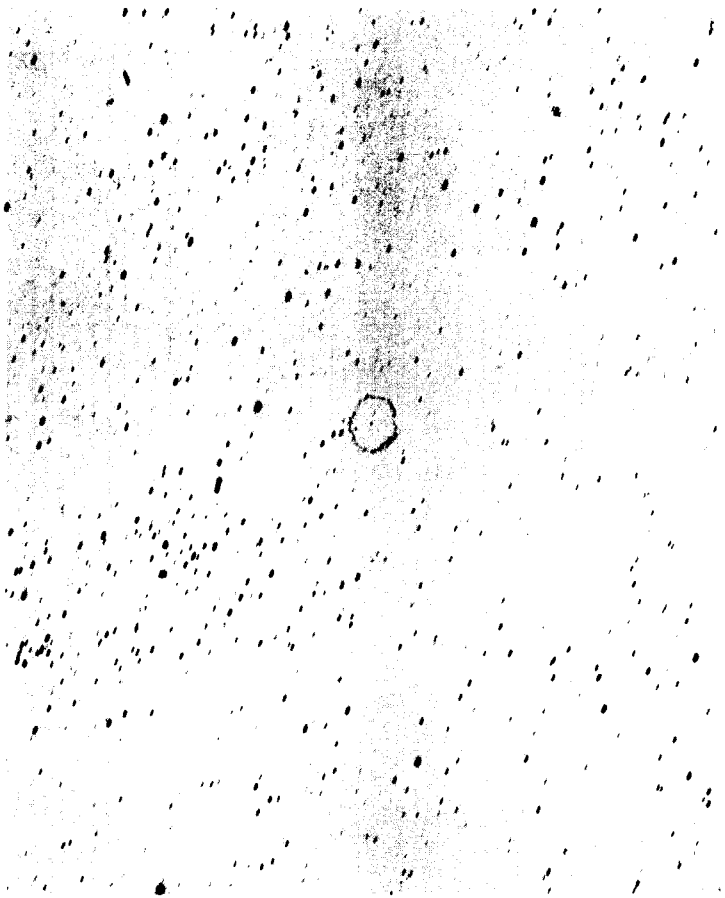
CHERNIACK, J. R., and GAPOSCHKIN, E. M.
1963. Smithsonian Astrophysical Observatory Program Write-up (SCROGE) Smithsonian Astrophys. Obs., Special Report No. 121, 18 pp.

HENIZE, K. G.
1957. The Baker-Nunn satellite-tracking camera. Sky and Tel., vol. 16, pp. 108-111.

SOLOMON, L. H.
1964. Study of the Baker-Nunn limiting magnitude. Unpublished.



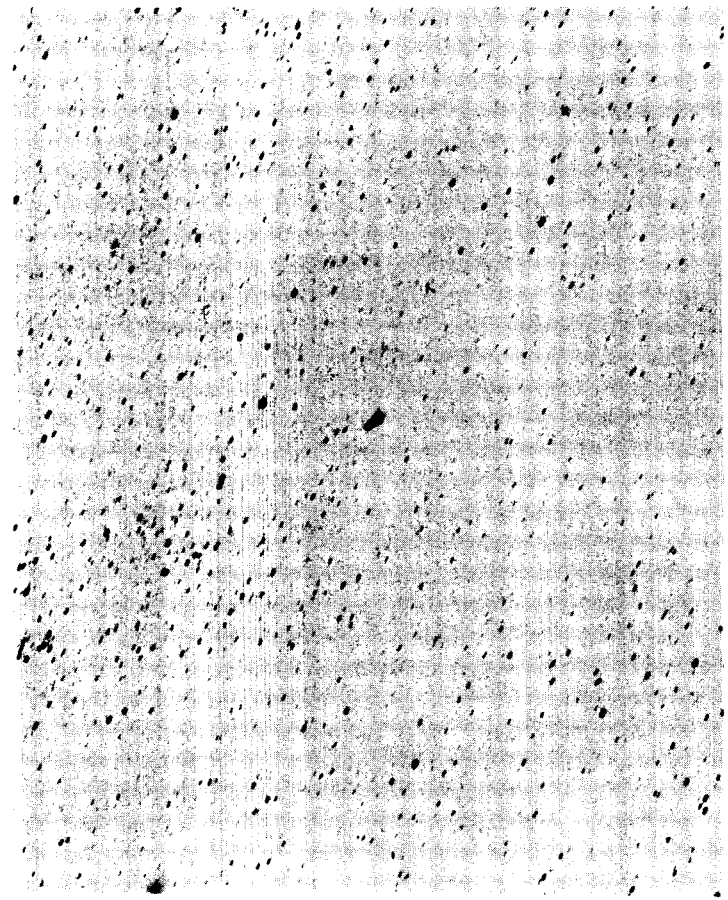
frame 0



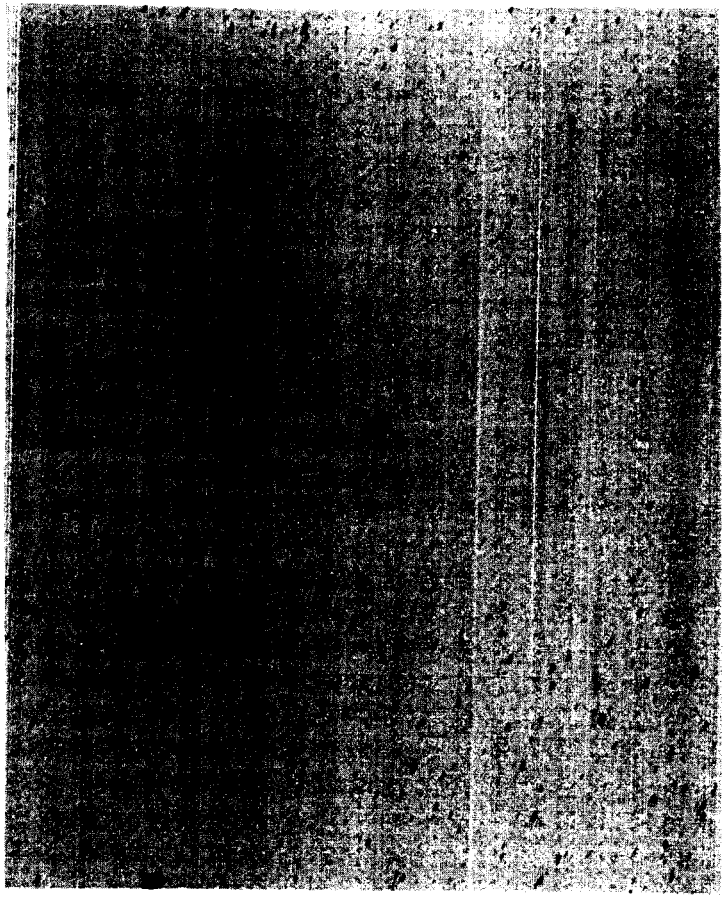
frame 1

Figure 1, frames 0-18.--Enlarged photographs of the fourth-stage ignition of Syncom II taken by the Baker-Nunn Camera Station in South Africa. (Scale: approximately 106" of arc per mm.) Appendix 1 gives the details of exposure times, magnitudes of arc, times, and descriptions of each image. (Note: Apparent nebulosity around bright stars may be used for photometry of cloud.)

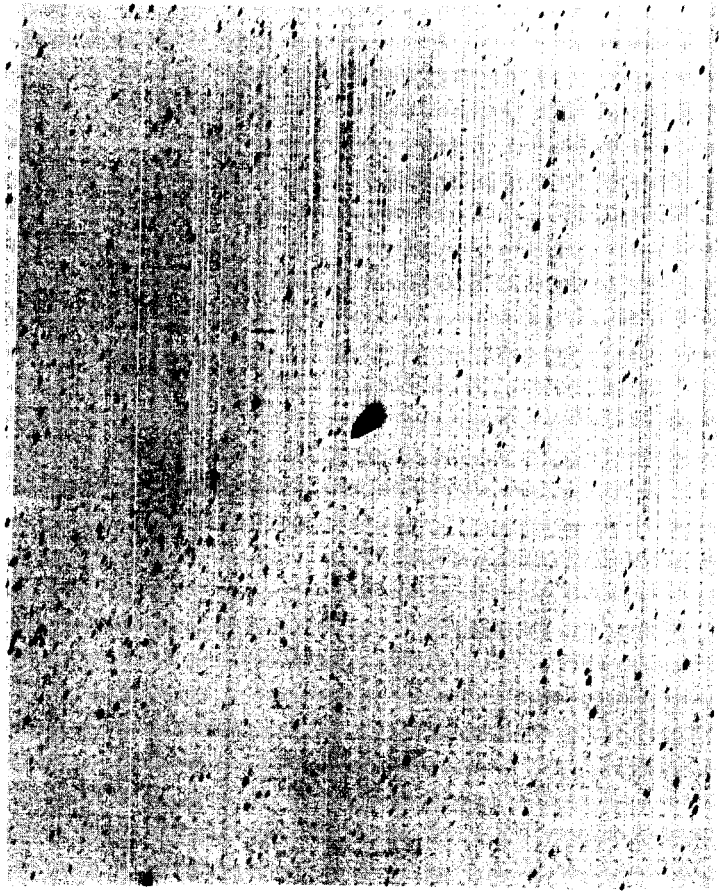
frame 2



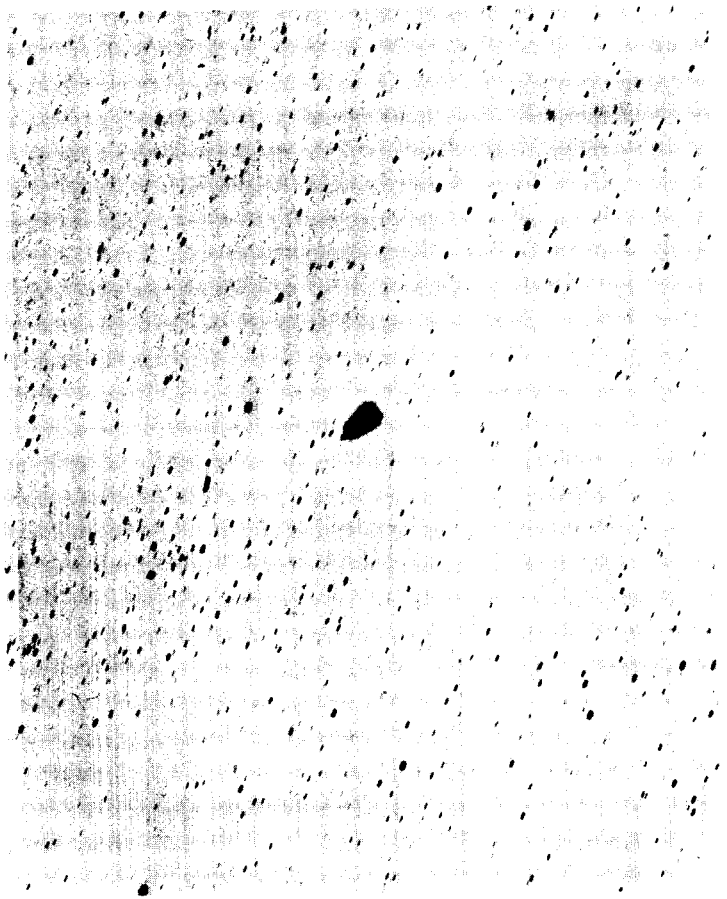
frame 3



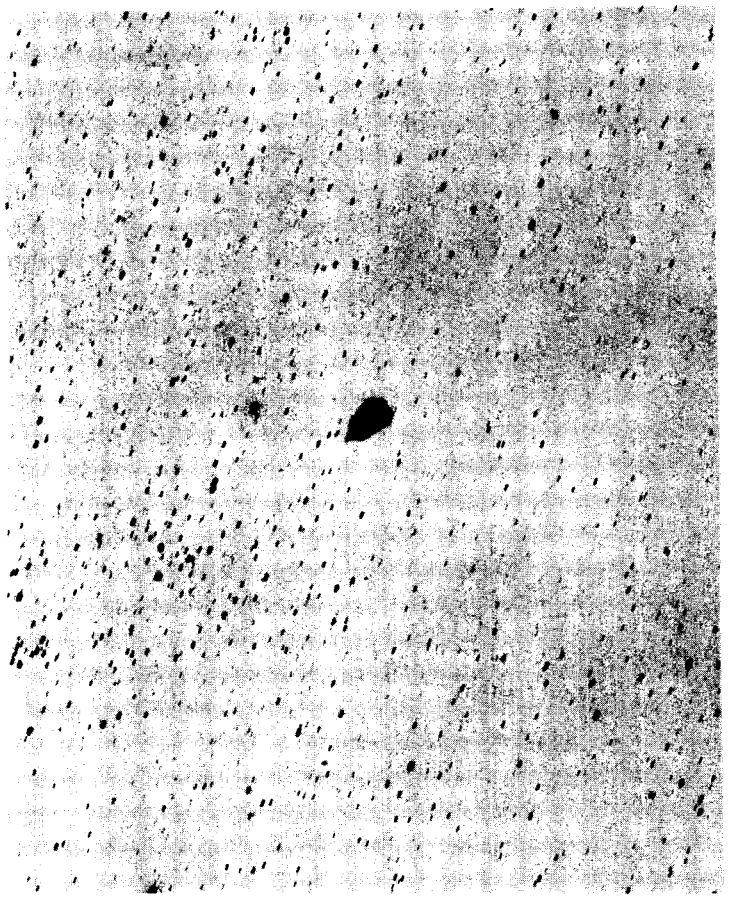
frame 4



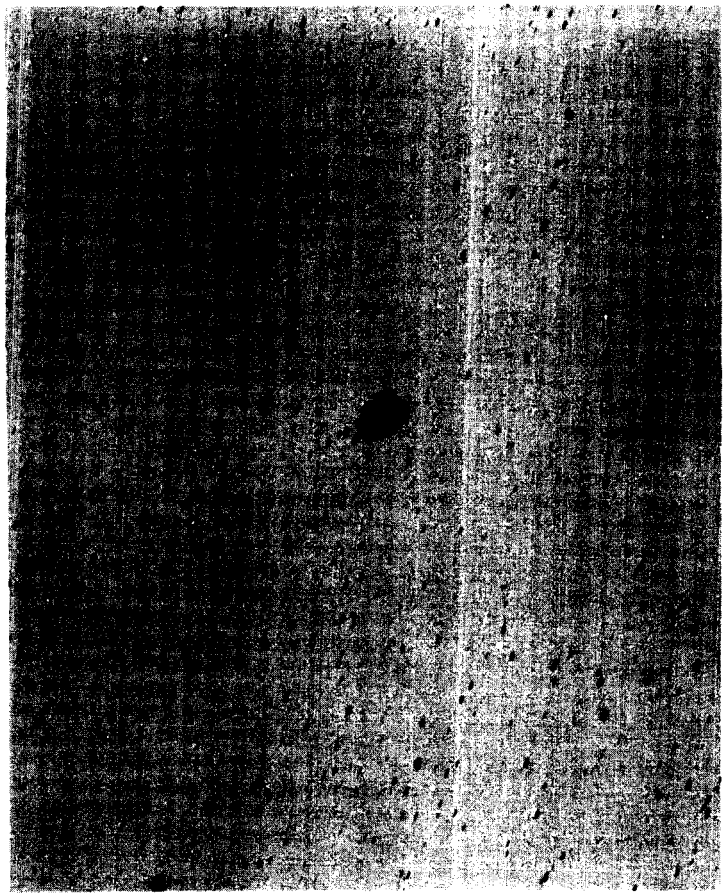
frame 5



frame 6



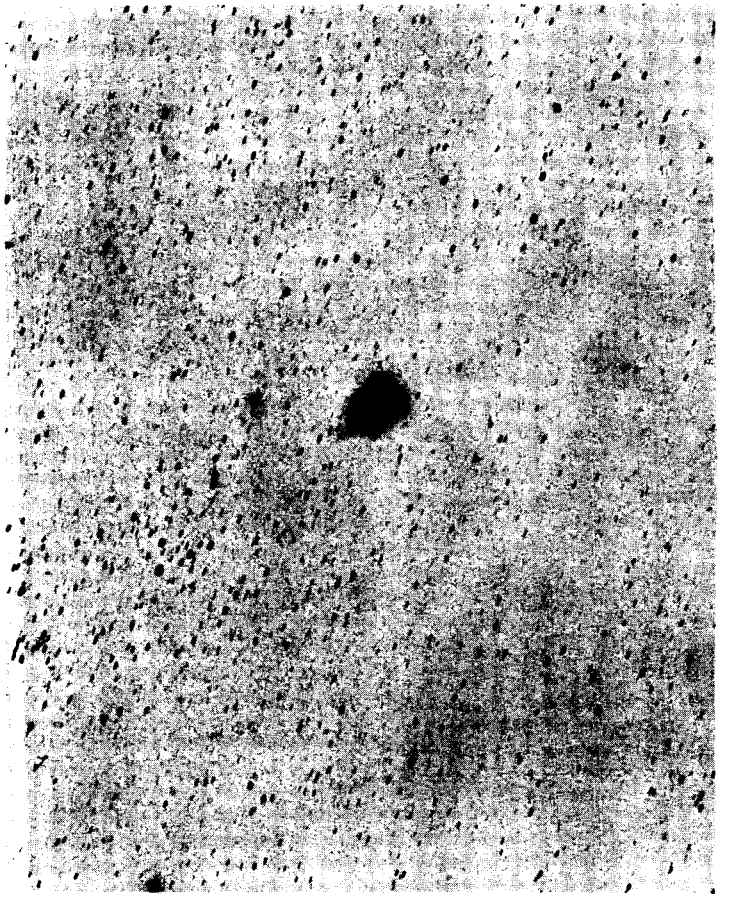
frame 7



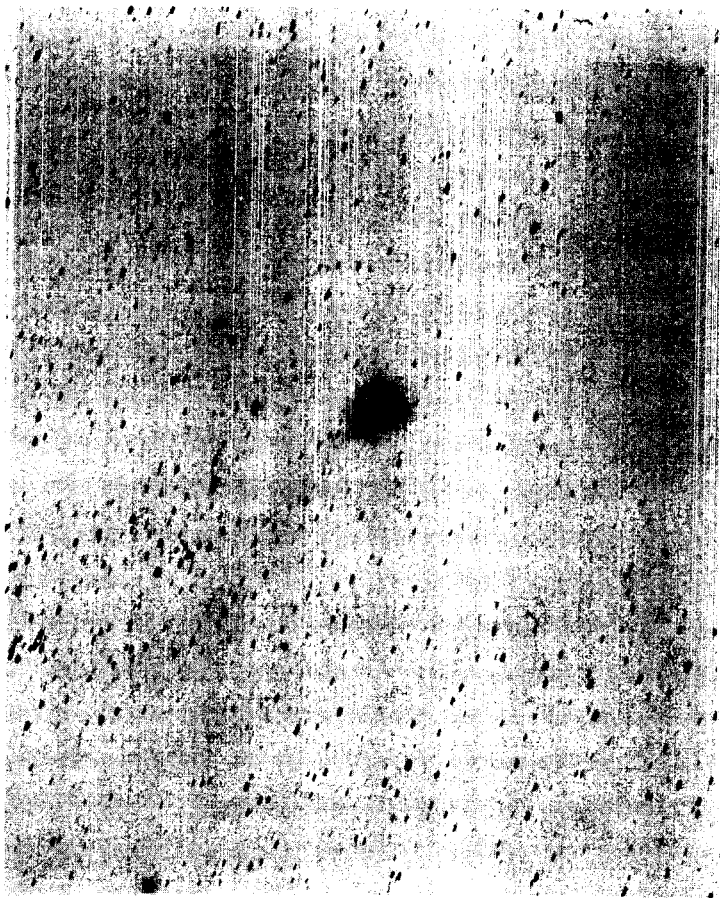
frame 8

frame 9

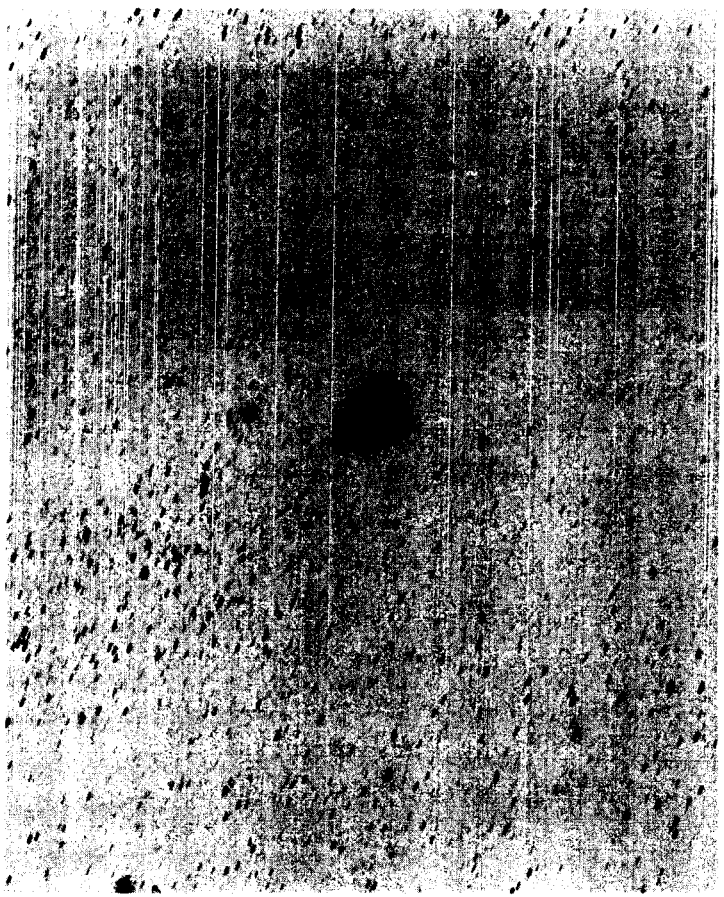
frame 10



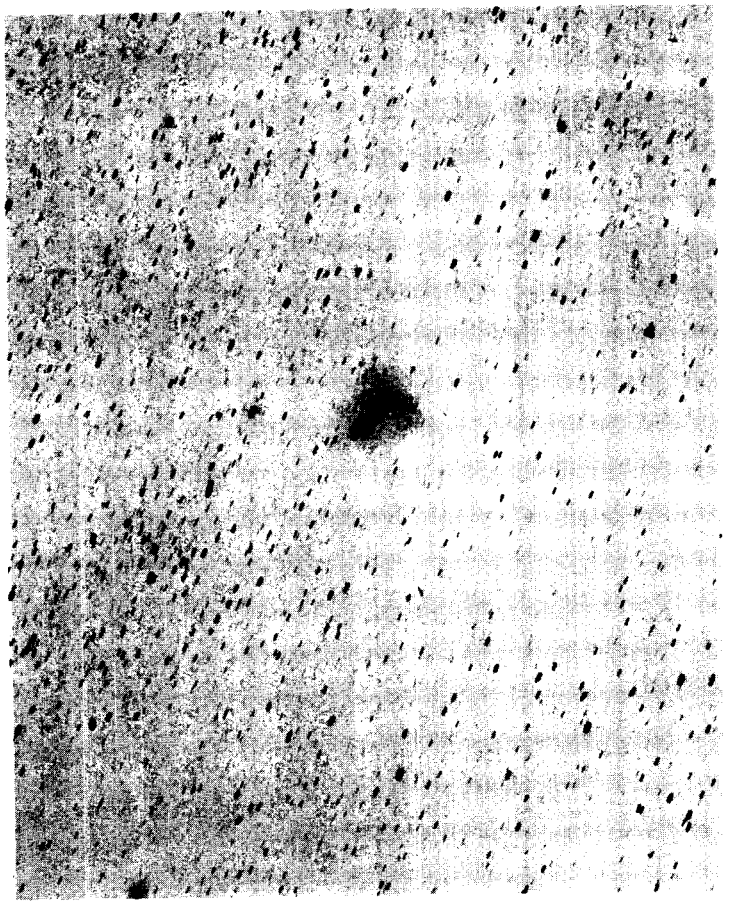
frame 11



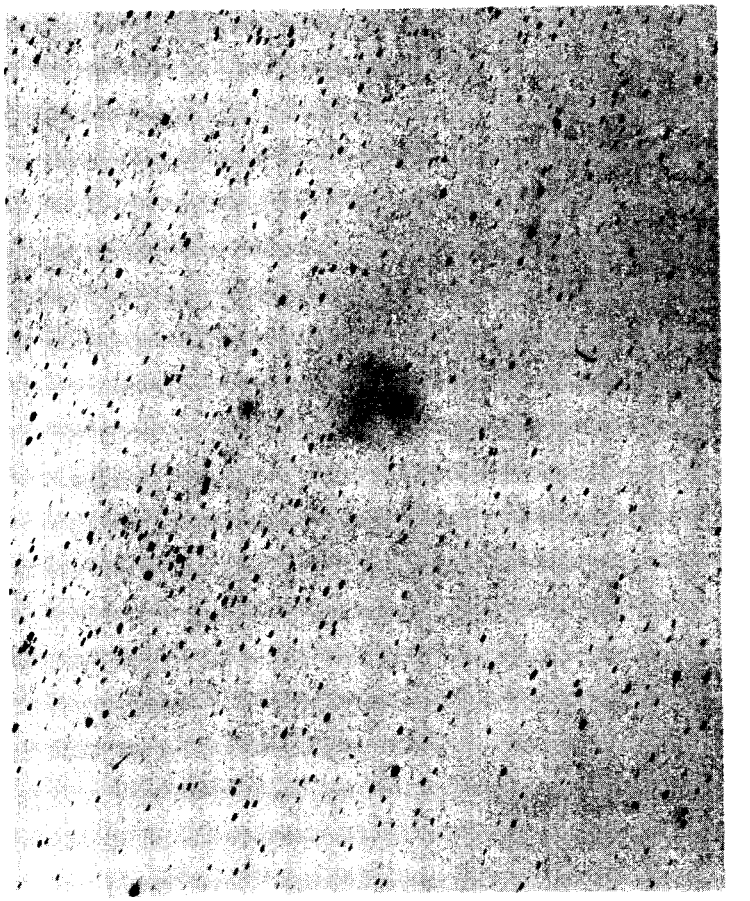
frame 12



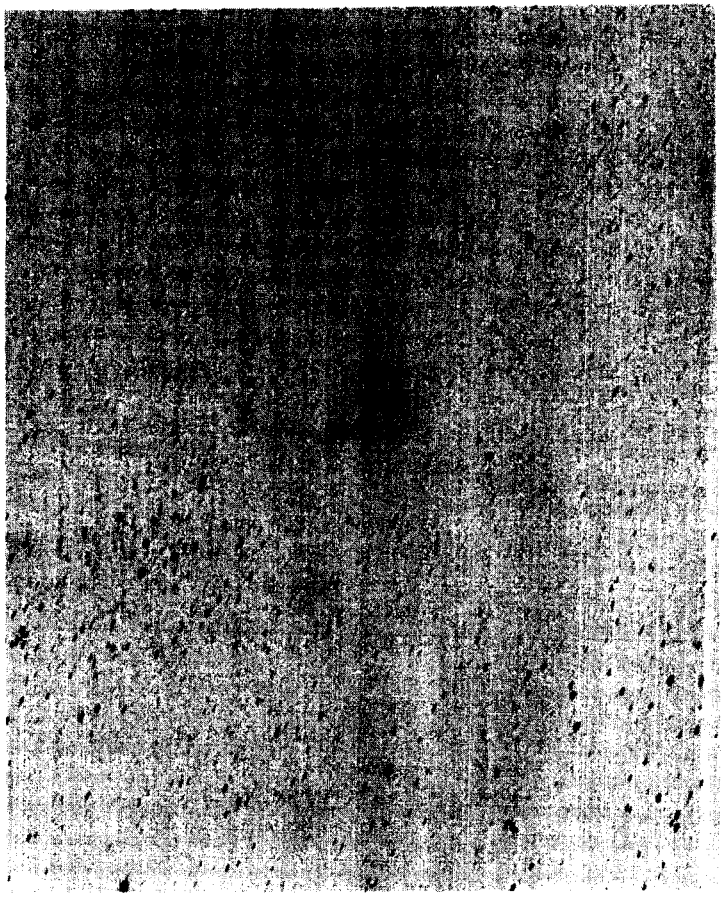
frame 13



frame 14



frame 15



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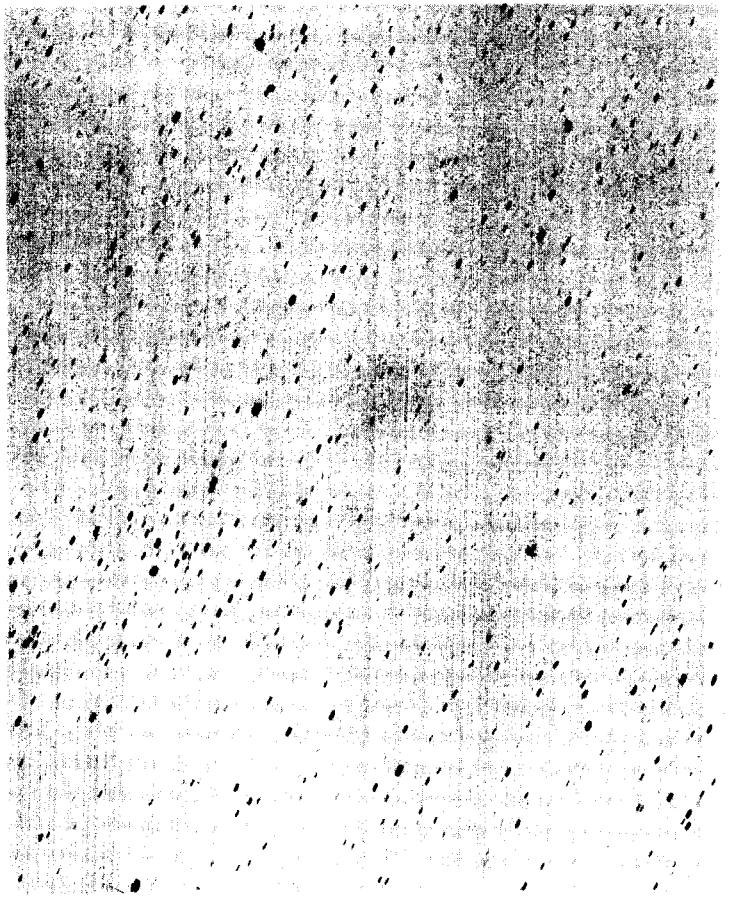
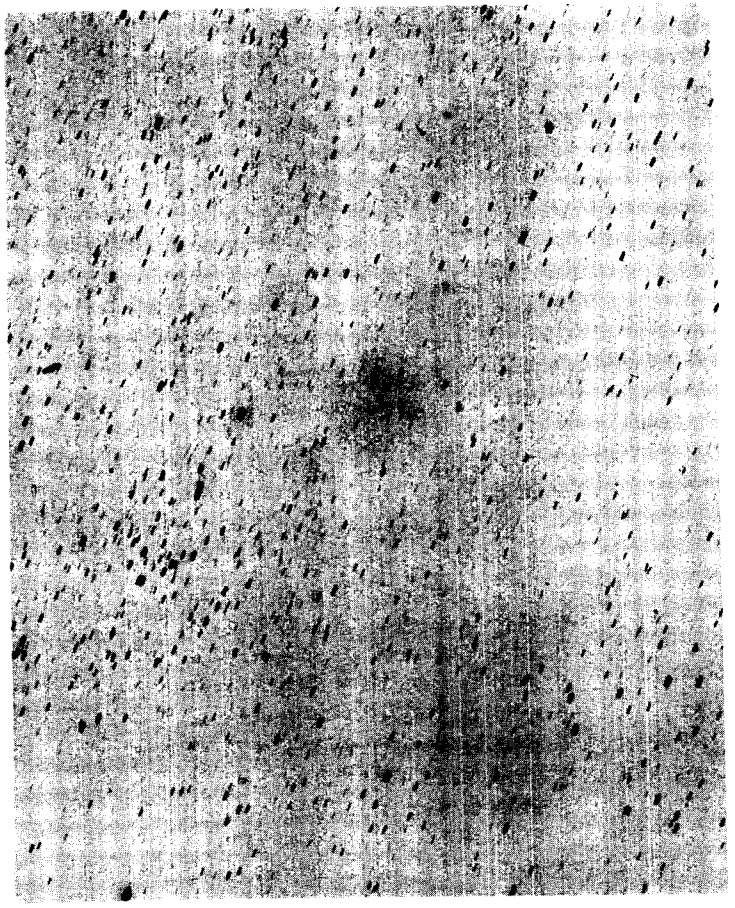


frame 17



frame 18

APPENDIX 1

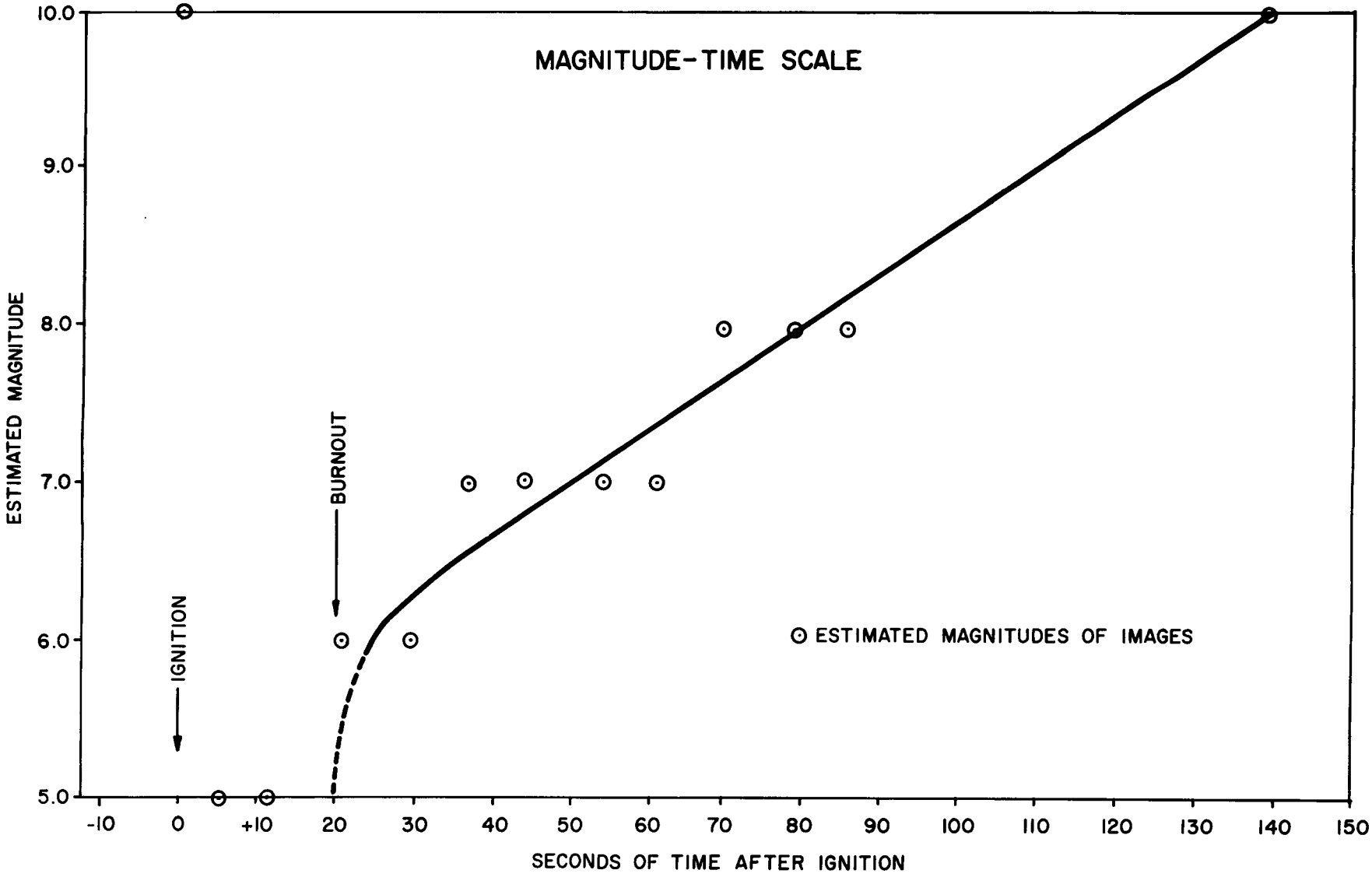
FILM DATA

Frame No.	T	Time	Time Diff.	Exposure Time	Mag.	Description of Image	
						Length	Width
0	No Image						
1	-3	05m54.8s			10	Point	
2	+5.3	06m03.1s	8.3	6.7	5	3' arc	
3	+13	06m10.8s	7.6	6.0	5	3' arc	
4	+20.8	06m18.6s	7.8	6.2	6	8' arc	
5	+28.9	06m26.7s	8.1	6.5	6	9' arc	
6	+37.1	06m34.9s	8.2	6.6	7	10'	5'
7	+44.7	06m42.5s	7.6	6.0	7	12'	7'
8	+53.7	06m51.5s	9.0	7.4	7	12'	9'
9	+61.6	06m59.3s	7.8	6.2	7	14'	10'
10	+70.0	07m07.8s	8.5	6.9	8	17'	11'
11	+77.9	07m15.7s	7.9	6.3	8	20'	11'
12	+86.2	07m24.0s	8.3	6.7	8	20'	12'
18	+139.6	08m17.4s			10	28'	21'

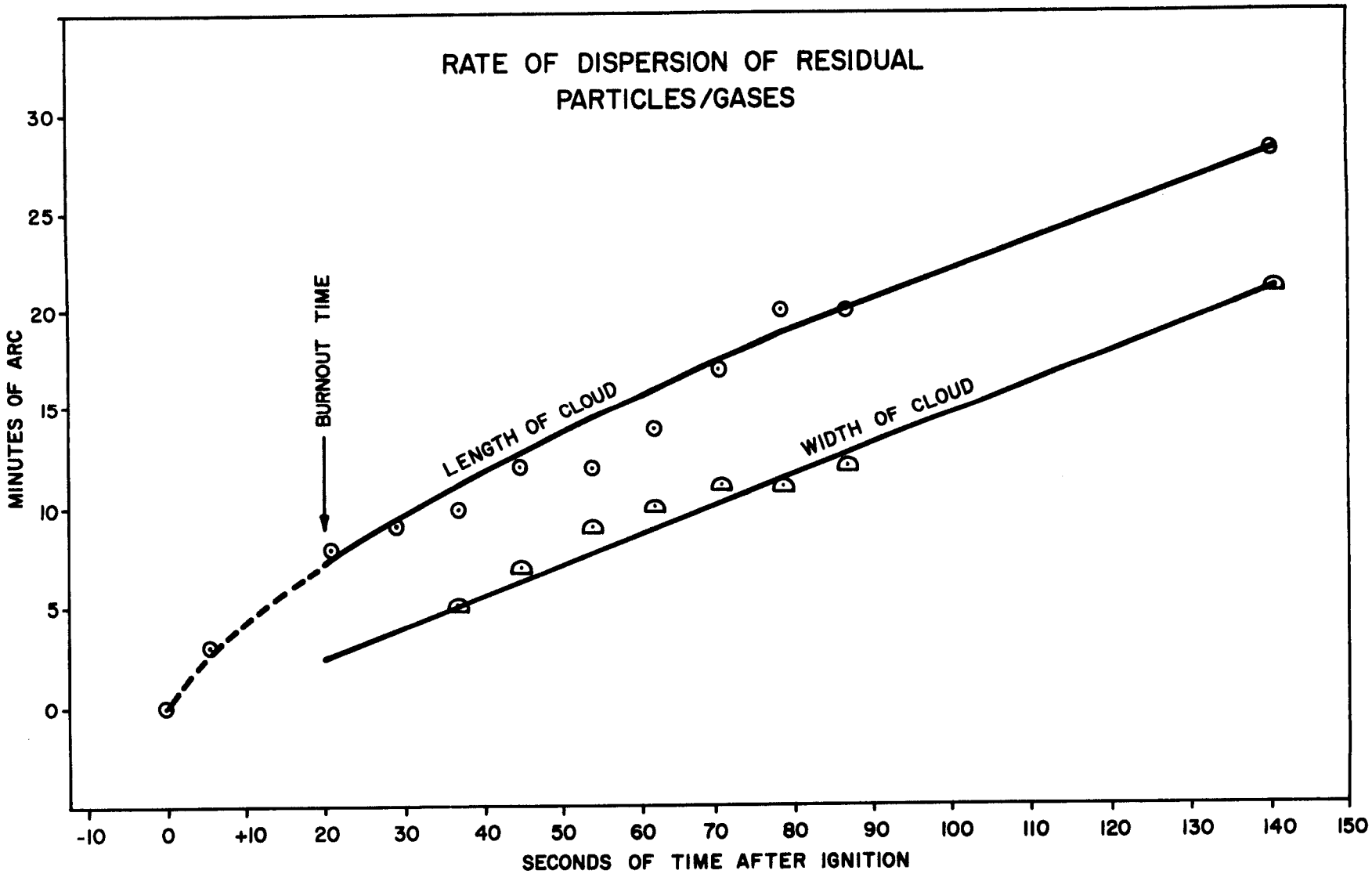
Notes:

1. Magnitude estimates to ±1 magnitude.
2. Gas-cloud size estimates to ±1 minute of arc.
3. Average exposure time is 6.5 seconds.
4. Magnitude decreases at the rate of approximately one magnitude every thirty seconds.
5. Frame numbers 13 through 17 were not reduced.
6. In column 2 above, T = estimated ignition time.

APPENDIX 2


MAGNITUDE-TIME SCALE
ESTIMATED MAGNITUDE
10.0
9.0
8.0
7.0
6.0
5.0
IGNITION
BURNOUT
⊙ ESTIMATED MAGNITUDES OF IMAGES
-10
0
+10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
SECONDS OF TIME AFTER IGNITION

APPENDIX 3


RATE OF DISPERSION OF RESIDUAL PARTICLES/GASES
MINUTES OF ARC
30
25
20
15
10
5
0
BURNOUT TIME
LENGTH OF CLOUD
WIDTH OF CLOUD
-10
0
+10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
SECONDS OF TIME AFTER IGNITION

TRACKING OF CENTAUR (AC-2)

by

Leonard H. Solomon

TRACKING OF CENTAUR (AC-2)[1]

by

Leonard H. Solomon[2]

Abstract.--The Smithsonian Astrophysical Observatory's Baker-Nunn System tracked the Centaur vehicle AC-2. AC-2 was photographed 155 times during the first 10 days; orbits were analyzed for piece B and for piece A which appeared to be accelerating. The film of the unplanned breakup (into five pieces) of AC-2 taken by the Smithsonian Astrophysical Observatory South Africa Station indicates the time of the breakup and its probable relation to the abnormal acceleration of piece A.

The Smithsonian Astrophysical Observatory, on request, furnished the Lewis Research Center with optical-tracking support in the launch of Centaur vehicle AC-2. Our object was to determine the parameters of position and velocity (X, Y, Z, $\dot{X}$, $\dot{Y}$, $\dot{Z}$) at the instant of injection into orbit. Accuracy of velocity vectors was needed to ± 1 meter/second or better, with equivalent position accuracy; the Research Center wanted the information within four weeks of launch. From preliminary discussion, we expected the following procedure to apply:

1. Since this information would be used to back up electronic systems, no surveillance-type information was necessary; therefore Moonwatch was not expected to support.

2. The time available would allow use of field-measured Baker-Nunn positions only. Theory, and preliminary studies, showed that the expected accuracy could be obtained under optimum conditions with these data.

3. We planned to obtain the best possible smoothed elements covering the first days after launch and then to use the modified Ephemeris Zero program to determine X, Y, Z, $\dot{X}$, $\dot{Y}$, $\dot{Z}$ and the accuracy estimates.

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[1]Supported by grant number NsG 87/60 from the National Aeronautics and Space Administration.

[2]Chief, Data Division.

Once the procedure was arranged, the liaison for obtaining prelaunch and early postlaunch data was setup. The Observatory received prelaunch data from Goddard Space Flight Center and the countdown from Cape Canaveral; we were to receive early postlaunch data from GSFC. Data Division prepared nominal predictions for all Baker-Nunn camera sites for launch times at each hour during the given launch window. The stations normally use the actual launch time to interpolate into this set and thus derive accurate predictions in a short time and with minimum effort.

On the day of launch we found that the launch window extended later than had been anticipated; hence predictions were computed and sent to stations only a few minutes before liftoff. In addition, minor difficulties delayed for several hours receipt of postlaunch data from GSFC. The first time that photography was possible, AC-2 was photographed. One earlier attempt was clouded out.

During the first 10 days, AC-2 was photographed 155 times. To the surprise of all concerned, the first photographs, obtained on revolution three, showed several objects where only one should have been (see figure 1). Later photographs and visual sightings by Moonwatch teams confirmed this observation.

When we began orbital analysis, we encountered an additional difficulty. The nominal orbit was not useful past the first few revolutions. As we had received no information from GSFC, our first impulse was to obtain information from any possible source. This problem was compounded by some difficulty in receiving information from certain Baker-Nunn sites, as the teletype lines were tied up by other users. When we received the first few observations and computed an orbit for the major piece (expected to be the rocket case itself) we seriously doubted the computations and immediately began repeating them. Finally we obtained an orbit for piece B (the brightest minor object) and prepared predictions for it. These were transmitted, together with a message explaining the difficulties with piece A, to all stations. Observations of A and B then became routine (see tables 1 and 2).

The initial orbits for pieces A and B appear below.

1963 47A	1963 47B
$T_0 = 38361.0$	$T_0 = 38361.0$
$\omega = 115.10 + 7.783(t - T_0)$	$\omega = 117.072 + 7.783(t - T_0)$
$\Omega = 159.137 - 4.932(t - T_0)$	$\Omega = 158.2764 - 4.932(t - T_0)$
$i = 30.359$	$i = 30.0136$
$e = .07686$	$e = .069506$
$M = .6887 + 13.37430(t - T_0)$ $-.00518(t - T_0)^2$	$M = .685288 + 13.3524168(t - T_0)$ $+.281 \times 10^{-4}(t - T_0)^2$

Note that the change in eccentricity and the acceleration in mean anomaly for A appear to be in the wrong direction; apparently energy is being added to this orbit. The orbit has been analyzed in some detail for the first 6 days. Results of that analysis are shown in table 3; similarly constructed orbits for piece B are shown for comparison in table 4. Note that the acceleration terms for A reverse direction on December 2, 5 days after launch. The orbits are derived by taking 3-day files of observations, with epoch at the center of the file. Hence, files overlap by 1.5 day. Because of the overlap, it is likely that the physical action causing the abnormal energy reaction ceased on December 1, 4 days after launch.

The only physical agent that could have caused this action is venting of the residual fuel and oxidizer in the rocket tanks. This event was planned, but we assumed that the venting would be symmetrical and that no net thrust would be produced. Even unsymmetrical venting (which we later learned occurred) should have produced rotation but zero net thrust. Because of the object's history both in breaking up and in accelerating, we felt that analysis of the orbit to determine velocity vectors would be useless, as we would be extrapolating data without much basis for doing so.

It appears that the unplanned breakup may have been related in some way to the abnormal acceleration. A proper connection of the incidents requires as much information as possible about the breakup. Unfortunately, the point of separation could not be determined from orbits derived from Baker-Nunn observations of the minor pieces. Only piece B was observed for any length of time; objects C, D, and the rest separated rapidly from the main body, and after one or two days were not reobserved. We did not have enough observations to derive accurate orbits. Our feeling is that object A should not be used to derive point of breakup because of its abnormal acceleration.

The time (and thence the position) of breakup has been roughly estimated, however, by Pedro Kokaras and Jan Rolff, from the changing separation of the images on the first film obtained by the South Africa Station:

> We confirmed the reality of the five objects reported on the first photographs of revolution three. A sixth object was detected by Kokaras (on the same film). Since the objects appeared to be moving at different angular velocities, we attempted graphically to determine the time of breakup. Extrapolations from the changing separation of the images (figure 2) indicate that the breakup probably took place while the satellite was appearing on the South African horizon. This was at approximately $23^h\ 28^m$ UT on November 27, 1963. We feel that the objects could not have separated much earlier than that. When first seen at $23^h\ 34^m\ 58^s$, they had already separated and were accelerating. Figure 3 is an enlarged photograph of the breakup at $23^h\ 37^m\ 23^s$ UT.

The time they found compares favorably with two independent estimates, one from observational data analyzed by the U.S. Air Force, the other from estimates of the stress forces placed on the vehicle surface by the unsymmetrical venting.

This exercise has led us to several conclusions. Operationally, we have resolved to include as much surveillance coverage as possible on all future operations of this nature, even though only precision results are requested. In addition, we hope that we have overcome certain deficiencies in the program communication.

On this particular mission we have provided certain data on the performance of the vehicle after all its electronic systems failed. We hope that this information will be useful to the project managers. The optical coverage also provided partial confirmation of the time of breakup, which lends credence to the theory given for breakup. Unforunately, the optical data could not yield the originally expected results for velocity determination because of the object's behavior. The solution of the general problem of this computation remains theoretical. We hope to obtain numerical results by analysis of the flight of AC-3.

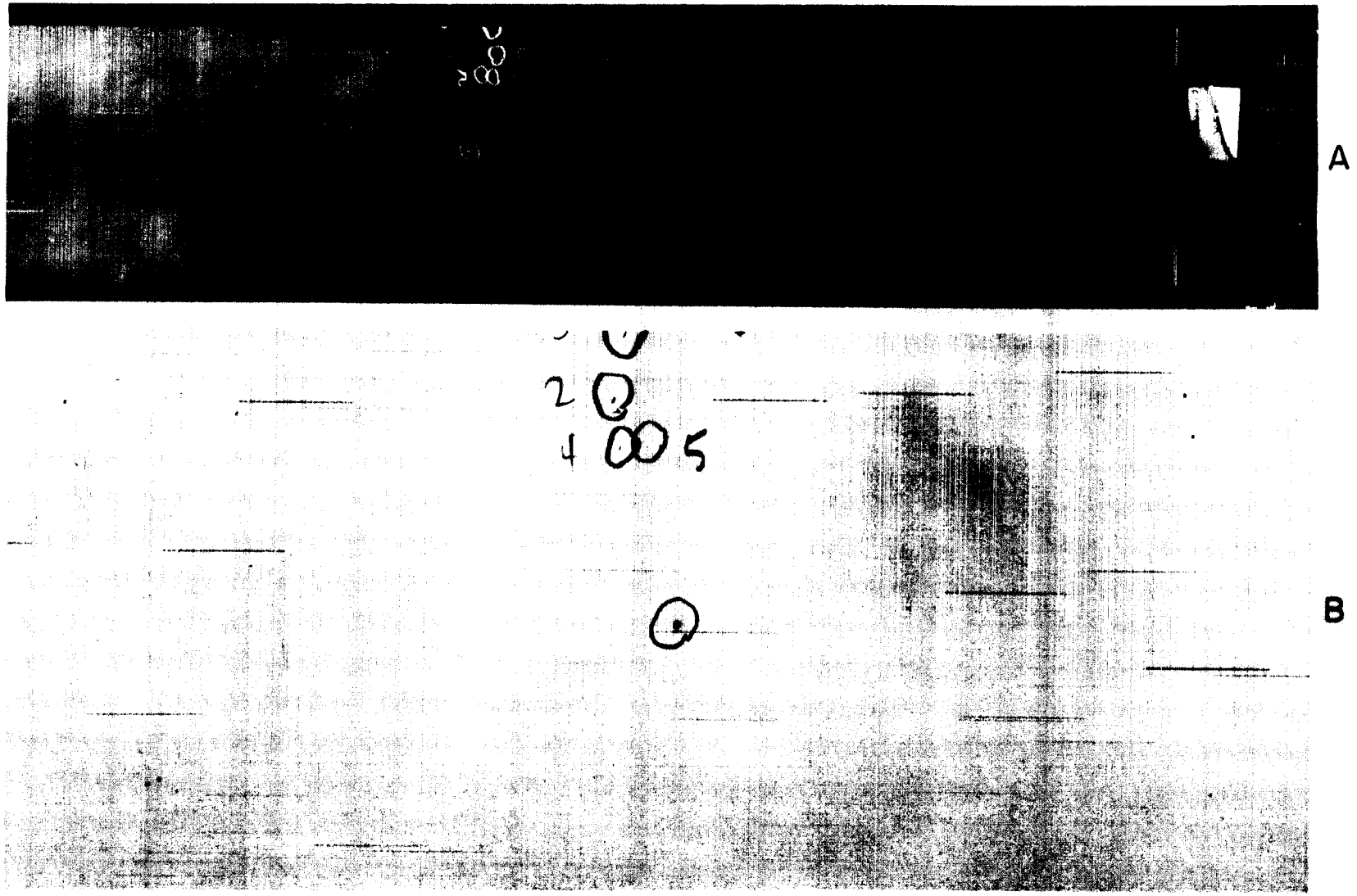

Figure 1.-- (A) Contact print of a time exposure, $36^{m}\ 03^{s}$, of the first film of Centaur AC-2 taken at the South Africa Baker-Nunn Camera Station; (B) Enlargement of satellite images.

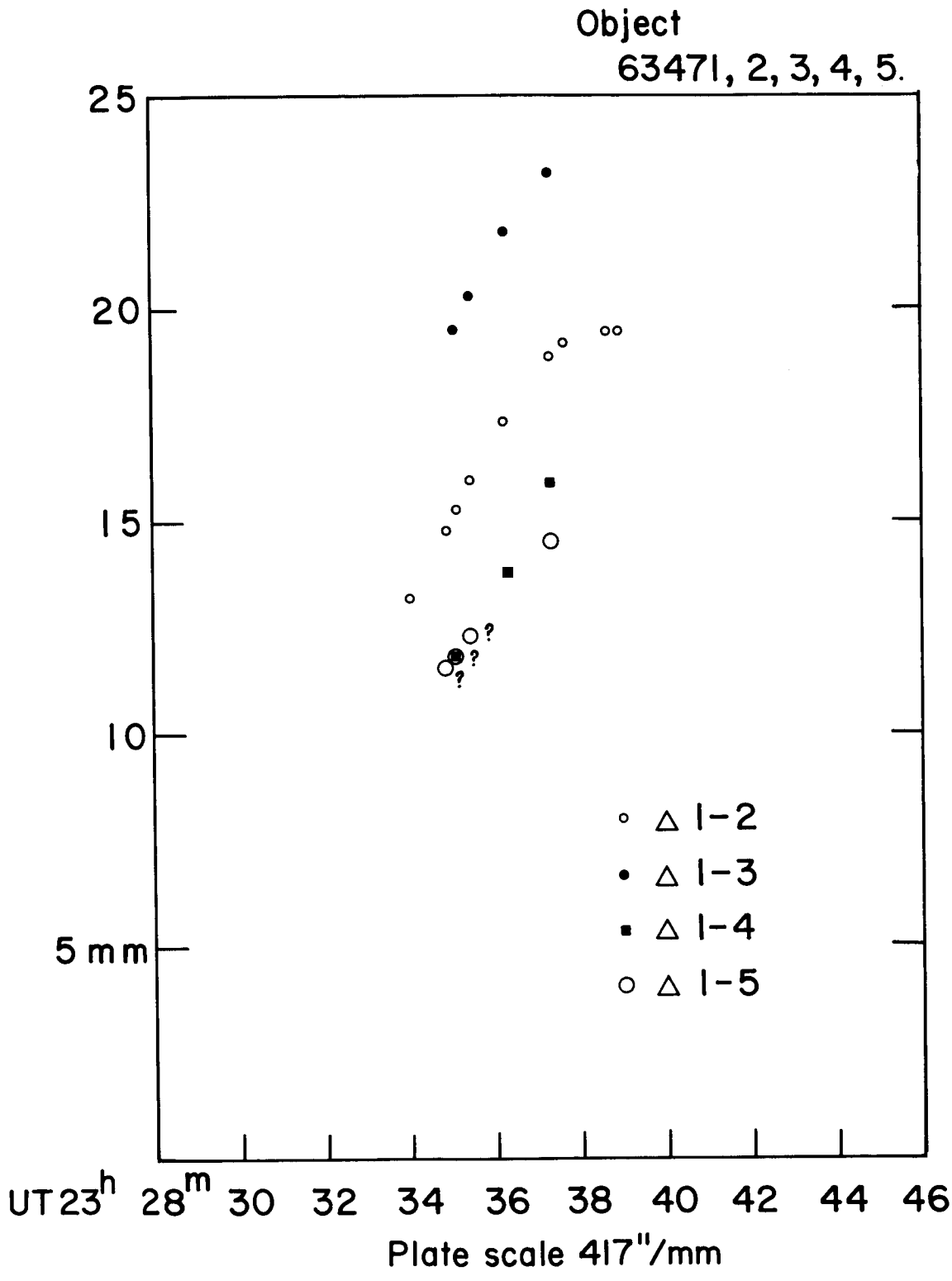

Figure 2.--Linear distance on original Baker-Nunn film of Centaur AC-2.

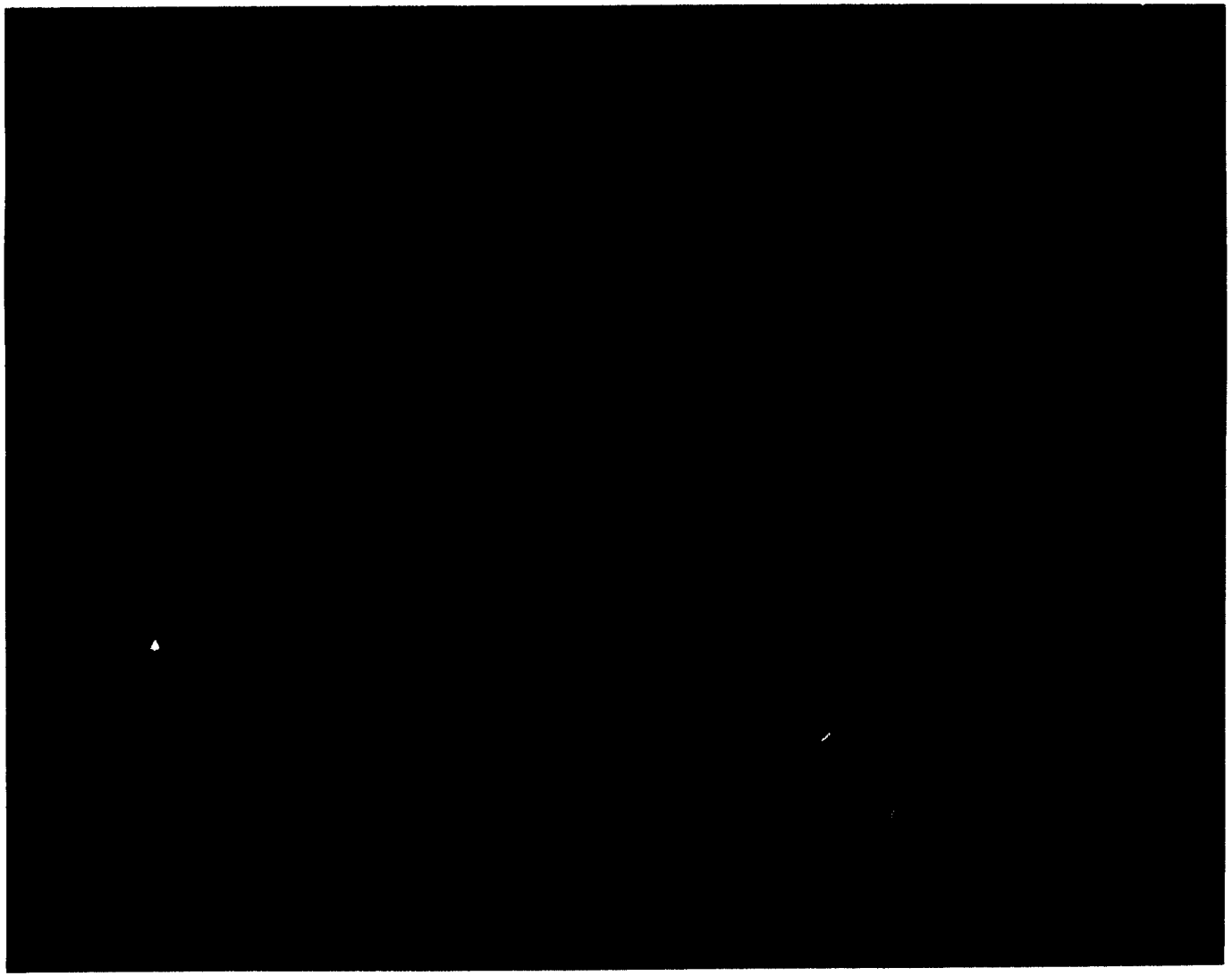

Figure 3.--Enlarged photo of the breakup of Centaur AC-2 at $23^h\ 37^m\ 23^s$ UT. The circles surround the five objects moving at different angular velocities. The arrow points to the sixth object, detected by Kokaras.

TABLE 1

Baker-Nunn Observations 1963 47 A

OBS NO	STATION	STA NO	DATE	TIME	R. A.	DECL.	AZIMUTH	ALTITUDE	RANGE	INDEX
10001	OLIFANTSFNTN-BN	9002	11 27	23 35 07.59	3 59 24	-41 29				434023
10002	OLIFANTSFNTN-BN	9002	11 27	23 37 19.41	6 23 54	-39 17				434023
10003	OLIFANTSFNTN-BN	9002	11 27	23 44 14.35	10 25 18	- 7 29				434013
10028	OLIFANTSFNTN-BN	9002	11 28	1 29 55.37	4 45 18	-17 53				434013
10029	OLIFANTSFNTN-BN	9002	11 28	1 31 38.72	5 57 54	-13 19				434013
10030	OLIFANTSFNTN-BN	9002	11 28	1 33 19.01	7 17 06	- 6 06				434013
10056	AREQUIPA-BN	9007	11 28	8 42 22.74	4 27 00	-32 28				434023
10057	AREQUIPA-BN	9007	11 28	8 43 22.74	5 01 48	-32 00				434023
10058	AREQUIPA-BN	9007	11 28	8 44 41.63	5 56 36	-30 01				434023
10059	AREQUIPA-BN	9007	11 28	8 47 00.20	7 49 24	-21 00				434013
10060	AREQUIPA-BN	9007	11 28	8 48 56.81	9 25 00	- 8 18				434013
10061	AREQUIPA-BN	9007	11 28	8 51 02.71	10 49 24	4 55				434013
10062	AREQUIPA-BN	9007	11 28	8 54 07.07	12 16 36	17 20				434013
10042	WOOMERA-BN	9003	11 28	11 48 30.42	0 08 06	19 15				434013
10043	WOOMERA-BN	9003	11 28	11 49 37.04	1 04 12	14 28				434013
10044	WOOMERA-BN	9003	11 28	11 51 42.39	2 55 12	3 51				434013
10045	WOOMERA-BN	9003	11 28	15 42 01.61	4 50 18	-25 36				434023
10046	WOOMERA-BN	9003	11 28	15 43 45.46	6 25 24	-21 44				434013
10047	WOOMERA-BN	9003	11 28	15 47 00.31	8 29 54	-10 28				434013
10048	WOOMERA-BN	9003	11 28	17 39 30.02	7 11 30	3 09				434013
10049	WOOMERA-BN	9003	11 28	17 42 31.91	9 02 54	13 33				434013
10050	WOOMERA-BN	9003	11 28	17 44 18.98	9 53 18	18 00				434013
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10023	OLIFANTSFNTN-BN	9002	11 28	19 00 22.35	1 25 54	- 7 39				434013
10024	OLIFANTSFNTN-BN	9002	11 28	19 01 03.66	2 11 24	-11 54				434013
10016	OLIFANTSFNTN-BN	9002	11 28	22 52 10.27	4 29 00	-44 22				434023
10017	OLIFANTSFNTN-BN	9002	11 28	22 53 07.18	5 34 18	-42 57				434023
10074	AREQUIPA-BN	9007	11 29	0 17 28.16	0 46 42	- 8 45				434013
10039	OLIFANTSFNTN-BN	9002	11 29	0 48 44.18	6 11 30	-17 08				434013
10040	OLIFANTSFNTN-BN	9002	11 29	0 49 04.18	6 27 48	-15 49				434013
10075	AREQUIPA-BN	9007	11 29	6 06 43.94	6 32 12	-61 39				434023
10078	VILLA DOLORES-BN	9011	11 29	8 03 21.93	6 25 36	15 35				434013
10100	WOOMERA-BN	9003	11 29	11 07 00.76	1 09 36	19 19				434013
10101	WOOMERA-BN	9003	11 29	11 10 19.94	3 49 06	1 46				434013
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10103	WOOMERA-BN	9003	11 29	13 01 51.36	1 34 18	-15 11				434013
10104	WOOMERA-BN	9003	11 29	13 03 55.61	3 43 18	-21 11				434013
10105	WOOMERA-BN	9003	11 29	16 53 39.52	4 46 06	-11 18				434013
10081	OLIFANTSFNTN-BN	9002	11 29	18 16 05.85	23 32 36	12 13				434013
10082	OLIFANTSFNTN-BN	9002	11 29	18 16 21.85	23 49 00	10 25				434013
10087	OLIFANTSFNTN-BN	9002	11 29	18 16 21.85	23 49 00	10 28				434013
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10084	OLIFANTSFNTN-BN	9002	11 29	20 09 46.10	22 53 06	-19 51				434013
10085	OLIFANTSFNTN-BN	9002	11 29	20 12 42.22	1 34 48	-38 59				434023
10086	OLIFANTSFNTN-BN	9002	11 29	20 13 12.60	2 14 06	-41 02				434023
10116	AREQUIPA-BN	9007	11 30	5 27 02.08	8 44 30	-46 56				434023
10117	AREQUIPA-BN	9007	11 30	5 27 18.08	8 52 30	-45 19				434023
10118	AREQUIPA-BN	9007	11 30	5 27 38.08	9 01 54	-43 17				434023
10119	AREQUIPA-BN	9007	11 30	7 18 40.56	5 09 00	-42 42				434023
10120	AREQUIPA-BN	9007	11 30	7 19 49.48	6 10 30	-40 24				434023
10122	AREQUIPA-BN	9007	11 30	9 18 20.89	7 56 42	18 28				434013
10125	CURACAO-BN	9009	11 30	9 25 43.87	12 18 06	-24 42				434023
10088	WOOMERA-BN	9003	11 30	10 26 14.64	1 58 06	18 32				434013
10089	WOOMERA-BN	9003	11 30	10 26 28.64	2 09 30	17 04				434013
10090	WOOMERA-BN	9003	11 30	10 27 00.84	2 34 36	13 43				434013
10091	WOOMERA-BN	9003	11 30	12 17 45.24	23 22 48	- 0 32				434013
10092	WOOMERA-BN	9003	11 30	12 20 41.13	2 11 54	-14 12				434013
10093	WOOMERA-BN	9003	11 30	12 22 19.21	3 53 54	-18 03				434013
10094	WOOMERA-BN	9003	11 30	16 13 44.77	6 08 24	- 8 18				434013
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10096	WOOMERA-BN	9003	11 30	16 16 57.15	8 07 06	2 35				434013
10097	WOOMERA-BN	9003	11 30	18 06 55.25	5 14 24	9 05				434013
10098	WOOMERA-BN	9003	11 30	18 08 26.97	6 02 24	14 55				434013
10099	WOOMERA-BN	9003	11 30	18 10 07.44	6 57 12	21 17				434013
10123	AREQUIPA-BN	9007	12 01	6 35 40.91	3 57 18	-48 27				434023
10124	AREQUIPA-BN	9007	12 01	8 34 57.96	6 53 18	3 32				434013
30006	TOWNSVILLE	8578	12 01	9 45 16.30	23 42 30	-28 46				845023
10108	WOOMERA-BN	9003	12 01	11 39 34.03	2 26 30	-10 28				434013
10109	WOOMERA-BN	9003	12 01	11 40 27.68	3 22 36	-13 06				434013
30007	TOWNSVILLE	8578	12 01	11 41 01.05	0 51 30	-64 47				845023
10110	WOOMERA-BN	9003	12 01	11 41 36.13	4 21 54	-14 43				434013
30021	TOWNSVILLE	8578	12 01	11 44 47.05	6 22 25	-52 47				845023
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10112	WOOMERA-BN	9003	12 01	13 32 41.43	1 16 12	-24 28				434023
10113	WOOMERA-BN	9003	12 01	13 35 03.83	3 53 42	-27 54				434023
10114	WOOMERA-BN	9003	12 01	17 30 46.06	8 06 24	25 43				434013
10115	WOOMERA-BN	9003	12 01	17 31 14.06	8 20 06	26 53				434013
30003	WEST PALM BEACH	8632	12 02	9 55 28.60			147 36	18 30		845303
10128	WOOMERA-BN	9003	12 02	10 55 01.15	22 42 42	12 32				434013
10129	WOOMERA-BN	9003	12 02	10 57 11.95	1 08 24	0 43				434013
10130	WOOMERA-BN	9003	12 02	10 59 03.46	3 11 18	- 7 58				434013
30009	WICHITA	8605	12 02	11 48 27.74	12 41 42	-31 41				845023
10132	WOOMERA-BN	9003	12 02	12 51 48.65	1 41 30	-25 42				434023
10133	WOOMERA-BN	9003	12 02	12 53 03.21	3 14 12	-27 20				434023
30022	ADELAIDE	8597	12 02	12 53 56.7			28 25 00	63 35 00		845303
10134	MAUI-BN	9012	12 02	15 17 37.28	10 34 36	-33 18				434023
10135	MAUI-BN	9012	12 02	15 18 46.09	11 18 12	-27 58				434023

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10136	MAUI-BN	9012	12 02	15 20 00.64	12 02 42	-21 22				434013
10126	OLIFANTSFNTN-BN	9002	12 02	18 03 50.69	20 35 12	4 20				434013
30024	CAPETOWN	0402	12 02	18 06 00.3			20 24 00	32 42 00		845303
10127	OLIFANTSFNTN-BN	9002	12 02	18 08 54.61	2 29 00	-30 28				434023
30011	QUEZON CITY	0500	12 02	18 44 04.54	10 27 12	-45 18				845023
30025	CAPETOWN	0402	12 02	20 01 48.7			43 50 00	60 25 00		845303
30026	CAPETOWN	0402	12 02	20 03 32.1			70 10 00	45 02 00		845303
30012	QUEZON CITY	0500	12 02	20 40 36.84	10 47 42	-19 27				845013
30013	QUEZON CITY	0500	12 02	20 41 44.14	11 31 42	-12 36				845013
30014	QUEZON CITY	0500	12 02	20 42 10.90	11 49 06	- 9 55				845013
10147	WOOMERA-BN	9003	12 03	12 08 20.00	23 05 36	-14 20				434013
10148	WOOMERA-BN	9003	12 03	12 09 11.27	23 57 48	-18 58				434013
10149	WOOMERA-BN	9003	12 03	12 11 42.73	3 16 54	-25 31				434023
10137	MAUI-BN	9012	12 03	14 36 22.71	10 42 42	-32 28				434023
10141	OLIFANTSFNTN-BN	9002	12 03	17 26 32.74	0 46 00	-18 45				434013
10142	OLIFANTSFNTN-BN	9002	12 03	17 28 20.10	3 16 30	-24 27				434023
30015	PRETORIA	0405	12 03	17 28 44.10	3 41 18	-25 21				845023
10143	OLIFANTSFNTN-BN	9002	12 03	19 21 03.33	0 56 00	-49 36				434023
30016	PRETORIA	0405	12 03	19 22 45.30	3 57 06	-49 21				845023
10144	OLIFANTSFNTN-BN	9002	12 03	19 24 05.49	5 24 24	-40 54				434023
30010	QUEZON CITY	0500	12 03	19 58 48.12	10 37 06	-22 56				845023
10087	NAINI TAL-BN	9006	12 03	23 40 43.18	11 52 18	-25 04				434023
10088	NAINI TAL-BN	9006	12 03	23 40 47.18	11 54 36	-24 47				434023
10152	VILLA DOLORES-BN	9011	12 04	0 41 44.92	1 34 06	-11 56				434013
10145	OLIFANTSFNTN-BN	9002	12 04	1 13 28.87	7 38 06	38 24				434013
10146	OLIFANTSFNTN-BN	9002	12 04	1 13 54.99	7 51 30	39 34				434013
10150	JUPITER-BN	9010	12 04	10 27 45.51	11 51 54	-17 08				434013
10156	WOOMERA-BN	9003	12 04	11 25 39.01	21 32 42	- 3 20				434013
10157	WOOMERA-BN	9003	12 04	11 28 19.08	0 16 24	-18 10				434013
10159	WOOMERA-BN	9003	12 04	13 20 55.43	23 29 12	-19 15				434013
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10162	MAUI-BN	9012	12 04	13 58 23.53	12 09 42	-16 02				434013
10163	MAUI-BN	9012	12 04	13 59 59.53	12 45 24	- 9 29				434013
10164	MAUI-BN	9012	12 04	15 50 00.08	10 16 18	- 4 18				434013
10165	MAUI-BN	9012	12 04	15 51 14.18	11 17 00	2 50				434013
10153	OLIFANTSFNTN-BN	9002	12 04	18 39 28.57	0 22 48	-49 05				434023
30018	PRETORIA	0405	12 04	18 39 55.70	1 20 06	-51 56				845023
10154	OLIFANTSFNTN-BN	9002	12 04	18 41 01.37	3 26 00	-48 33				434023
10155	OLIFANTSFNTN-BN	9002	12 04	18 43 00.39	5 30 12	-36 33				434023
30020	QUEZON CITY	0500	12 04	19 19 25.96	11 42 00	-13 00				845043
30017	PRETORIA	0405	12 04	20 34 45.30	2 14 48	-48 22				845023
10166	VILLA DOLORES-BN	9011	12 05	0 00 20.76	1 14 30	- 5 29				434013
10167	VILLA DOLORES-BN	9011	12 05	1 54 32.56	1 39 06	-23 03				434023
10163	AREQUIPA-BN	9007	12 05	1 56 12.93	6 51 30	-58 30				434023
10161	SAN FERNANDO-BN	9004	12 05	6 17 21.31	12 31 12	-17 45				434013
10164	AREQUIPA-BN	9007	12 05	7 45 58.84	7 52 24	35 47				434013
10165	CURACAO-BN	9009	12 05	7 49 04.50	9 18 36	-27 45				434023
10172	WOOMERA-BN	9003	12 05	10 47 34.51	0 54 36	-16 09				434013
10173	WOOMERA-BN	9003	12 05	10 48 24.16	2 12 42	-18 31				434013
10174	WOOMERA-BN	9003	12 05	10 50 54.06	4 43 54	-16 32				434013
30035	VAN NUYS	8637	12 05	11 30 12.2			148 00 00	13 24		845303
30036	VAN NUYS	8637	12 05	11 35 48.2			118 19 12	8 48 00		845308
10175	WOOMERA-BN	9003	12 05	12 39 34.43	22 56 42	-19 03				434013
10176	WOOMERA-BN	9003	12 05	12 40 24.30	23 41 54	-22 19				434013
10177	WOOMERA-BN	9003	12 05	12 43 48.00	4 02 12	-22 51				434013
30037	VAN NUYS	8637	12 05	13 26 24.0			153 06 36	33 18 00		845303
30038	VAN NUYS	8637	12 05	13 31 18.5			107 22 12	18 10 24		845303
10168	OLIFANTSFNTN-BN	9002	12 05	18 01 11.99	4 59 24	-36 22				434023
10169	OLIFANTSFNTN-BN	9002	12 05	18 03 51.99	6 11 00	-24 27				434023
10170	OLIFANTSFNTN-BN	9002	12 05	19 50 43.48	22 29 12	-38 20				434023
30019	CAPETOWN	0402	12 05	19 50 46.9			357 18	67 58		845303
10171	OLIFANTSFNTN-BN	9002	12 05	19 55 38.84	5 28 54	-38 17				434023
10223	TOKYO-BN	9005	12 05	20 38 51.30	11 53 30	-15 41				434013
10224	TOKYO-BN	9005	12 05	20 39 29.70	12 20 36	-13 44				434013
10225	TOKYO-BN	9005	12 05	20 40 30.40	13 03 24	-10 37				434013
10178	NAINI TAL-BN	9006	12 05	22 15 26.72	10 22 06	-33 25				434023
10179	NAINI TAL-BN	9006	12 05	22 15 34.72	10 25 54	-32 58				434023
10180	NAINI TAL-BN	9006	12 05	22 15 42.72	10 29 42	-32 29				434023
10181	NAINI TAL-BN	9006	12 06	0 11 33.31	11 05 48	- 9 47				434013
10182	NAINI TAL-BN	9006	12 06	0 11 37.31	11 08 42	- 9 31				434013
10183	NAINI TAL-BN	9006	12 06	0 11 41.31	11 11 48	- 9 12				434013
10196	VILLA DOLORES-BN	9011	12 06	1 09 04.71	21 09 06	- 5 51				434013
10197	VILLA DOLORES-BN	9011	12 06	1 12 23.96	0 12 42	-20 18				434013
10198	VILLA DOLORES-BN	9011	12 06	1 14 28.43	3 17 12	-21 25				434013
10199	VILLA DOLORES-BN	9011	12 06	3 03 29.58	22 55 24	-11 42				434013
10200	VILLA DOLORES-BN	9011	12 06	3 04 50.68	23 43 36	-13 16				434013
10201	VILLA DOLORES-BN	9011	12 06	3 06 41.86	1 15 42	-13 46				434013
10184	JUPITER-BN	9010	12 06	9 02 50.52	10 30 54	-26 25				434023
10189	ORGAN PASS-BN	9001	12 06	10 52 05.73	10 56 42	-27 32				434023
10190	ORGAN PASS-BN	9001	12 06	10 52 21.73	11 04 06	-26 37				434023
10191	ORGAN PASS-BN	9001	12 06	10 52 37.73	11 11 30	-25 39				434023
10185	JUPITER-BN	9010	12 06	10 58 33.99	10 57 48	2 39				434013
10220	WOOMERA-BN	9003	12 06	11 56 54.36	21 24 30	-12 09				434013
10221	WOOMERA-BN	9003	12 06	12 01 09.56	2 16 12	-26 49				434023
10222	WOOMERA-BN	9003	12 06	12 04 29.56	5 40 00	-14 08				434013
10192	ORGAN PASS-BN	9001	12 06	12 46 11.90	10 42 06	-12 37				434013
10193	ORGAN PASS-BN	9001	12 06	12 47 03.04	11 19 12	- 9 48				434013
10194	ORGAN PASS-BN	9001	12 06	12 47 45.24	11 50 48	- 7 21				434013

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30026	CAPETOWN	0402	12 06	19 10 01.20			35 32	61 38		845303
30027	CAPETOWN	0402	12 06	21 01 51.60			294 58	42 23		845303
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10261	NAINI TAL-BN	9006	12 06	21 33 29.99	10 02 54	-34 46				434023
10262	NAINI TAL-BN	9006	12 06	21 35 46.07	10 58 24	-26 27				434023
10240	SHIRAZ-BN	9008	12 06	23 21 25.63	10 05 42	-34 10				434023
10263	NAINI TAL-BN	9006	12 06	23 30 09.13	11 04 42	-10 52				434013
10264	NAINI TAL-BN	9006	12 06	23 30 21.13	11 13 06	-10 05				434013
10265	NAINI TAL-BN	9006	12 06	23 30 25.13	11 15 36	- 9 45				434013
10244	VILLA DOLORES-BN	9011	12 07	0 28 12.18	20 44 48	- 3 35				434013
10245	VILLA DOLORES-BN	9011	12 07	0 30 13.61	22 33 00	-13 20				434013
10246	VILLA DOLORES-BN	9011	12 07	0 32 06.10	1 33 42	-20 44				434013
10241	SHIRAZ-BN	9008	12 07	1 17 00.32	10 27 42	-14 32				434013
10247	VILLA DOLORES-BN	9011	12 07	2 22 33.23	22 30 00	-12 05				434013
10248	VILLA DOLORES-BN	9011	12 07	2 24 28.60	23 58 48	-14 56				434013
10249	VILLA DOLORES-BN	9011	12 07	2 26 53.72	2 46 30	-12 50				434013
10202	ORGAN PASS-BN	9001	12 07	10 10 11.90	10 34 48	-28 44				434023
10203	ORGAN PASS-BN	9001	12 07	10 10 35.90	10 44 48	-27 21				434023
10204	ORGAN PASS-BN	9001	12 07	10 11 21.13	11 03 12	-24 44				434023
10208	WOOMERA-BN	9003	12 07	11 15 35.65	20 43 48	- 9 18				434013
10209	WOOMERA-BN	9003	12 07	11 19 40.38	1 49 48	-26 59				434023
10210	WOOMERA-BN	9003	12 07	11 22 15.78	4 56 36	-16 58				434013
30039	VAN NUYS	8637	12 07	12 02 30.6			149 27 12	27 42 00		845303
10211	WOOMERA-BN	9003	12 07	13 10 08.00	22 44 42	-13 13				434013
10213	WOOMERA-BN	9003	12 07	13 13 27.76	1 42 06	-13 28				434013
10195	OLIFANTSFNTN-BN	9002	12 07	18 33 09.57	5 35 18	-35 06				434023
10294	TOKYO-BN	9005	12 07	19 15 08.60	11 02 24	-18 29				434013
10295	TOKYO-BN	9005	12 07	19 15 38.70	11 19 30	-16 57				434013
10296	TOKYO-BN	9005	12 07	19 16 17.10	11 41 12	-14 56				434013
10229	NAINI TAL-BN	9006	12 07	22 47 33.57	10 19 42	-16 21				434013
10230	NAINI TAL-BN	9006	12 07	22 47 57.57	10 33 54	-14 42				434013
10231	NAINI TAL-BN	9006	12 07	22 48 11.26	10 42 00	-13 50				434013
10250	VILLA DOLORES-BN	9011	12 08	1 40 55.34	21 37 48	-10 42				434013
10251	VILLA DOLORES-BN	9011	12 08	1 43 53.05	0 18 30	-16 34				434013
10252	VILLA DOLORES-BN	9011	12 08	1 46 30.12	3 49 30	-10 44				434013
10239	SHIRAZ-BN	9008	12 08	2 30 39.80	10 35 48	11 42				434013
10243	JUPITER-BN	9010	12 08	9 34 37.26	10 16 48	- 6 17				434013
10214	WOOMERA-BN	9003	12 08	10 35 12.28	20 38 06	- 9 47				434013
10215	WOOMERA-BN	9003	12 08	10 38 06.66	1 02 24	-26 00				434023
10216	WOOMERA-BN	9003	12 08	10 41 47.46	5 12 18	-13 05				434013
10205	ORGAN PASS-BN	9001	12 08	11 22 58.96	10 25 06	-15 29				434013
10206	ORGAN PASS-BN	9001	12 08	11 23 14.96	10 34 36	-14 34				434013
10207	ORGAN PASS-BN	9001	12 08	11 23 30.96	10 44 18	-13 38				434013
10217	WOOMERA-BN	9003	12 08	12 30 45.41	23 41 18	-16 24				434013
10218	WOOMERA-BN	9003	12 08	12 32 12.55	1 31 42	-15 37				434013
10219	WOOMERA-BN	9003	12 08	12 33 50.46	3 39 42	- 9 37				434013
10253	MAUI-BN	9012	12 08	13 04 36.86	10 39 24	-10 22				434013
10254	MAUI-BN	9012	12 08	13 05 17.32	10 57 48	- 7 21				434013
10256	MAUI-BN	9012	12 08	14 57 50.08	9 14 00	15 40				434013
10257	MAUI-BN	9012	12 08	14 58 17.81	9 36 12	18 15				434013
10258	MAUI-BN	9012	12 08	14 59 02.72	10 13 48	22 05				434013
10226	TOKYO-BN	9005	12 08	18 33 16.20	10 40 18	-19 57				434013
10227	TOKYO-BN	9005	12 08	18 33 45.00	10 55 06	-18 26				434013
10228	TOKYO-BN	9005	12 08	18 34 33.00	11 19 24	-15 56				434013
10259	OLIFANTSFNTN-BN	9002	12 08	19 42 22.59	23 57 00	-40 44				434023
10297	TOKYO-BN	9005	12 08	20 27 40.70	10 48 18	- 4 26				434013
10298	TOKYO-BN	9005	12 08	20 28 57.60	11 46 54	- 1 23				434013
10233	NAINI TAL-BN	9006	12 08	22 05 16.89	9 50 30	-20 19				434013
10234	NAINI TAL-BN	9006	12 08	22 05 24.89	9 54 48	-19 48				434013
10266	SHIRAZ-BN	9008	12 08	23 51 41.33	9 06 00	-25 21				434023
10235	NAINI TAL-BN	9006	12 09	0 01 01.88	10 19 30	8 28				434013
10236	NAINI TAL-BN	9006	12 09	0 01 05.88	10 22 48	8 44				434013
10237	NAINI TAL-BN	9006	12 09	0 01 17.88	10 32 42	9 29				434013
10268	VILLA DOLORES-BN	9011	12 09	1 00 27.57	21 26 36	-11 34				434013
10269	VILLA DOLORES-BN	9011	12 09	1 02 47.83	0 08 06	-17 41				434013
10270	VILLA DOLORES-BN	9011	12 09	1 04 33.88	2 58 36	-14 15				434013
10267	SHIRAZ-BN	9008	12 09	1 48 22.07	9 58 48	6 25				434013
10287	JUPITER-BN	9010	12 09	8 52 35.08	9 56 48	-10 26				434013
10242	CURACAO-BN	9009	12 09	8 53 50.11	8 23 48	42 38				434013
10274	ORGAN PASS-BN	9001	12 09	10 41 15.36	10 12 24	-17 08				434013
10275	ORGAN PASS-BN	9001	12 09	10 41 19.36	10 14 42	-16 52				434013
10276	ORGAN PASS-BN	9001	12 09	10 41 23.36	10 16 48	-16 39				434013
10288	JUPITER-BN	9010	12 09	10 48 21.17	10 26 00	23 20				434013
10277	WOOMERA-BN	9003	12 09	11 47 20.22	21 11 54	-12 30				434013
10278	WOOMERA-BN	9003	12 09	11 50 54.99	1 14 54	-18 03				434013
10271	ORGAN PASS-BN	9001	12 09	12 37 02.29	11 05 24	7 16				434013
10272	ORGAN PASS-BN	9001	12 09	12 37 14.29	11 15 36	7 49				434013
10273	ORGAN PASS-BN	9001	12 09	12 37 30.29	11 28 54	8 29				434013
10289	MAUI-BN	9012	12 09	14 15 13.03	8 37 06	6 12				434013
10290	MAUI-BN	9012	12 09	14 16 22.38	9 28 06	12 22				434013
10291	MAUI-BN	9012	12 09	14 16 46.38	9 46 18	14 22				434013
10281	NAINI TAL-BN	9006	12 09	21 25 25.81	10 34 36	-14 39				434013
10282	NAINI TAL-BN	9006	12 09	21 26 26.92	11 02 06	-10 51				434013
10283	NAINI TAL-BN	9006	12 09	21 28 32.01	11 53 48	- 4 03				434013
10284	NAINI TAL-BN	9006	12 09	23 19 42.04	10 29 30	6 49				434013
10285	NAINI TAL-BN	9006	12 09	23 20 02.04	10 45 24	7 59				434013
10286	NAINI TAL-BN	9006	12 09	23 20 46.04	11 19 18	10 19				434013
10279	SAN FERNANDO-BN	9004	12 10	4 42 11.86	10 34 06	-11 35				434013

Table 1 cont.

OBS NO	STATION	STA NO	DATE	TIME	R. A.	DECL.	AZIMUTH	ALTITUDE	RANGE	INDEX
10299	JUPITER-BN	9010	12 10	10 06 33.65	10 17 06	19 28				434013
10292	CURACAO-BN	9009	12 10	10 08 47.71	8 50 54	66 51				434013
10300	MAUI-BN	9012	12 10	15 30 33.62	9 38 42	46 06				434013
10301	MAUI-BN	9012	12 10	15 32 47.04	12 13 06	50 26				434013
10302	MAUI-BN	9012	12 10	15 33 58.39	13 25 42	48 15				434013
10303	OLIFANTSFNTN-BN	9002	12 10	18 21 14.54	2 31 00	-51 12				434023
10312	VILLA DOLORES-BN	9011	12 11	1 33 03.34	22 52 42	- 4 54				434013
10313	VILLA DOLORES-BN	9011	12 11	1 36 11.64	2 45 24	5 54				434013
10311	JUPITER-BN	9010	12 11	7 33 29.99	11 33 36	0 30				434013
10304	CURACAO-BN	9009	12 11	7 33 44.56	11 19 06	41 16				434013
10305	CURACAO-BN	9009	12 11	9 21 32.10	5 38 36	33 33				434013
10309	JUPITER-BN	9010	12 11	9 21 32.42	7 49 42	1 50				434013
10310	JUPITER-BN	9010	12 11	9 25 50.33	10 59 18	18 42				434013
10306	CURACAO-BN	9009	12 11	9 25 50.78	7 49 42	59 49				434013
10307	WOOMERA-BN	9003	12 11	12 19 56.22	22 33 30	- 4 31				434013
10308	WOOMERA-BN	9003	12 11	12 22 15.31	0 55 42	3 07				434013
10321	MAUI-BN	9012	12 11	12 57 01.28	11 41 06	16 36				434013
10322	MAUI-BN	9012	12 11	14 44 50.43	6 42 54	20 41				434013
10323	MAUI-BN	9012	12 11	14 49 06.10	10 00 30	43 45				434013
30029	CAPETOWN	0402	12 11	19 30 38.1			327 36	42 49		845303
30030	CAPETOWN	0402	12 11	19 31 59.8			4 58	43 27		845303
10316	SHIRAZ-BN	9008	12 11	23 44 09.01	10 15 12	0 59				434013
10314	VILLA DOLORES-BN	9011	12 12	0 53 16.56	0 03 54	- 2 50				434013
10317	SHIRAZ-BN	9008	12 12	1 37 55.45	9 27 54	21 49				434013
10336	SAN FERNANDO-BN	9004	12 12	5 08 00.73	7 21 48	-10 00				434013
10337	SAN FERNANDO-BN	9004	12 12	5 13 32.01	10 32 00	1 30				434013
10318	JUPITER-BN	9010	12 12	8 42 49.82	9 53 24	10 56				434013
10319	JUPITER-BN	9010	12 12	8 47 08.45	12 36 30	19 02				434013
10320	JUPITER-BN	9010	12 12	10 37 58.32	10 00 30	36 45				434013
10315	WOOMERA-BN	9003	12 12	11 42 40.89	2 52 54	9 05				434013
10340	TOKYO-BN	9005	12 12	17 44 20.50	11 43 24	- 1 25				434013
10327	OLIFANTSFNTN-BN	9002	12 12	18 49 52.21	21 17 36	-24 41				434023
30031	CAPETOWN	0402	12 12	18 49 52.9			344 45	45 47		845303
30032	CAPETOWN	0402	12 12	18 52 44.1			45 02	27 49		845303
10328	OLIFANTSFNTN-BN	9002	12 12	18 53 56.60	3 34 12	-13 28				434013
10338	TOKYO-BN	9005	12 12	19 30 25.00	7 15 42	- 5 19				434013
10339	TOKYO-BN	9005	12 12	19 35 53.90	10 31 30	6 26				434013
10324	AREQUIPA-BN	9007	12 13	2 03 47.32	21 47 54	-49 24				434023
10325	VILLA DOLORES-BN	9011	12 13	2 04 44.25	23 29 30	11 21				434013
10358	MAUI-BN	9012	12 13	15 21 26.98	10 46 48	58 43				434013
10341	TOKYO-BN	9005	12 13	17 03 46.40	11 47 54	- 0 35				434013
10342	TOKYO-BN	9005	12 13	18 56 11.30	11 43 42	7 52				434013
10345	NAINI TAL-BN	9006	12 13	22 31 26.13	12 47 24	22 05				434013
10351	SHIRAZ-BN	9008	12 14	0 18 47.57	12 32 36	21 51				434013
10346	NAINI TAL-BN	9006	12 14	0 21 38.97	9 25 36	32 10				434013
10350	AREQUIPA-BN	9007	12 14	1 23 46.96	22 34 12	-64 31				434023
10357	VILLA DOLORES-BN	9011	12 14	1 24 19.82	23 36 36	14 40				434013
10352	SHIRAZ-BN	9008	12 14	2 09 31.39	9 32 42	31 39				434013
10332	WOOMERA-BN	9003	12 14	12 10 59.54	22 59 42	12 43				434013
10333	WOOMERA-BN	9003	12 14	12 12 12.93	0 05 30	20 01				434013
30040	VAN NUYS	8637	12 14	12 54 32.8			180 18 00	71 40 48		845303
10326	ORGAN PASS-BN	9001	12 14	12 54 35.37	8 14 42	17 52				434013
10359	MAUI-BN	9012	12 14	14 41 02.46	12 18 06	53 35				434013
10343	TOKYO-BN	9005	12 14	18 16 08.10	12 20 48	7 46				434013
10329	OLIFANTSFNTN-BN	9002	12 14	19 21 45.61	22 16 30	- 3 11				434013
10330	OLIFANTSFNTN-BN	9002	12 14	19 24 00.36	0 31 48	10 45				434013
10344	TOKYO-BN	9005	12 14	20 07 34.70	10 53 24	12 49				434013
10347	NAINI TAL-BN	9006	12 14	21 50 17.95	12 40 42	19 30				434013
10353	SHIRAZ-BN	9008	12 14	23 37 44.82	12 30 54	19 15				434013
10348	NAINI TAL-BN	9006	12 14	23 42 05.96	11 28 48	34 11				434013
10354	SHIRAZ-BN	9008	12 15	1 31 31.04	12 55 48	29 53				434013
10356	CURACAO-BN	9009	12 15	8 37 02.60	12 02 30	69 31				434013
10362	ORGAN PASS-BN	9001	12 15	10 24 35.77	12 16 12	15 09				434013
10334	WOOMERA-BN	9003	12 15	11 28 50.20	21 32 18	6 07				434013
10335	WOOMERA-BN	9003	12 15	11 32 21.05	1 10 48	27 21				434013
30041	VAN NUYS	8637	12 15	12 12 12.6			180 18 00	69 48 00		845303
10363	ORGAN PASS-BN	9001	12 15	12 17 03.85	11 24 18	23 44				434013
10360	MAUI-BN	9012	12 15	14 00 15.96	12 48 24	46 50				434013
30042	VAN NUYS	8637	12 15	14 08 50.6			180 18 00	68 42 00		845303
10361	MAUI-BN	9012	12 15	15 52 51.97	10 36 00	61 37				434013
10365	TOKYO-BN	9005	12 15	17 35 24.50	12 23 54	7 07				434013
30033	CAPETOWN	0402	12 15	18 40 43.40			349 11	27 23		845303
10374	OLIFANTSFNTN-BN	9002	12 15	18 40 51.51	21 44 06	- 6 00				434013
10375	OLIFANTSFNTN-BN	9002	12 15	18 44 39.87	2 53 36	20 33				434013
10366	TOKYO-BN	9005	12 15	19 27 39.20	12 03 36	12 04				434013
10349	NAINI TAL-BN	9006	12 15	23 01 37.17	12 22 24	30 22				434013
10355	SHIRAZ-BN	9008	12 16	0 49 36.84	12 31 42	29 02				434013
10376	WOOMERA-BN	9003	12 16	10 51 27.77	1 16 18	27 45				434013
10364	ORGAN PASS-BN	9001	12 16	11 36 10.14	11 54 54	22 13				434013
10373	MAUI-BN	9012	12 16	15 12 09.84	12 05 54	58 59				434013
10367	TOKYO-BN	9005	12 16	18 48 55.20	13 24 24	8 32				434013
10368	TOKYO-BN	9005	12 16	20 37 42.20	10 05 48	10 11				434013
10369	NAINI TAL-BN	9006	12 16	22 21 02.05	12 48 24	25 57				434013
10371	SHIRAZ-BN	9008	12 17	0 09 20.21	13 04 12	24 01				434013
10370	NAINI TAL-BN	9006	12 17	0 12 36.10	10 38 42	32 58				434013

Table 1 cont.

OBS NO	STATION	STA NO	DATE	TIME	R. A.	DECL.	AZIMUTH	ALTITUDE	RANGE	INDEX
10372	SHIRAZ-BN	9008	12 17	2 00 56.76	11 13 12	31 04				434013
10386	CURACAO-BN	9009	12 17	9 08 46.35	12 27 30	72 01				434013
10379	ORGAN PASS-BN	9001	12 17	10 55 32.26	12 24 12	19 30				434013
30043	VAN NUYS	8637	12 17	12 44 09.4			180 18 00	72 48 00		845303
10380	ORGAN PASS-BN	9001	12 17	12 47 36.63	10 45 18	19 22				434013
10387	MAUI-BN	9012	12 17	14 33 20.31	14 05 30	43 06				434013
10382	TOKYO-BN	9005	12 17	18 05 29.00	12 14 06	10 27				434013
10381	OLIFANTSFNTN-BN	9002	12 17	19 13 18.61	22 53 48	22 16				434013
10383	TOKYO-BN	9005	12 17	19 56 30.50	10 18 24	11 17				434013
10384	NAINI TAL-BN	9006	12 17	23 32 26.08	12 02 06	30 27				434013
10388	AREQUIPA-BN	9007	12 18	0 34 20.41	0 26 12	-50 30				434023
10385	SHIRAZ-BN	9008	12 18	1 20 40.65	12 24 42	27 42				434013
10390	MAUI-BN	9012	12 18	13 51 20.70	13 36 36	42 19				434013
13091	MAUI-BN	9012	12 18	15 43 16.84	11 30 12	55 48				434013
10393	TOKYO-BN	9005	12 18	19 17 36.60	12 10 30	8 02				434013
30034	KAGOSHIMA	8626	12 18	21 00 02.6	10 04 12	14 06				845013
10394	NAINI TAL-BN	9006	12 18	22 51 26.67	12 26 18	27 45				434013
10399	JUPITER-BN	9010	12 19	9 38 53.11	12 50 36	31 40				434013
10392	ORGAN PASS-BN	9001	12 19	11 26 51.15	12 31 06	15 28				434013
10400	MAUI-BN	9012	12 19	15 03 01.85	13 02 36	48 48				434013
10401	OLIFANTSFNTN-BN	9002	12 19	17 51 09.74	21 41 12	17 40				434013
10402	OLIFANTSFNTN-BN	9002	12 19	17 53 26.85	0 40 06	39 10				434013
10407	TOKYO-BN	9005	12 19	18 37 02.50	12 34 12	6 48				434013
10408	TOKYO-BN	9005	12 19	20 27 40.40	10 18 06	1 48				434013
10395	NAINI TAL-BN	9006	12 19	22 11 55.24	13 18 42	19 58				434013
10396	NAINI TAL-BN	9006	12 19	23 57 16.40	7 04 06	22 39				434013
10403	SHIRAZ-BN	9008	12 19	23 57 47.43	12 23 36	25 13				434013
10397	NAINI TAL-BN	9006	12 20	0 02 57.31	11 10 24	21 28				434013
10404	SHIRAZ-BN	9008	12 20	1 50 55.06	11 20 06	19 23				434013
10398	CURACAO-BN	9009	12 20	9 00 03.78	13 41 12	61 11				434013
10416	MAUI-BN	9012	12 20	14 22 52.40	13 47 12	38 52				434013
10420	TOKYO-BN	9005	12 20	17 55 39.00	12 25 54	6 56				434013
10421	TOKYO-BN	9005	12 20	19 48 00.80	11 31 18	- 0 59				434013
10409	NAINI TAL-BN	9006	12 20	21 29 37.71	12 45 18	21 18				434013
10410	NAINI TAL-BN	9006	12 20	23 22 32.24	12 08 12	18 53				434013
10413	AREQUIPA-BN	9007	12 21	0 25 20.25	23 36 42	10 34				434013
10414	SHIRAZ-BN	9008	12 21	1 10 39.90	12 21 48	16 09				434013
10415	JUPITER-BN	9010	12 21	10 08 48.81	11 32 00	26 15				434013
10405	ORGAN PASS-BN	9001	12 21	11 56 57.11	11 33 54	6 44				434013
10417	MAUI-BN	9012	12 21	13 41 38.02	13 41 12	35 27				434013
10418	MAUI-BN	9012	12 21	15 34 20.88	12 27 24	37 23				434013
10427	TOKYO-BN	9005	12 21	19 07 38.60	12 09 36	- 2 01				434013
10411	NAINI TAL-BN	9006	12 21	22 42 06.12	12 46 30	15 14				434013
10422	SHIRAZ-BN	9008	12 22	0 30 31.42	13 04 06	11 43				434013
10423	SHIRAZ-BN	9008	12 22	2 19 37.95	9 19 12	8 26				434013
10406	SAN FERNANDO-BN	9004	12 22	4 03 58.59	12 09 30	0 11				434013
10433	JUPITER-BN	9010	12 22	9 29 25.25	12 59 54	17 18				434013
10419	ORGAN PASS-BN	9001	12 22	11 16 41.37	12 20 06	4 26				434013
10424	MAUI-BN	9012	12 22	14 54 05.12	13 24 48	29 50				434013
10428	TOKYO-BN	9005	12 22	18 26 45.50	12 21 54	10 15				434013
10429	TOKYO-BN	9005	12 22	20 17 56.00	10 30 42	-11 34				434013
10431	SHIRAZ-BN	9008	12 22	23 49 14.11	13 00 18	11 32				434013
10432	SHIRAZ-BN	9008	12 23	1 40 45.35	11 07 54	2 20				434013
10425	ORGAN PASS-BN	9001	12 23	10 36 31.51	12 50 30	2 06				434013
10426	ORGAN PASS-BN	9001	12 23	12 27 10.71	10 34 24	- 7 08				434013
10434	MAUI-BN	9012	12 23	16 01 51.74	8 48 12	26 36				434013
10436	TOKYO-BN	9005	12 23	19 37 42.40	11 12 48	-13 38				434013
10430	NAINI TAL-BN	9006	12 23	23 13 25.34	12 25 30	- 1 15				434013
10439	AREQUIPA-BN	9007	12 24	0 15 52.22	22 09 42	38 29				434013
10440	SHIRAZ-BN	9008	12 24	1 00 30.91	12 01 24	- 0 04				434013
10441	MAUI-BN	9012	12 24	13 31 59.71	13 34 00	23 49				434013
10442	MAUI-BN	9012	12 24	15 24 19.00	11 59 06	15 34				434013
10443	NAINI TAL-BN	9006	12 24	22 31 52.84	12 23 42	0 56				434013
10437	NAINI TAL-BN	9006	12 25	0 23 44.64	10 23 18	-14 08				434013
10438	NAINI TAL-BN	9006	12 25	23 43 24.05	11 05 42	-16 47				434013
10444	CURACAO-BN	9009	12 26	8 41 12.02	13 18 18	30 43				434013
30044	KANSAS CITY	0036	12 26	10 25 28.5	10 23 09	-19 55				845003
30045	KANSAS CITY	0036	12 26	10 25 29.18	10 22 50	-21 22				845003
30046	KANSAS CITY	0036	12 27	11 41 38.1	11 40 40	-39 49				845023
30047	KANSAS CITY	0036	12 27	11 43 23.02	12 27 00	-41 27				845023

TABLE 2

Baker-Nunn Observations 1963 47 B

OBS NO	STATION	STA NO	DATE	TIME	R. A.	DECL.	AZIMUTH	ALTITUDE	RANGE	INDEX
10004	OLIFANTSFNTN-BN	9002	11 27	23 35 07.59	4 02 12	-39 41				434023
10005	OLIFANTSFNTN-BN	9002	11 27	23 37 19.41	6 25 48	-37 04				434023
10006	OLIFANTSFNTN-BN	9002	11 27	23 44 14.35	10 24 54	- 5 45				434013
10031	OLIFANTSFNTN-BN	9002	11 28	1 29 55.37	4 41 06	-15 53				434013
10032	OLIFANTSFNTN-BN	9002	11 28	1 31 38.72	5 52 06	-11 13				434013
10033	OLIFANTSFNTN-BN	9002	11 28	1 33 19.01	7 10 36	- 3 56				434013
10063	AREQUIPA-BN	9007	11 28	8 43 14.74	4 29 42	-30 30				434023
10065	AREQUIPA-BN	9007	11 28	8 47 00.20	7 09 06	-21 55				434013
10067	AREQUIPA-BN	9007	11 28	8 51 02.71	10 22 00	3 40				434013
10068	AREQUIPA-BN	9007	11 28	8 53 51.07	11 52 30	16 20				434013
10051	WOOMERA-BN	9003	11 28	15 46 50.31	7 39 12	-13 27				434013
10052	WOOMERA-BN	9003	11 28	15 47 00.31	7 45 18	-12 50				434013
10054	WOOMERA-BN	9003	11 28	17 42 31.91	8 13 12	11 53				434013
10055	WOOMERA-BN	9003	11 28	17 44 18.98	9 14 00	17 08				434013
10025	OLIFANTSFNTN-BN	9002	11 28	19 02 08.61	1 17 18	- 7 25				434013
10026	OLIFANTSFNTN-BN	9002	11 28	19 02 31.55	1 43 06	- 9 52				434013
10027	OLIFANTSFNTN-BN	9002	11 28	19 03 12.39	2 28 48	-13 41				434013
10019	OLIFANTSFNTN-BN	9002	11 28	22 55 43.42	6 17 48	-38 57				434023
10020	OLIFANTSFNTN-BN	9002	11 28	22 55 53.03	6 28 00	-38 15				434023
10021	OLIFANTSFNTN-BN	9002	11 28	22 56 01.03	6 35 54	-37 39				434023
10076	AREQUIPA-BN	9007	11 29	6 09 34.20	7 12 48	-58 48				434023
10079	VILLA DOLORES-BN	9011	11 29	8 02 57.93	5 01 12	8 33				434013
10080	VILLA DOLORES-BN	9011	11 29	8 03 21.93	5 12 54	10 00				434013
10070	AREQUIPA-BN	9007	11 29	8 06 36.77	8 11 36	-21 19				434013
10022	WOOMERA-BN	9003	11 29	11 11 38.26	2 40 54	9 18				434013
10023	WOOMERA-BN	9003	11 29	11 13 07.84	3 48 42	2 09				434013
10024	WOOMERA-BN	9003	11 29	11 14 18.34	4 31 54	- 1 52				434013
10001	OLIFANTSFNTN-BN	9002	11 29	18 19 58.63	0 11 12	6 26				434013
10002	OLIFANTSFNTN-BN	9002	11 29	18 20 22.63	0 38 06	3 37				434013
10003	OLIFANTSFNTN-BN	9002	11 29	18 20 54.63	1 14 18	- 0 13				434013
30002	TOWNSVILLE	8578	11 30	10 30 22.50	23 52 12	-38 06				845023
30007	TOWNSVILLE	8578	11 30	10 30 24.8	23 55 35	-38 23				845023
10007	WOOMERA-BN	9003	11 30	12 23 58.26	1 56 12	-12 33				434013
10008	WOOMERA-BN	9003	11 30	12 25 50.56	3 59 18	-17 04				434013
10009	WOOMERA-BN	9003	11 30	12 27 22.76	5 16 18	-17 01				434013
10010	WOOMERA-BN	9003	11 30	16 17 53.09	6 53 42	- 0 24				434013
10011	WOOMERA-BN	9003	11 30	16 18 03.09	7 00 42	0 11				434013
10012	WOOMERA-BN	9003	11 30	18 11 18.19	5 57 24	18 24				434013
10028	WOOMERA-BN	9003	12 01	11 43 01.01	2 09 18	- 9 01				434013
10029	WOOMERA-BN	9003	12 01	11 44 22.78	3 37 54	-12 52				434013
30004	TOWNSVILLE	8578	12 01	11 44 46.55	0 52 36	-65 24				845023
10030	WOOMERA-BN	9003	12 01	11 46 32.58	5 17 12	-13 58				434013
10034	CURACAO-BN	9009	12 02	9 58 44.34	10 29 06	- 2 39				434013
10035	WOOMERA-BN	9003	12 02	11 00 51.81	0 51 54	1 23				434013
10036	WOOMERA-BN	9003	12 02	11 02 39.05	2 56 18	- 6 55				434013
10037	WOOMERA-BN	9003	12 02	11 05 23.23	5 00 42	-11 04				434013
10038	WOOMERA-BN	9003	12 02	12 55 59.11	2 06 42	-24 49				434023
10039	WOOMERA-BN	9003	12 02	12 56 27.11	2 43 06	-25 25				434023
10040	WOOMERA-BN	9003	12 02	12 57 22.98	3 52 36	-24 59				434023
10041	MAUI-BN	9012	12 02	15 21 38.37	11 24 36	-26 53				434023
10042	MAUI-BN	9012	12 02	15 22 41.74	12 04 06	-20 57				434013
10043	MAUI-BN	9012	12 02	15 24 51.30	13 17 42	- 9 17				434013
10115	ORGAN PASS-BN	9001	12 03	13 00 32.05	12 16 48	-23 12				434023
10116	ORGAN PASS-BN	9001	12 03	13 00 40.05	12 22 18	-22 40				434013
10117	ORGAN PASS-BN	9001	12 03	13 00 48.05	12 27 48	-22 09				434013
10046	OLIFANTSFNTN-BN	9002	12 03	17 30 00.42	23 43 48	-15 26				434013
10047	OLIFANTSFNTN-BN	9002	12 03	17 33 40.92	4 21 24	-24 03				434023
10048	OLIFANTSFNTN-BN	9002	12 03	19 25 58.45	2 30 42	-50 10				434023
30005	PRETORIA	0405	12 03	19 26 53.70	4 05 00	-48 03				845023
10049	OLIFANTSFNTN-BN	9002	12 03	19 29 22.89	6 18 30	-32 28				434023
10071	VILLA DOLORES-BN	9011	12 04	0 47 28.10	3 33 18	-14 11				434013
10072	VILLA DOLORES-BN	9011	12 04	0 50 47.97	5 47 30	-11 17				434013
10073	VILLA DOLORES-BN	9011	12 04	2 41 01.84	3 05 48	-20 03				434013
10151	AREQUIPA-BN	9007	12 04	8 27 44.41	5 50 12	25 17				434013
10059	JUPITER-BN	9010	12 04	10 30 32.95	11 47 00	-17 48				434013
10086	WOOMERA-BN	9003	12 04	11 31 40.23	23 13 54	-12 58				434013
10087	WOOMERA-BN	9003	12 04	11 33 20.28	1 31 48	-20 35				434013
10088	WOOMERA-BN	9003	12 04	11 37 26.63	5 38 00	-15 20				434013
10081	ORGAN PASS-BN	9001	12 04	12 18 52.88	11 49 24	-24 56				434023
10082	ORGAN PASS-BN	9001	12 04	12 18 56.88	11 51 42	-24 39				434023
10089	WOOMERA-BN	9003	12 04	13 23 23.24	22 32 00	-12 58				434013
10090	WOOMERA-BN	9003	12 04	13 23 43.24	22 41 48	-13 48				434013
10097	MAUI-BN	9012	12 04	15 53 41.66	10 48 54	0 42				434013
10098	MAUI-BN	9012	12 04	15 53 55.66	11 01 18	2 07				434013
10084	OLIFANTSFNTN-BN	9002	12 04	18 43 59.26	0 57 48	-49 17				434023
30006	PRETORIA	0405	12 04	18 44 21.30	1 43 54	-51 06				845023
10085	OLIFANTSFNTN-BN	9002	12 04	18 45 30.22	3 48 42	-46 14				434023
10091	NAINI TAL-BN	9006	12 04	22 58 12.31	9 26 06	-39 54				434023
10092	NAINI TAL-BN	9006	12 04	22 58 52.31	9 48 12	-37 59				434023
10093	NAINI TAL-BN	9006	12 04	23 02 05.87	11 34 18	-26 13				434023
10100	VILLA DOLORES-BN	9011	12 05	0 04 00.74	0 23 30	- 3 03				434013
10101	VILLA DOLORES-BN	9011	12 05	1 59 00.23	1 55 36	-20 47				434013
10099	CURACAO-BN	9009	12 05	7 53 19.45	9 50 00	-22 31				434013
10094	JUPITER-BN	9010	12 05	9 48 33.96	11 13 36	-22 00				434013

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10102	OLIFANTSFNTN-BN	9002	12 05	18 06 03.86	5 18 36	-32 46				434023
10103	OLIFANTSFNTN-BN	9002	12 05	18 07 31.10	5 58 48	-26 06				434023
10104	OLIFANTSFNTN-BN	9002	12 05	19 57 04.83	1 02 06	-48 00				434023
10105	OLIFANTSFNTN-BN	9002	12 05	19 58 58.47	4 18 00	-43 40				434023
10109	NAINI TAL-BN	9006	12 05	22 19 29.34	10 44 00	-31 29				434023
10107	NAINI TAL-BN	9006	12 05	22 19 37.34	10 47 48	-30 58				434023
10106	NAINI TAL-BN	9006	12 05	22 19 45.34	10 51 42	-30 27				434023
10110	NAINI TAL-BN	9006	12 06	0 16 35.24	12 33 18	- 2 11				434013
10111	NAINI TAL-BN	9006	12 06	0 16 39.24	12 36 24	- 1 57				434013
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10124	VILLA DOLORES-BN	9011	12 06	1 16 10.56	23 26 18	-16 12				434013
10125	VILLA DOLORES-BN	9011	12 06	1 17 54.33	1 53 30	-20 20				434013
10126	VILLA DOLORES-BN	9011	12 06	1 22 03.08	5 51 54	- 9 34				434013
10113	JUPITER-BN	9010	12 06	9 06 34.01	10 42 54	-25 39				434023
10118	ORGAN PASS-BN	9001	12 06	10 55 20.68	10 55 24	-28 38				434023
10119	ORGAN PASS-BN	9001	12 06	10 56 00.68	11 14 54	-26 11				434023
10114	JUPITER-BN	9010	12 06	11 02 09.74	11 16 12	4 28				434013
10140	WOOMERA-BN	9003	12 06	12 05 48.54	2 31 30	-23 42				434023
10141	WOOMERA-BN	9003	12 06	12 07 36.62	4 41 42	-17 03				434013
10121	ORGAN PASS-BN	9001	12 06	12 49 54.19	11 01 42	-11 33				434013
10122	ORGAN PASS-BN	9001	12 06	12 50 48.84	11 44 12	- 8 19				434013
10123	ORGAN PASS-BN	9001	12 06	12 51 52.53	12 34 00	- 4 33				434013
10165	NAINI TAL-BN	9006	12 06	23 32 50.20	10 36 54	-14 05				434013
10166	NAINI TAL-BN	9006	12 06	23 32 58.20	10 42 42	-13 35				434013
10167	NAINI TAL-BN	9006	12 06	23 33 10.20	10 51 12	-12 44				434013
10148	VILLA DOLORES-BN	9011	12 07	0 34 13.43	22 04 12	-10 13				434013
10149	VILLA DOLORES-BN	9011	12 07	0 36 05.55	0 37 42	-18 06				434013
10150	VILLA DOLORES-BN	9011	12 07	0 38 22.24	3 53 42	-16 00				434013
10146	SHIRAZ-BN	9008	12 07	1 20 28.37	10 30 00	-14 47				434013
10151	VILLA DOLORES-BN	9011	12 07	2 29 48.60	0 49 12	-12 08				434013
10152	VILLA DOLORES-BN	9011	12 07	2 30 04.60	1 07 12	-11 54				434013
10153	VILLA DOLORES-BN	9011	12 07	2 30 52.81	2 04 12	-10 32				434013
10130	WOOMERA-BN	9003	12 07	11 23 51.25	1 04 12	-24 28				434023
10131	WOOMERA-BN	9003	12 07	11 25 45.83	3 54 48	-19 37				434013
10132	WOOMERA-BN	9003	12 07	11 28 08.33	5 39 42	-10 25				434013
10133	WOOMERA-BN	9003	12 07	13 16 14.01	23 52 24	-11 54				434013
10134	WOOMERA-BN	9003	12 07	13 16 34.01	0 09 54	-11 48				434013
10185	TOKYO-BN	9005	12 07	19 18 38.10	11 03 48	-19 23				434013
10186	TOKYO-BN	9005	12 07	19 19 02.10	11 18 06	-18 05				434013
10145	SHIRAZ-BN	9008	12 08	0 38 00.94	9 43 30	-20 43				434013
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10155	VILLA DOLORES-BN	9011	12 08	1 49 39.28	1 48 12	-12 22				434013
10156	VILLA DOLORES-BN	9011	12 08	1 51 14.75	3 50 00	- 7 01				434013
10163	JUPITER-BN	9010	12 08	9 39 14.46	10 58 12	- 2 22				434013
10135	WOOMERA-BN	9003	12 08	10 43 13.82	1 46 30	-23 32				434023
10136	WOOMERA-BN	9003	12 08	10 44 53.37	4 01 24	-17 36				434013
10137	WOOMERA-BN	9003	12 08	10 46 26.01	5 07 06	-11 54				434013
10127	ORGAN PASS-BN	9001	12 08	11 25 38.96	9 47 54	-19 50				434013
10128	ORGAN PASS-BN	9001	12 08	11 25 54.96	9 57 54	-18 56				434013
10129	ORGAN PASS-BN	9001	12 08	11 26 42.96	10 28 42	-16 08				434013
10138	WOOMERA-BN	9003	12 08	12 36 15.36	0 36 48	-13 07				434013
10139	WOOMERA-BN	9003	12 08	12 37 32.02	2 16 54	-10 02				434013
10157	MAUI-BN	9012	12 08	13 08 39.18	10 49 36	- 9 28				434013
10158	MAUI-BN	9012	12 08	13 09 26.85	11 12 36	- 5 47				434013
10159	MAUI-BN	9012	12 08	13 10 25.73	11 38 48	- 1 47				434013
10160	MAUI-BN	9012	12 08	15 01 34.33	9 10 24	16 47				434013
10161	MAUI-BN	9012	12 08	15 01 46.33	9 20 48	18 00				434013
10162	MAUI-BN	9012	12 08	15 02 35.88	10 05 42	22 40				434013
10142	TOKYO-BN	9005	12 08	18 37 02.00	10 43 42	-20 49				434013
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10144	TOKYO-BN	9005	12 08	18 38 28.60	11 30 12	-16 02				434013
10187	TOKYO-BN	9005	12 08	20 32 09.60	11 30 36	- 3 19				434013
10188	TOKYO-BN	9005	12 08	20 32 33.60	11 50 06	- 2 23				434013
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10168	SHIRAZ-BN	9008	12 08	23 56 28.63	9 34 42	-23 00				434023
10169	VILLA DOLORES-BN	9011	12 09	1 07 49.66	0 31 36	-14 46				434013
10170	VILLA DOLORES-BN	9011	12 09	1 08 21.46	1 21 30	-14 10				434013
10171	VILLA DOLORES-BN	9011	12 09	1 08 41.46	1 52 54	-13 23				434013
10180	JUPITER-BN	9010	12 09	8 56 17.73	9 49 48	-11 54				434013
10147	CURACAO-BN	9009	12 09	8 57 39.53	8 11 24	44 24				434013
10172	ORGAN PASS-BN	9001	12 09	10 45 03.84	10 11 12	-18 26				434013
10173	ORGAN PASS-BN	9001	12 09	10 45 11.84	10 15 48	-17 59				434013
10174	ORGAN PASS-BN	9001	12 09	10 45 27.84	10 25 24	-16 57				434013
10181	JUPITER-BN	9010	12 09	10 52 21.68	10 42 18	24 34				434013
10178	WOOMERA-BN	9003	12 09	11 56 12.33	1 52 00	-13 04				434013
10175	ORGAN PASS-BN	9001	12 09	12 40 39.27	11 01 36	6 05				434013
10176	ORGAN PASS-BN	9001	12 09	12 40 47.27	11 08 42	6 27				434013
10177	ORGAN PASS-BN	9001	12 09	12 41 03.27	11 22 42	7 11				434013
10182	MAUI-BN	9012	12 09	14 19 20.72	8 38 48	7 46				434013
10183	MAUI-BN	9012	12 09	14 20 27.84	9 33 42	14 09				434013
10184	MAUI-BN	9012	12 09	14 22 13.74	11 02 48	21 53				434013
10179	SAN FERNANDO-BN	9004	12 10	4 45 22.23	10 07 06	-14 58				434013
10190	JUPITER-CN	9010	12 10	10 10 29.61	10 16 42	19 25				434013
10191	OLIFANTSFNTN-BN	9002	12 10	18 27 08.88	3 54 12	-37 42				434023
10194	JUPITER-BN	9010	12 11	9 28 21.79	9 40 12	13 07				434013
10192	CURACAO-BN	9009	12 11	9 30 31.04	8 10 12	64 02				434013

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10193	WOOMERA-BN	9003	12 11	12 27 32.45	1 05 36	6 47				434013
10199	MAUI-BN	9012	12 11	14 52 24.51	9 02 06	41 31				434013
10196	SHIRAZ-BN	9008	12 12	1 42 50.73	10 06 42	23 40				434013
10210	SAN FERNANDO-BN	9004	12 12	5 18 00.21	11 40 48	2 19				434013
10197	JUPITER-BN	9010	12 12	8 50 43.32	12 22 42	18 15				434013
10198	JUPITER-BN	9010	12 12	10 42 35.38	10 26 00	37 40				434013
10195	WOOMERA-BN	9003	12 12	11 47 38.80	2 23 18	10 41				434013
10212	TOKYO-BN	9005	12 12	17 48 13.00	11 35 06	- 3 45				434013
10211	TOKYO-BN	9005	12 12	19 40 46.50	11 01 36	5 35				434013
10202	VILLA DOLORES-BN	9011	12 13	0 20 48.05	4 10 54	9 51				434013
10201	AREQUIPA-BN	9007	12 13	2 09 13.98	22 08 24	-46 12				434023
10203	VILLA DOLORES-BN	9011	12 13	2 09 48.63	23 23 36	11 41				434013
10200	ORGAN PASS-BN	9001	12 13	11 50 00.27	11 15 36	17 01				434013
10206	WOOMERA-BN	9003	12 13	12 57 14.55	23 28 30	13 39				434013
10229	MAUI-BN	9012	12 13	15 25 59.77	10 58 24	59 44				434013
10213	TOKYO-BN	9005	12 13	17 08 23.30	11 56 12	- 1 33				434013
10214	TOKYO-BN	9005	12 13	19 00 52.50	11 58 24	6 17				434013
10217	NAINI TAL-BN	9006	12 13	22 35 19.79	12 33 54	21 35				434013
10222	SHIRAZ-BN	9008	12 14	0 23 17.35	12 40 00	20 54				434013
10218	NAINI TAL-BN	9006	12 14	0 26 09.72	9 26 36	31 02				434013
10221	AREQUIPA-BN	9007	12 14	1 28 52.28	22 14 12	-57 18				434023
10228	VILLA DOLORES-BN	9011	12 14	1 29 15.37	23 14 12	13 08				434013
10223	SHIRAZ-BN	9008	12 14	2 14 04.43	9 39 48	30 30				434013
10207	WOOMERA-BN	9003	12 14	12 15 53.27	22 42 00	11 00				434013
10230	MAUI-BN	9012	12 14	14 45 31.31	12 19 18	54 43				434013
10215	TOKYO-BN	9005	12 14	18 20 10.20	12 08 12	5 47				434013
10205	OLIFANTSFNTN-BN	9002	12 14	19 27 41.77	22 45 18	1 15				434013
10216	TOKYO-BN	9005	12 14	20 11 55.90	10 44 00	10 11				434013
10224	SHIRAZ-BN	9008	12 14	23 42 56.71	12 53 18	17 57				434013
10219	NAINI TAL-BN	9006	12 14	23 47 01.95	11 52 00	32 29				434013
10225	SHIRAZ-BN	9008	12 15	1 34 11.93	11 13 54	32 12				434013
10227	CURACAO-BN	9009	12 15	8 42 03.45	12 32 42	69 55				434013
10233	ORGAN PASS-BN	9001	12 15	10 30 28.06	12 56 36	13 15				434013
10208	WOOMERA-BN	9003	12 15	11 34 44.19	21 59 48	8 49				434013
10209	WOOMERA-BN	9003	12 15	11 38 18.86	1 32 12	29 45				434013
10234	ORGAN PASS-BN	9001	12 15	12 21 55.43	21 37 12	21 17				434013
10231	MAUI-BN	9012	12 15	14 05 35.69	13 19 12	44 54				434013
10232	MAUI-BN	9012	12 15	15 56 45.63	9 22 54	60 09				434013
10236	TOKYO-BN	9005	12 15	17 39 51.80	12 21 30	5 24				434013
10245	OLIFANTSFNTN-BN	9002	12 15	18 49 34.27	1 42 12	18 33				434013
10237	TOKYO-BN	9005	12 15	19 33 00.90	12 34 54	8 47				434013
10220	NAINI TAL-BN	9006	12 15	23 06 45.99	12 45 12	28 02				434013
10226	SHIRAZ-BN	9008	12 16	0 54 23.49	12 37 24	27 35				434013
10247	WOOMERA-BN	9003	12 16	10 54 03.90	21 37 18	8 35				434013
10248	WOOMERA-BN	9003	12 16	10 59 28.62	3 38 18	32 55				434013
10235	ORGAN PASS-BN	9001	12 16	11 41 25.90	12 18 06	19 22				434013
10244	MAUI-BN	9012	12 16	15 17 10.63	12 20 18	58 49				434013
10246	OLIFANTSFNTN-BN	9002	12 16	18 10 05.06	3 38 00	22 02				434013
10238	TOKYO-BN	9005	12 16	18 52 01.00	12 35 36	8 27				434013
10239	TOKYO-BN	9005	12 16	20 40 50.80	8 53 24	7 51				434013
10240	NAINI TAL-BN	9006	12 16	22 26 46.27	13 19 48	22 32				434013
10242	SHIRAZ-BN	9008	12 17	0 13 47.13	12 55 00	23 48				434013
10241	NAINI TAL-BN	9006	12 17	0 18 08.80	11 17 48	29 46				434013
10243	SHIRAZ-BN	9008	12 17	2 05 47.64	11 10 06	28 40				434013
10255	CURACAO-BN	9009	12 17	9 13 44.21	12 28 54	73 13				434013
10249	ORGAN PASS-BN	9001	12 17	11 00 59.88	12 44 48	16 37				434013
10250	ORGAN PASS-BN	9001	12 17	12 52 38.56	10 47 54	15 57				434013
10256	MAUI-BN	9012	12 17	14 37 14.88	13 38 18	48 18				434013
10251	TOKYO-BN	9005	12 17	18 11 42.20	12 52 12	7 14				434013
10252	TOKYO-BN	9005	12 17	20 02 17.30	10 52 30	7 00				434013
10253	NAINI TAL-BN	9006	12 17	23 37 48.78	12 20 36	27 06				434013
10258	AREQUIPA-BN	9007	12 18	0 39 34.01	22 53 30	-42 28				434023
10259	VILLA DOLORES-BN	9011	12 18	0 40 53.92	0 09 30	36 45				434013
10254	SHIRAZ-BN	9008	12 18	1 25 41.45	12 24 54	25 30				434013
10257	ORGAN PASS-BN	9001	12 18	12 12 22.18	11 46 18	15 00				434013
10260	MAUI-BN	9012	12 18	13 55 38.84	13 18 18	46 24				434013
10261	MAUI-BN	9012	12 18	15 48 41.19	11 47 12	54 29				434013
10263	TOKYO-BN	9005	12 18	19 22 46.10	12 11 48	4 47				434013
10264	NAINI TAL-BN	9006	12 18	22 57 19.23	12 55 18	23 18				434013
10308	SHIRAZ-BN	9008	12 19	0 45 12.92	12 58 18	21 47				434013
10267	AREQUIPA-BN	9007	12 19	1 51 38.30	22 25 36	5 45				434013
10269	JUPITER-BN	9010	12 19	9 44 03.08	12 49 30	30 27				434013
10262	ORGAN PASS-BN	9001	12 19	11 31 55.99	12 25 24	13 09				434013
10270	MAUI-BN	9012	12 19	15 07 57.57	12 45 24	50 31				434013
10277	TOKYO-BN	9005	12 19	18 42 11.60	12 31 06	4 13				434013
10278	TOKYO-BN	9005	12 19	20 33 39.90	10 43 42	- 3 49				434013
10265	NAINI TAL-BN	9006	12 19	22 15 58.83	12 46 36	22 27				434013
10272	SHIRAZ-BN	9008	12 20	0 04 34.76	13 09 42	18 46				434013
10266	NAINI TAL-BN	9006	12 20	0 08 46.19	11 32 06	16 11				434013
10281	AREQUIPA-BN	9007	12 20	1 11 34.00	22 42 54	9 29				434013
10273	SHIRAZ-BN	9008	12 20	1 56 46.04	11 43 06	13 52				434013
10268	CURACAO-BN	9009	12 20	9 05 16.96	13 37 30	62 55				434013
10271	ORGAN PASS-BN	9001	12 20	12 43 11.17	10 58 24	2 43				434013

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10284	MAUI-BN	9012	12 20	14 27 46.62	13 36 18	41 16				434013
10288	TOKYO-BN	9005	12 20	18 01 50.90	12 46 30	3 13				434013
10289	TOKYO-BN	9005	12 20	19 53 22.00	11 25 00	- 4 43				434013
10279	NAINI TAL-BN	9006	12 20	23 28 32.89	12 29 00	13 26				434013
10282	SHIRAZ-BN	9008	12 21	1 16 27.51	12 33 12	11 31				434013
10283	CURACAO-BN	9009	12 21	8 24 16.68	13 50 30	57 52				434013
10274	ORGAN PASS-BN	9001	12 21	12 03 04.93	11 54 42	0 56				434013
10285	MAUI-BN	9012	12 21	13 47 34.08	13 53 12	33 08				434013
10286	MAUI-BN	9012	12 21	15 39 34.86	12 05 48	37 20				434013
10296	TOKYO-BN	9005	12 21	18 32 23.30	12 17 24	- 4 56				434013
10280	NAINI TAL-BN	9006	12 21	22 48 12.33	13 01 48	10 36				434013
10291	SHIRAZ-BN	9008	12 22	0 35 20.44	12 39 42	11 53				434013
10292	SHIRAZ-BN	9008	12 22	2 22 53.76	7 52 42	9 30				434013
10275	SAN FERNANDO-BN	9004	12 22	4 10 02.61	12 20 18	- 3 47				434013
10276	SAN FERNANDO-BN	9004	12 22	6 00 44.95	10 12 06	-11 51				434013
10301	JUPITER-BN	9010	12 22	9 34 29.24	12 38 24	17 32				434013
10287	ORGAN PASS-BN	9001	12 22	11 22 39.60	12 27 30	0 06				434013
10293	MAUI-BN	9012	12 22	14 59 16.52	13 06 48	31 20				434013
10297	TOKYO-BN	9005	12 22	20 23 45.50	10 28 36	-15 31				434013
10290	NAINI TAL-BN	9006	12 22	22 07 26.29	13 07 42	9 30				434013
10299	SHIRAZ-BN	9008	12 22	23 55 14.11	13 06 48	8 28				434013
10300	SHIRAZ-BN	9008	12 23	1 48 11.08	12 10 12	- 8 20				434013
10294	ORGAN PASS-BN	9001	12 23	10 42 13.65	12 47 12	- 0 33				434013
10295	ORGAN PASS-BN	9001	12 23	12 33 15.63	10 36 36	-12 00				434013
10303	TOKYO-BN	9005	12 23	19 43 15.20	10 54 54	-16 32				434013
10298	NAINI TAL-BN	9006	12 23	23 19 06.86	12 15 06	- 4 30				434013
10305	AREQUIPA-BN	9007	12 24	0 22 39.47	22 40 36	41 31				434013
10302	ORGAN PASS-BN	9001	12 24	11 53 28.97	11 36 42	-15 01				434013
10306	MAUI-BN	9012	12 24	13 37 50.79	13 33 18	23 30				434013
10307	MAUI-BN	9012	12 24	15 30 05.44	11 40 48	13 08				434013
10304	NAINI TAL-BN	9006	12 25	0 29 32.03	10 06 36	-16 48				434013
10309	CURACAO-BN	9009	12 26	8 47 45.72	13 26 24	27 38				434013

TABLE 3

Orbital Elements 1963 47 A

T (MJD)	ω	Ω	i	e	M	n	n'/2	q	N	D	σ
* 38361.5	119.63 5	156.648 6	30.363 2	.07643 4	.3725 2	13.3728 2	-.475E-2 4	6.922905	45	3	.91
* 38362.0	122.65 5	154.179 7	30.358 3	.07903 5	.0587 2	13.3676 2	-.434E-2 2	6.905191	52	3	1.57
* 38362.5	126.15 5	151.695 8	30.358 3	.08186 5	.7413 1	13.3631 2	-.438E-2 1	6.885533	52	3	1.63
* 38363.0	129.59 9	149.22 2	30.354 5	.0843 1	.4217 3	13.3553 4	-.335E-2 2	6.870193	50	3	2.85
* 38363.5	133.56 7	146.73 1	30.364 4	.08667 8	.0989 2	13.3551 3	-.190E-2 2	6.852181	43	3	1.80
* 38364.0	137.3 1	144.26 2	30.365 6	.0869 1	.7764 3	13.3542 3	-.90E-3 2	6.850579	45	3	2.78
* 38364.5	141.15 2	141.786 4	30.366 1	.08682 2	.45333 5	13.35395 5	-.22E-4 5	6.851445	51	3	.50
38365.0	145.11 1	139.308 3	30.3680 9	.08691 2	.13009 4	13.35408 3	-.5E-5 2	6.850769	62	4	.45
38366.0	152.83 1	134.354 3	30.3680 7	.08683 1	.48427 3	13.35405 3	.9E-5 2	6.851328	61	4	.34
38367.0	160.628 8	129.406 3	30.3691 6	.086739 8	.83822 2	13.35398 2	.8E-5 1	6.852072	70	4	.35
38368.0	168.43 1	124.454 3	30.3693 7	.08666 1	.19218 3	13.35397 3	.4E-5 2	6.852667	84	4	.48
38369.0	176.226 8	119.505 3	30.3700 6	.086580 8	.54618 3	13.35394 2	.1E-5 1	6.853277	90	4	.44
38370.0	184.035 6	114.557 2	30.3708 5	.086504 7	.90013 2	13.35399 2	.1E-5 1	6.853832	98	4	.39
38371.0	191.857 7	109.609 2	30.3715 5	.086447 9	.25405 2	13.35396 2	-.1E-5 1	6.854271	99	4	.41
38372.0	199.668 8	104.660 2	30.3718 5	.08639 1	.60799 3	13.35394 2	.3E-5 1	6.854737	78	4	.40
38373.0	207.486 8	99.712 2	30.3725 6	.08632 1	.96193 3	13.35394 2	.3E-5 2	6.855244	72	4	.41
38374.0	215.319 9	94.768 2	30.3747 7	.08626 1	.31582 3	13.35394 2	-.1E-6 9	6.855659	58	4	.43
38375.0	223.14 1	89.819 3	30.3765 8	.08620 2	.66975 3	13.35393 4	.4E-5 3	6.856127	40	4	.42
38376.0	230.974 8	84.874 3	30.3782 7	.08616 2	.02365 3	13.35392 2	.1E-5 1	6.856408	50	4	.38
38377.0	238.805 7	79.926 3	30.3784 6	.08613 1	.37755 2	13.35392 2	.5E-5 1	6.856667	51	4	.35
38378.0	246.641 6	74.978 3	30.3785 6	.08611 1	.73145 2	13.35395 2	.12E-4 1	6.856770	45	4	.28
38379.0	254.475 7	70.025 4	30.3788 6	.08607 1	.08539 2	13.35396 2	.9E-5 1	6.857110	51	4	.28
38380.0	262.301 7	65.080 3	30.3780 6	.08603 2	.43935 2	13.35395 2	.4E-5 1	6.857398	40	4	.25
38381.0	270.146 8	60.131 4	30.3780 8	.08602 2	.79328 2	13.35389 2	-.1E-5 1	6.857480	32	4	.30
38382.0	277.94 6	55.182 7	30.379 1	.08604 4	.1474 2	13.3541 2	.7E-5 2	6.857293	33	4	.40
38383.0	285.84 1	50.23 1	30.380 2	.08603 4	.50113 4	13.35399 5	.15E-4 3	6.857382	31	4	.51
38384.0	293.67 1	45.281 8	30.379 2	.08605 4	.85513 4	13.35406 5	.4E-5 4	6.857190	33	4	.47
38385.0	301.7 2	40.32 1	30.382 4	.08607 5	.2084 7	13.3533 7	.6E-5 3	6.857338	30	4	.45
38386.0	309.36 1	35.37 1	30.383 4	.08610 5	.56309 4	13.35396 3	.3E-5 3	6.856911	27	4	.44
38387.0	317.20 2	30.44 2	30.378 8	.08618 5	.91704 4	13.3545 7	.7E-5 3	6.856140	21	4	.42
38388.0	325.7 4	25.43 2	30.41 1	.0863 1	.269 1	13.352 1	.3E-5 5	6.855727	14	4	.39

*A cubic term was used in the mean anomaly equation.

TABLE 4

Orbital Elements 1963 47 B

T (MJD)	ω	Ω	i	e	M	n	n'/2	q	N	D	σ
38362.0	124.85 3	153.345 3	30.012 1	.06951 3	.03774 9	13.3526 1	.45E-4 5	6.981827	34	4	.52
38363.0	132.69 3	148.402 5	30.012 1	.06957 4	.3901 1	13.35243 9	.21E-4 3	6.981427	34	4	.43
38364.0	140.48 3	143.462 4	30.014 1	.06943 3	.74270 8	13.35253 5	.22E-4 3	6.982405	30	4	.44
38365.0	148.29 3	138.522 5	30.014 1	.06937 2	.09526 9	13.35263 7	.13E-4 3	6.982856	28	4	.47
38366.0	156.08 2	133.581 3	30.0160 7	.069283 9	.44791 4	13.35268 4	.13E-4 2	6.983477	38	4	.35
38367.0	163.88 1	128.642 3	30.0166 8	.06921 1	.80055 4	13.35265 4	.14E-4 2	6.984000	45	4	.42
38368.0	171.68 1	123.703 3	30.0168 7	.069134 9	.15321 4	13.35258 4	.13E-4 2	6.984632	53	4	.42
38369.0	179.52 1	118.766 3	30.0171 6	.069062 9	.50578 4	13.35255 3	.14E-4 2	6.985178	60	4	.43
38370.0	187.38 1	113.831 3	30.0177 6	.069008 9	.85833 3	13.35258 3	.12E-4 1	6.985581	61	4	.41
38371.0	195.24 1	108.890 3	30.0190 6	.06895 1	.21091 4	13.35257 3	.12E-4 2	6.986050	69	4	.45
38372.0	203.10 2	103.950 3	30.0191 6	.06888 2	.56350 5	13.35262 4	.10E-4 1	6.986507	54	4	.46
38373.0	210.94 2	99.014 3	30.0201 7	.06879 2	.91618 6	13.35269 5	.9E-5 2	6.987194	45	4	.45
38374.0	218.80 2	94.076 4	30.0209 8	.06873 3	.26881 7	13.35265 6	.8E-5 2	6.987633	27	4	.41
38375.0	226.65 2	89.140 4	30.0216 9	.06868 2	.62148 6	13.35256 6	.10E-4 2	6.988077	20	4	.34
38376.0	234.56 2	84.200 5	30.024 1	.06868 3	.97399 6	13.35262 5	.5E-5 2	6.988052	29	4	.45
38377.0	242.43 1	79.264 4	30.0238 7	.06865 2	.32663 4	13.35262 4	.11E-4 2	6.988263	33	4	.34
38378.0	250.33 1	74.326 4	30.0247 8	.06864 2	.67924 3	13.35264 2	.8E-5 2	6.988321	36	4	.34
38379.0	258.22 1	69.388 4	30.0261 8	.06860 2	.03187 4	13.35262 3	.4E-5 2	6.988602	38	4	.36
38380.0	266.09 1	64.447 4	30.0266 8	.06859 2	.38457 3	13.35269 3	.12E-4 2	6.988654	37	4	.34
38381.0	273.98 1	59.502 6	30.028 1	.06860 3	.73726 4	13.35272 4	.10E-4 2	6.988631	33	4	.37
38382.0	281.88 1	54.563 6	30.029 1	.06861 3	.08993 3	13.35268 3	.6E-5 2	6.988544	35	4	.38
38383.0	289.77 2	49.619 6	30.029 2	.06861 3	.44262 5	13.35271 4	.7E-5 2	6.988510	31	4	.39
38384.0	297.6 4	44.69 2	30.026 5	.06863 6	.796 1	13.3531 9	.15E-4 4	6.988274	31	4	.49
38385.0	305.5 3	39.77 2	30.023 5	.06860 5	.148 1	13.3529 5	.10E-4 3	6.988502	30	4	.51
38386.0	313.6 2	34.83 2	30.021 9	.06866 7	.5004 7	13.3533 7	-.3E-5 5	6.987913	25	4	.59
38387.0	321.26 3	29.90 2	30.02 1	.06875 8	.85371 8	13.353 1	.7E-5 9	6.987289	20	4	.65
38388.0	329.2 7	24.93 4	30.04 2	.0688 2	.206 2	13.353 2	.12E-4 9	6.987119	11	4	.73