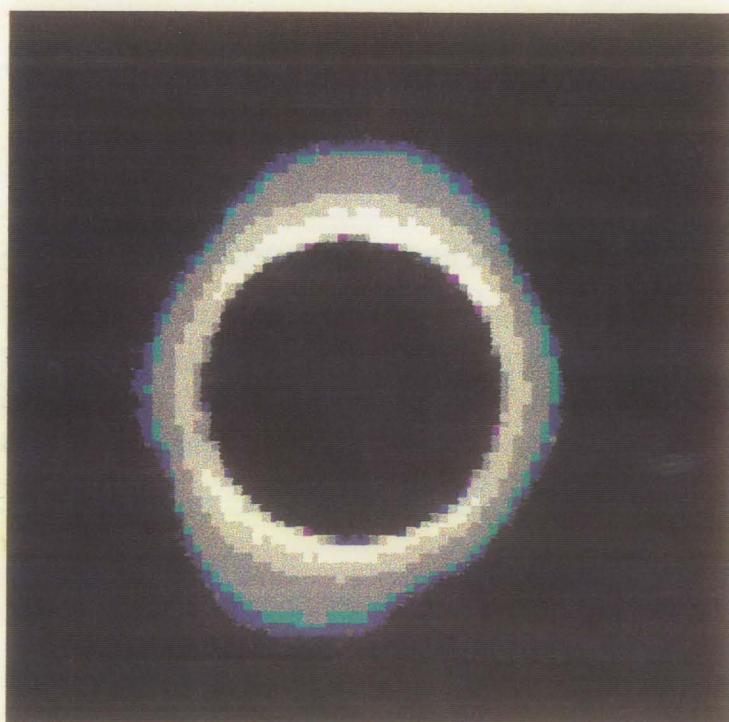


Amateur Astronomers' Association (Bombay)

C/o. Physics Dept. St.Xavier's College, Mahapalika Marg, Bombay - 400 001.

TOTAL SOLAR ECLIPSE

24th October, 1995



**Report of
Eastern site
BARKAKANA (Bihar)**

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Inner Corona photograph
during TSE 24th Oct., 95 on
1000mm - C90 set up

Introduction :

While India still reverberated with the sounds of fire crackers and the post deepavali haze hung on the morning of October 24th, the Sun was eclipsed by the Moon. It took years of planning and preparation for an event of few seconds. Apart from the scientists, it was a grand celestial festival for the people in India, it was the event for any one who has slightest love for the nature.

The Amateur Astronomers' Association (Bombay) was planning the visit of its members to the observation site on central line of the eclipse for two different sites one in Eastern India and another in Western India. In the preliminary study for the sites in Eastern India, three regions were chosen for site survey viz. Purulia (West Bengal), Daltenganj (Bihar) and Allahabad (U.P.). Two of the association members - Mr. Ajay Talwar and Mr. Nilesh Vayada were deputed to carry out site survey. The survey was co-ordinated by association's Vice President Prof. J.B. Mistry from Bombay.

An eleven day site survey visit was undertaken starting from 18th June, 1995. The visit was planned for three sites - Purulia (W.B.), Daltenganj (Bihar) and Allahabad (U.P.). The second place, Daltengaj could not be surveyed due to non availability of detailed maps of the region. However, two other places Barkakana and Patratu in the same region were surveyed. The survey was undertaken with the view of :-

- i) **To find suitable site on the central line for scientific experiments and general observation.**
- ii) **To find suitable lodging and boarding facilities for a group of 50 people.**
- iii) **Making arrangements for local transport, to and fro from base to observation site.**

Based on the report, recommendations and comparative ratings, on the above matters for the three sites **Barkakana was chosen as the Eastern site** for the eclipse expedition of the Association.

Following is the report of the various projects undertaken during expedition at Barkakana, the eastern site of the Total Solar Eclipse 1995 expedition of Amateur Astronomers' Association (Bombay).

Expedition Members :

1. Ajay Talwar
2. Manogna Desai
3. Neelam Talwar
4. Nilesh Vayada
5. R. K. P. Sinha
6. S. Raghu
7. Samir Gandhi
8. Satish Nagarajan
9. Shankar Laxmanan
10. Subhada S. Pandya
11. Swapnil Desai
12. Uma Kannan
13. V. Kannan
14. V. Suresh

LOCAL CIRCUMSTANCES FOR THE SITE

BARKAKANA (SITE)

Latitude : 23°37' 07" N
Longitude : 85° 27'29" E
Height : 340 Metres

	LOCAL TIME (IST)	Sun's Alt.	P.A. of Moon's Center North	Zenith
Partial Eclipse Begins :	07:29:35.4	21° 02'	294° 42'	353° 32'
Total Eclipse Begins :	08:44:12.7	35° 53'	280° 29'	329° 39'
Maximum Eclipse :	08:44:47.8	36° 00'	025° 52'	074° 55'
Total Eclipse Ends :	08:45:23.0	36° 06'	131° 11'	180° 09'
Partial Eclipse Ends :	10:10:32.2	49° 30'	116° 38'	146° 01'

Duration of Totality : 1m 10s
Magnitude of Eclipse : 1.00542 Ratio of Moon / Sun : 1.0147
Sun Rise on 24th October 1995: 05:49 IST; Sun Azimuth : 102°

THE INDIAN TOTAL SOLAR ECLIPSE

Nightfall on a Sunny Morning

The morning of 21st October was one of suppressed excitement. After a refreshing cup of tea, 14 members of **Amateur Astronomers' Association Bombay (AAA)** started for DAV Public school at Barkakana, Bihar. The heavy equipment was transported and set up at the site (School terrace). With the precision of a military drill, the members started firing away at their respective photographic setups, cameras. The villagers would see the same routine repeat for the next 3 days.

To photograph the entire sequence of the eclipse one old Box camera and a twin lens reflex were mounted and bolted facing the direction of the Sun (114° Azimuth, 36° Altitude). To photograph the stars and planets that appear during the totality two cameras (50mm f.l.) with different films were similarly mounted. These setups were manned by **Neelam Talwar** and **Shanker Laxmanan**.

When one thinks of a Total Solar Eclipse, one invariably imagines the brilliant Diamond ring and the silky smooth Corona. To capture these on film has always been the driving force for the young astrophotographer. Apart from their aesthetic appeal they can also be of a great scientific value. To shoot these sights, two SLR cameras with varying focal lengths were mounted. **Nilesh Vayada** and **Satish Nagarajan** manned the 600mm Cosina mounted equatorially. To get a closeup and prominences **Ajay Talwar** and **Shanker** manned the 1000mm Celestron 90 with a Pentax body.

As proposed by Dr. J.J.Rawal of Nehru Planetarium, Bombay the Sun has Saturn like rings, which could possibly emit Infra Red radiation. It was attempted to photograph this proposed ring, with an Infra red film through a 105mm Pentax camera. The exposures were taken only during totality. The setup was manned by **Samir Gandhi**.

Three more cameras were manned by **Manogna Desai**, **Swapnil** and **Prof. Sinha**. These consisted of an Agfa Isoly (120 format, 100ASA film), Canon 100mm (3200 ASA film) and Zenith-E (100ASA film). These cameras took a few exposures during totality.

Since arrangements had to be made for about 300 school children to witness the eclipse, a 90mm telescope was used to project the Sun's image on a white screen. To answer the student's queries and also to manage the group, **Mr. & Mrs. Kannan** and **Swapnil** took up positions around this telescope. The whole set up was controlled under the supervision of **Dr.(Mrs.) Pandya**.

On arrival at Barkakana, there was some cause for alarm since it had been drizzling throughout the journey as well as at the site. After making a few trips to the local Meteorological offices, it was confirmed that the sky would clear up by 23rd. The rehearsals on the previous two days were however not hampered. Also since the timing of the eclipse synchronised with the Diwali festival, the mood was generally jubilant. The villagers were also in a festive mood and equally enthusiastic about the forthcoming event.

Due to the annual sports event, school children from the entire Ranchi Zone had gathered at D.A.V. Barkakana. The school principal took this opportunity to popularise A.A.A. (Bombay)

and the eclipse. This was done through regular announcements during the sports events. A slide show was also organised on the school grounds. **Dr.(Mrs.)Pandya**, the Vice President of the Association, was requested to award medals to the winners.

The morning of 24th October saw eager anticipation and a quite confidence on everybody's face. As everyone fell into position at their respective places, one could feel as if each was part of an orchestra. Announcements were made to the public on the often repeated cautions of safe methods of watching an eclipse. Solar filters were distributed free to all present. **On the dot of 7:29...** the first cut in the solar disk became visible through C90. **The ECLIPSE HAD BEGUN!** A cheer went up amongst the crowd and students clapped enthusiastically. Steadily, the exposures planned began on all the cameras.

Most student spectators started shooting queries which were answered promptly. As the eclipse advanced, and the Sun was visible as a crescent, one could see the hundreds of crescent images of the Sun on the ground. This, as a result of the fact that tiny spaces between thousands of leaves act as a pinpoint sources of light. These were photographed at various shutter speeds in rapid succession. About ten minutes before totality, the sunlight felt distinctly eerie; any unknown passerby would have guessed that this was no ominous cloud obstructing the Sun. The mercury dropped appreciably. Some members started feeling the same chill that existed before dawn.

The sight of thinning crescent pumped up the adrenalin. The moment of beauty was fast approaching! The first appearance of Baily's beads sent mummers from the spectators. The last big bead was guaranteed to attract everybody's gaze (except those die-hard astrophotographers who were busily shooting on their cameras). The cricket 'whistle' which had started some time before intensified as their diurnal rhythm were disturbed. The flocks of birds which had been flying in circle around the tall trees settled & the bats started making patterns in the sky. The much awaited shadow bands made their appearance in rapidity. They were quite contrasty & visible prominently and did not frighten anybody (as was made out in some texts).

AND THEN IT HAPPENED ! The NIGHT FELL ABRUPTLY as the Sun was hidden to view. Filters had been already removed. Apart from the incessant clicking of the cameras, cheer went up again as everyone exclaimed loudly at the marvelous sight which beheld them! A milky white corona glowed around the Moon's disk. As the eyes got used to the sight, one could make out more detail. The two spikes of the outer corona were clearly visible. Shutters and winding mechanisms were the only sounds one could hear for some seconds.

WAS IT ETERNITY ? OR A FLEETING GLIMPSE ? of the mighty forces that had aligned to make this sight possible. It was a moment of achievement, of one's insignificance in the order of the Universe... and as thousands of thoughts raced past one's mind, those sights frozen in the memory forever, one could only feel the urge of preparing for similar destiny at another times... in another place... to relive those few moments again!

A DAZZLING LIGHT Broke from the point of third contact. The beautiful and famed **DIAMOND RING !** The spectacle is not yet over. There is more to see, and to gaze at... and revel in its memories for posterity!

Sequence of the whole Eclipse on one frame

Camera - 135 mm f.l. Box Camera (Normal Lens)
Film format - 80 X 105 mm
Film - ORWO pan 100 ASA B&W
Tripod - Improvised stand
Cable - Standard
Battery - Not required
Operated by - Neelam Talwar & Shanker Laxmanan

Image scale = $135 / F$ min / mm (F in inches)
= $135 / 5.3$
= 25.5 min / mm

F.O.V. = $(25.5 \times 80) \times (25.5 \times 105)$
= 2040' X 2677'
= $34^\circ \times 45^\circ$

Sun's image = 1.2 mm on film

Diagonal of film = 54° (more than 3 hours of Solar motion)

Exposure according to tests

'B' Value (with filter) 80

Aperture ~ 9

Shutter speed 1 / 100

(filter made with B&W film on 100 ASA ORWO film)

Exposures after every 5 minutes for the whole duration of the eclipse.

The camera was aligned to the path of the Sun one day prior to the eclipse. The improvised tripod was checked two day prior to the eclipse, to align it correctly.

	1st contact	mid eclipse	4th contact
Altitude	24°	39°	52°
Azimuth	112°	126°	153°
Altitude range =	28°		
Azimuth range =	41°		

Result : Successful. An excellent photograph of whole sequence is obtained.

As the camera was not clicked during totality, a photo of Diamond ring was superimposed later to complete the picture.

Stars, Planets and Outermost Corona during totality

(Two Setups)

Cameras	-	Yashika Electro-35, 2 nos
Focal length	-	45 mm
Film format	-	35 mm
Films	-	Fujicolor 1600 ASA Ektachrome 400ASA
Tripod	-	Common improvised tripod for both camers
Cables	-	Standard
Battery	-	Yashika 5.6 volts
Operated by	-	Neelam Talwar

$$\begin{aligned}\text{Image scale} &= 135 / F \text{ min/mm (F in inches)} \\ &= 135 / 1.77 \\ &= 76.3 \text{ min / mm}\end{aligned}$$

$$\begin{aligned}\text{F.O.V.} &= (76.3 \times 24) \times (76.3 \times 36) \\ &= 1831' \times 2747' \\ &= 31^\circ \times 46^\circ\end{aligned}$$

$$\text{Sun's image} = 0.41 \text{ mm on film}$$

Exposure

$$\begin{aligned}\text{Aperture} &= f / 1.7 \\ \text{Shutter speed} &= 'B'\end{aligned}$$

The exposures for both the cameras started as soon as the Baily's Beads appeared and terminated when they reappeared after the eclipse.

Result : Partial success.

One set up failed as the film was overexposed. This was comparatively short eclipse & was quite bright.

The reason for failure was that the exposure began when Baily's Beads appeared, it should have been exposed during totality only

Baily's Beads and Diamond Ring & Partial phases

Telescope	-	C-90, 1000mm
Camera body-		ME-Super
Film format	-	35mm
Film (Totality)	-	Ektachrome Professional 400ASA, Slide film
Film for	-	Kodak Gold 400ASA, colour film
(Partial Phases)	-	Kodak Gold 100ASA, colour film
Tripod	-	Home made Dobsonian Mounting
Cable	-	Standard
Battery	-	LX-44 (Maxell) 2 nos
Operated by	-	Ajay Talwar & Shanker Laxmanan

$$\begin{aligned}\text{Image scale} &= 135 / F \text{ min/mm (F in inches)} \\ &= 135 / 39 \\ &= 3.46 \text{ min/mm}\end{aligned}$$

$$\begin{aligned}\text{F.O.V.} &= (3.46 \times 36) \times (3.46 \times 24) \\ &= 124.6' \times 83.1' \\ &= 2.08^\circ \times 1.38^\circ\end{aligned}$$

$$\text{Sun's image} = 9.09 \text{ mm on film}$$

Exposure

$$\begin{aligned}\text{Aperture} &= f / 11 \\ \text{'B' Value} &= 65 \\ \text{Film Speed} &= 400 \text{ ASA}\end{aligned}$$

$$\begin{aligned}\text{Estimated Exposure} &= f^2 / (B \times A) \\ &= 121 / (65 \times 400) \\ &\sim 1 / 250\end{aligned}$$

From the first contact to second contact & from third contact to fourth contact exposures were taken every 4 minutes. The film was changed five minutes before and immediately after totality. At the start of the totality the time of appearance of Baily's Beads and Diamond Ring are very uncertain, hence about 5 exposures, bracketed two stops on either side of the estimated exposure were shot. A 400 ASA film is being used as the f/ ratio of the lens is slow (fixed at f/11) and moreover Ektachrome Professional 400 ASA is a proven fine grain film from Kodak.

Result : First set of partial phase failed due to film winding problem.
Second set of partial phase successful.
Accurately obtain fourth contact time.
During totality - 38 exposures were shot 35 frames have resulted in good photographs.

Inner & Outer Corona and partial phase

Camera body	-	Cosina Body
Lens	-	300mm with 2X converter effective f.l. 600mm
Film format	-	35mm
Film (Totality)	-	Kodak Gold 400ASA
Film for	-	Ektachrome Professional 400ASA, Slide film
(Partial phases)	-	Kodak Gold 100ASA, colour film
Filter diameter	-	55mm
Mounting	-	Equatorial with manual tracking
Cable	-	Standard
Battery	-	LX - 44
Operated by	-	Nilesh Vayada & Satish Nagarajan

$$\begin{aligned}
 \text{Image scale} &= 135 / F \text{ min/mm (F in inches)} \\
 &= 135 / 23.6 \\
 &= 5.72 \text{ min / mm}
 \end{aligned}$$

$$\begin{aligned}
 \text{F.O.V.} &= (5.72 \times 24) \times (5.72 \times 36) \\
 &= 137.3' \times 205.9' \\
 &= 2.29^\circ \times 3.43^\circ
 \end{aligned}$$

$$\text{Sun's image} = 5.45 \text{ mm on film}$$

Exposure

$$\begin{aligned}
 \text{Aperture} &= f / 8 \\
 \text{'B' Value} &= 1 \\
 \text{Film Speed} &= 400 \text{ ASA} \\
 \text{Estimated Exposure} &= f^2 / (B \times A) \\
 &= 64 / (1 \times 400) \\
 &\sim 1 / 4
 \end{aligned}$$

Exposure

$$\begin{aligned}
 \text{Aperture} &= f / 11 \\
 \text{'B' Value} &= 65 \\
 \text{Film Speed} &= 400 \text{ ASA} \\
 \text{Estimated Exposure} &= f^2 / (B \times A) \\
 &= 121 / (65 \times 400) \\
 &\sim 1 / 250
 \end{aligned}$$

From the first contact to second contact & from third contact to fourth contact exposure were taken every 2 minutes.

The film was changed five minutes before totality.

Bracketed three stops on either side of the estimated exposure.

Result : Successful. Corona extending to 5 solar radii recorded

Infrared photography

Camera body- ME Super
Lens - 105
Film format - 35mm
Film - Kodak Infrared 80 ASA
Filter diameter- 72 mm
Cable - Standard
Battery - LX - 44
Filter - Kodak Wratten No. 90
Operated by - Samir Gandhi

Image scale = $135 / F$ min/mm (F in inches)
= $135 / 4.13$
= 32.69 min / mm

F.O.V. = $(32.69 \times 24) \times (32.69 \times 36)$
= $784.5' \times 1176.75'$
= $13.75^\circ \times 19.61^\circ$

Sun's image = 0.955 mm on film

Exposure : Varied exposures were given to capture most of the event.

Result : Partial success.

Other Setups:

Camera	Format	Film	Operated by
Agfa Isoly-I,	120mm	Kodak Gold 100 ASA	Manognya Desai
Cannon auto	35mm	Konica 3200ASA	Swapnil Desai
Cannon SLR	35mm	Kodak Gold 100ASA	R.K.P.Sinha
Kodak Kroma	35mm	Kodak Gold 100ASA	Shanker Laxmanan
Yasika Auto	35mm	Konica 100ASA	V.Kannan

Varied exposures were given on these setups.
Most of the photographs were taken during totality.

Shadow Bands

To photograph the shadow bands, white bed sheets were put on the floor. Camera used was Premier automatic with Kodak Gold 100 ASA film.
Operated by : **Neelam Talwar**

Result : The Shadow Bands were distinct while observing but not recorded on the film due to low light contrast.

General setup and curio photographs

Various curio photographs like partial eclipse on the ground through the tree, People observing the eclipse, Setups etc. were taken during the eclipse.

Operated by : **Neelam Talwar**

Sketching the Eclipse:

From the first contact to fourth contact, the whole sequence was sketched in 32 parts.

Successfully noted the time gap between first baily's bead & diamond ring.

The Baily's beads lasted for 1m25s!

Sketched by : **Neelam Talwar**

Video Recording of the Eclipse :

An arrangement with local video grapher was made prior to the eclipse day to record the entire event. The video grapher didn't turnup due to eclipse fear. However many team members were interviewed by the UGC team of television.

POPULARISATION :

Projection of Sun's image :

A 90mm newtonian alt-azimuth mounted telescope was used to project the Sun's image. The image was projected on the white screen (the screen used for slides shows). To observe the Sun through eyepiece (16mm), a glass solar filter was also kept at front end

About 300 school children and equal number of local people took advantage of this setup to witness the eclipse. The setup was managed by **Mr. & Mrs. Kannan and Swapnil Desai**.

Naked eye observation :

About 300 solar goggles were distributed to observe the eclipse with naked eye. Continuous announcements by **Manognya Desai** were made on how to observe the eclipse, precautions, series of events during eclipse & other related matters.

Both the above setups were controlled under the supervision of **Dr.(Mrs.) Pandya**.

Programmes prior to the Eclipse :

A talk on Ranchi Radio and an article in Ranchi Times on eclipse was given by **Manognya Desai**.

Two days prior to the eclipse a slide show & a talk at DAVP School was organised for school students and general public.

An exhibition of posters in English & Hindi on the eclipse were put-up at various places at the school.

The local press had given publicity to the group as "Scientists from Bombay", there was a continuous flow of people at school and at base camp for information & guidance.

Schedule of the Expedition Activities

Date	Activities
21 Oct. '95	<ul style="list-style-type: none">□ Talk on Eclipse by Manognya Desai broadcasted on Ranchi Radio.□ Mrs. Pandya gives away the prizes to winners of annual sports at the school.□ Slide show & general talk on astronomy for school students & public. Information on how to watch the eclipse & its circumstances.
22 Oct. '95	<ul style="list-style-type: none">□ Site set ups, checking of equipment & rehearsals.□ Visit to Ranchi Meteorological office for weather data□ Interaction with local people.
23 Oct. '95	<ul style="list-style-type: none">□ Final rehearsal.□ Diwali celebration
24 Oct. '95	<ul style="list-style-type: none">□ Total Solar Eclipse.□ Equipment pack up.

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- ❑ **Teachers & other staff members of D.A.V. Barkakana, Barkakana, Bihar 829 103 for help & co-operation,**
- ❑ **Director Central Coalfield Ltd. Barkakana, Bihar 829 103 for allowing to use school infrastructures,**
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