THE SOLAR FLARE EFFECT AT ALIBAG ON JUNE 13th. 1951

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The magnetic Observatory at Alibag (18° 38′ *N*, 72° 52′ *E*, 18 mile *SSE* of Colaba, Bombay) is situated at a low magnetic latitude (9°.5 *N*). The variometers are usually run on a time scale of 15 mm/hr. Though the broad features of a magnetic phenomenon are recorded, the detailed profile during such periods can only be obtained when an open time scale is used. For the last few years, on special occasions, the instruments have been run at 180 mm/hr.

It may just be possible to anticipate and put the quick-run in action for magnetic storms and be fortunate in obtaining detailed records of the same. Among the few phenomena that can hardly be anticipated at present is the solar flare effect or the 'Crochets'. Any such recording of the solar flare would be accidental. While the magnetic recorders had been on quick-run, on June 13th. 1951, a remarkable record was obtained. The solar flare effect commenced on the record at Alibag at 0546 GMT and the effect was over after about 140 minutes. Solar flares were visually recorded at Kanzelhöhe, Meudon, Zürich, Saltsjöbaden and Herstmonceux about that time of the day. The particular observations corresponding to the crochet are:

TABLE

Station	Time GMT	Importance	Number of Active Region of Quarter
Saltsjöbaden	0612	3	26
Kanzelhöhe	0641-0905	3	26
	0641-0700	1 —	24
Meudon	0710-0725	2 —	26
Zürich	0713-1000	2	26
Ondrejov	0756-0801	?	26
	0759-0948	?	23
	0900-0906	1	24
Herstmonceux	0910-0925	1	26

Canberra reported flare, radio fade-out and ionospheric disturbance from 0550 GMT for 31 minutes on a large number of bands (60, 62, 73, 100, 1200 and 3750 Mc/s). Tokyo had ionospheric disturbance from 0635 GMT for 100 minutes. (All the data above are from Quart. Bull. Solar Activity. N. 94. 1951. Zurich).

In a letter, the All India Radio has said that as observed at Todapur (Delhi), there was complete radio fadeout of short and medium wave bands between 0550 and 0730 GMT and that conditions started improving at 0840 GMT and became normal at 0850 GMT.

From data of CRPL bulletins of the National Bureau of Standards, Washington (U.S.A.) the following table has been constructed.

TABLE

Receiving Station	Time GMT	Location of Transmitters
Hongkong (China)	0555-0725	China, England, Formosa, French Indo-China, Japan, Malay States, Philippine Ids., Thailand.
Colombo (Ceylon)	0555-0800	China, England, India, Japan.
Lindau (Harz-Germany)	0550-1100	Munich, Lindau (pulse trasmitter and receiver), Wiesbaden.
Brentwood (England)	0600-0805	Alghanistan, Austria, Bahrein Ids. Belgian Congo, Bulgaria, Eritrea, Greece, India, Iran, Kenya, Malta, Palestine, Portugal, S. Rhodesia, Spain, Switzerland, Syria, Thailand, Trans-Jordan, U.S.R., Yugoslavia.
Somerton (England)	0600-0800	Aden, Australia, Ceylon, China, Cyprus, Formosa, India, Union of S. Africa.

The sub-solar point moved just south of the Tropic of Cancer from the Indo-Burma border to Oman. Alibag observatory was favourably situated for recording the crochet. The localities of the radio fade-out seem to fit a text book example of the area that should be affected.

On June. 14th at 1750 GMT a moderate magnetic storm started at Alibad with a s. c. of 25 r in H and the storm lasted about 52 hours.

The profile of the flare for the horizontal and vertical magnetic components and declination is given after taking out the effect of diurnal variation (Table and Diagram).

TABLE

Time	Relative displacement from values at 0546 GMT (corrected for diurnal variation)		
	H (γ)	V (γ)	D (minutes towards East)
0546	0.0	0.0	0.0
0551	4.75	0.0	
0556	10.55	— 2.28	—0.3
0601	18.10	— 2.95	
0606	30.90	— 6.43	—0.9
0611	47.65	— 8.93	
0616	58.40	—10.53	—1.1
0621	63.20	—11.90	
0626	66.40	—11.75	—1.6
0631	71.60	—13.55	
0636	69.55	—12.05	—2.0
0641	63.2	— 9.30	
0646	52.15	— 3.65	—1.7
0651	43.65	1.07	
0656	36.40	3.47	—1.0
0701	30.50	7.01	
0706	26.60	8.15	—0.6
0711	24.80	8.85	
0716	22.40	11.70	—0.3
0721	19.75	11.20	
0726	16.10	11.55	0.0
0731	10.90	12.25	
0736	8.60	12.30	0.4
0741	4.80	13.45	
0746	—	14.95	0.7
0806	0.00		

The variation in *D* is very small on most occasions, at Alibag. The decimal point figures are given to help to draw the resultant curve.

The main feature to notice is the fact that the rise to the maximum has been in two stages, with an inflection between 0621 and 0626 GMT. The maximum was attained at 0632 GMT. The active regions of flares that were observed (nos. 23, 24 and 26 of the quarter) crossed the central meridian of the sun on June. 7.9, 11.8 and 18.3. As the flare corresponding to active region n. 23 was observed at Ondrejov between 0759 and 0948 GMT, the crochet recorded at Alibag is due to flares of the active regions n. 24 and n. 26 and the two stages

step to the maximum, which is equivalent to two superposed maxima, is due to two distinct flares.

Most of the radio fade-outs have been reported 4 minutes after the crochet at Alibag commenced. The ionospheric disturbance at Tokyo has been reported about three to four minutes after the absolute maximum of the crochet was reached at Alibag. Though one should be reluctant to use the *V* records in these latitudes, it may be pointed out that from 0546 to 0551 GMT there has been little change and that from 0720 to 0730 GMT there has been a flattening

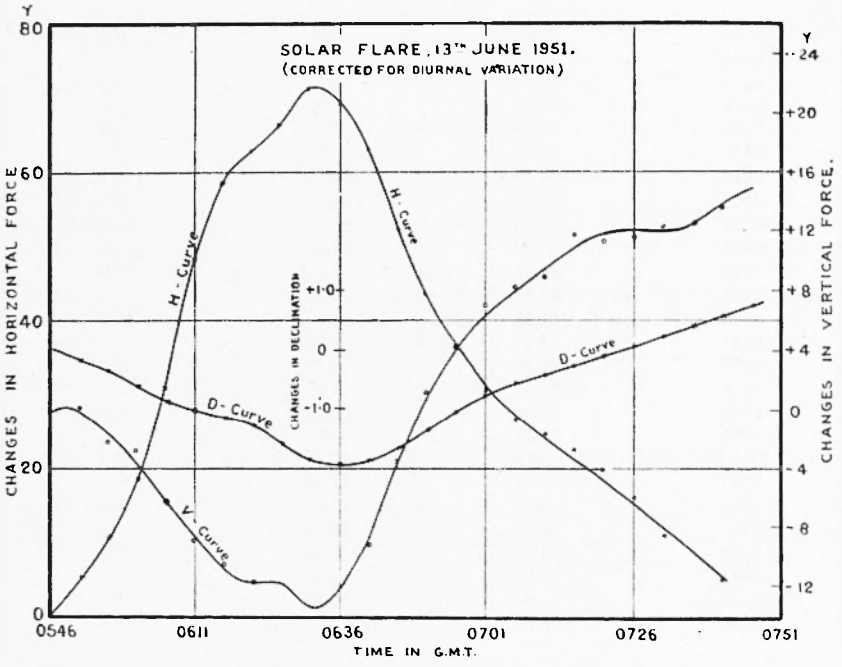

Fig. 1

in the smoothed *V* curves. Whether this has anything to do with the period of complete fade-out of stations as received at Delhi (0550 to 0730 GMT) cannot be definitely said.

The detailed correlation of the profile can only be done if any other institution has collected cognate data on a comparable time scale.

From the publications of the Norske Institutt for Kosmisk Fysik (Nr. 34. observations of 1951), it is noticed that the daily range of

Ozone at Tromsø were much larger on the 13th and 14th June. 1951 0.19 mm and 0.36 mm respectively while the average diurnal range for the month was only 0.08 mm.

The recording was done by Mr. A. S. Chaubal and Mr. D. K. Deshmukh and help was rendered in calculations by Mr. M. Panduranga Rao and Mr. K. S. Raja Rao.

Colaba Observatory. — Bombay. 5. Jan. 21st. 1953.

SUMMARY

A detailed study of the quick-run magnetograms of the Solar Flare of June 13, 1951. Alibag was favourably situated. Corresponding to different flares on that day the profile of the solar flare effect has a two-stage maximum. The time of the onset of the radio fade-out in relation to the flare has been pointed out. In the vertical force, effect corresponding to the onset and end of radio fade-out there has been a temporary no-variation-with-time stage or a sort of inflexion. The diurnal rang of ozone at Tromsø also was abnormally large within the next 24 hours.