B No. 15 (C87)

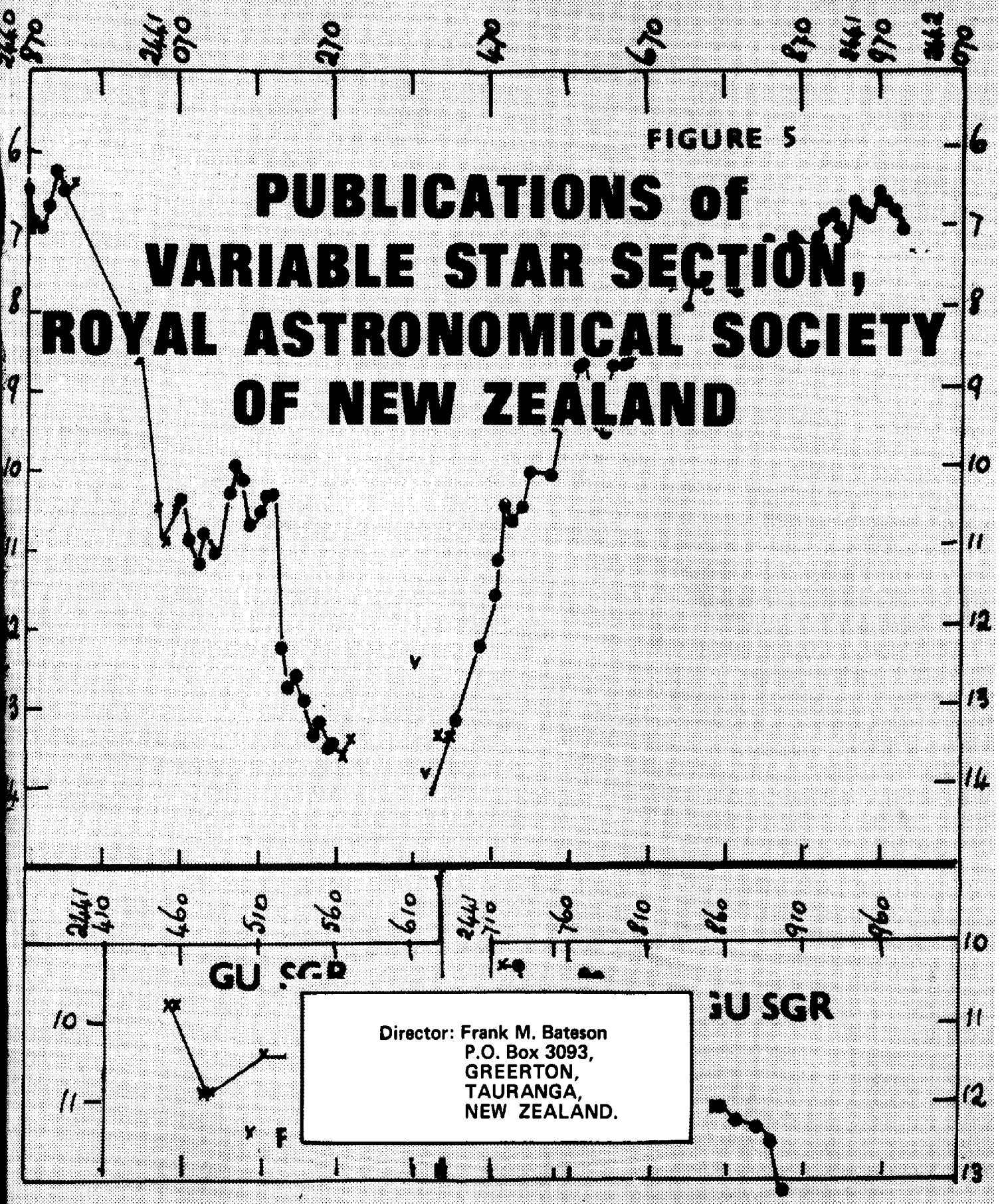

FIGURE 5

PUBLICATIONS of VARIABLE STAR SECTION, ROYAL ASTRONOMICAL SOCIETY OF NEW ZEALAND

Director: Frank M. Bateson
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GREERTON,
TAURANGA,
NEW ZEALAND.

ISSN 0111-736X

PUBLICATIONS OF THE VARIABLE STAR SECTION, ROYAL ASTRONOMICAL SOCIETY OF NEW ZEALAND.

No. 15.

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1989 September 7

PUBLISHED BY; ASTRONOMICAL RESEARCH LTD.,
P.O. BOX 3093, GREERTON
TAURANGA, NEW ZEALAND

OBSERVATIONS OF R CORONAE BOREALIS (RCB) STARS II : 5 more RCB's

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SUMMARY. Visual light curves for five bright R Coronae Borealis (RCB) stars are continued from previous publications.

1. INTRODUCTION

Lawson, Cottrell and Bateson (1) published light curves and observations for the RCB stars RY Sgr, Y Mus and U Aqr. In this paper we present light curves and observations for the RCB stars UW Cen, V CrA, GU Sgr, VZ Sgr and RS Tel, continuing the light curves for these stars published earlier by Bateson (2).

2. OBSERVATIONS

The individual observer estimates were binned, and observations derived from either 5 or 10 day means were calculated. The light curves and observations for UW Cen were derived from 5 day means. The light curves and observations for V CrA, GU Sgr, VZ Sgr and RS Tel were derived from 10 day means. Open circles on the light curves (Figures 1-9) denote single estimates. The light curve about a single observation is drawn as a dashed line. Filled circles on the light curves denote means derived from 2 or more estimates. The observations are listed in Appendices I-V.

Typical standard deviations for observations derived from 5 or more estimates, during times of maxima on the light curves, are given in Table I. Here, 'times of maxima' refer to times when the RCB star is not in a large amplitude (1-7 mag.) obscurational decline, rather than comments about the low amplitude (0.1-0.5 mag.) pulsation-related variations seen in RCB stars. The standard deviation for observations derived from 2-4 estimates is generally less than 0.3 mag. We note that the light curves for most stars, after JD 2445000, show less scatter than prior to JD 2445000. This is noticeable, for example, in the light curve for GU Sgr, and indicates the general increase in frequency that estimates have been obtained for these stars after this date.

Table I. Typical standard deviations (sigma) for observations derived from more than 5 estimates.

RCB star	sigma (mag)
UW Cen	0.15
V CrA	0.15
GU Sgr	0.10
VZ Sgr	0.10
RS Tel	0.15

UW CENTAURI

Bateson (2) published light curves for UW Cen to JD 2443334. The light curve from JD 2443511-7000 is given in Figures 1 and 2.

UW Cen declined near JD 2443555 and remained below, or near, mag. 14 until JD 2444020. The star brightened to mag. 10.7 before declining again near JD 2444130. During this rising phase the semi-regular pulsations of UW Cen (3) were discernable with a period of approximately 40 day and an amplitude exceeding 0.5 mag. The star remained below mag. 14 until JD 2444320 before brightening slowly, reaching mag. 10.0 around JD 2444650 and mag. 9.5 (maximum) around JD 2445000. UW Cen declined again on JD 2446460, falling to below mag. 14 near JD 2446500. The star was observed to rise to mag. 12.4 near JD 2446660 but fell to remain between mag. 13-14 between JD 2446750-6900.

The observations of UW Cen are compiled in Appendix I.

V CORONAE AUSTRINI

Bateson (2) published light curves for V CrA to JD 2442690. The light curve from JD 2443015-7000 is given in Figures 3 and 4.

V CrA was in a particularly active state between the onset of a decline near JD 2443300 and a final rise to maximum light near JD 2446100. During this interval (2800 day) V CrA regained its normal magnitude at maximum, mag. 10.0-10.5, only briefly around JD 2443770 and at times between JD 2445760-5900. Declines to near, or below, mag. 13 were recorded near JD 2443780, 5040 and 5900. The star remained undetected between JD 2444000-4670. A later decline, at JD 2446330, was of short duration. V CrA recovered to mag. 10.3 in approximately 100 day and remained at maximum to JD 2447000.

The observations of V CrA are compiled in Appendix II.

GU SAGITTARII

Bateson (2) published light curves for GU Sgr to JD 2443020. The light curve from JD 2443037-7000 is given in Figure 5.

Throughout this time GU Sgr remained at, or near, maximum light.

The observations of GU Sgr are compiled in Appendix III.

VZ SAGITTARII

Bateson (2) published light curves for VZ Sgr to JD 2442655. The light curve is extended to JD 2447000 in Figures 6 and 7.

Bateson (4) discussed that the magnitudes for the comparison star sequence for VZ Sgr were derived from step estimates with an arbitrary zero magnitude. Kilkenny (5) has published UBV photometry for the comparison star sequence. These data confirm that the zero point magnitude assumed by Bateson (2,4) was faint by approximately one magnitude. The V magnitudes given by Kilkenny are given in Table II, with the adopted magnitudes in this paper. Several of the previously used arbitrary values are given for comparison.

Table II. Comparison star magnitudes for VZ Sgr.

Star	V	Adopted	Arbitrary
e	10.15	10.1	11.0
f	10.21	10.2	11.3
h	10.28	10.3	11.2
k	10.84	10.8	11.8
l	10.94	10.9	
m	11.05	11.1	
n	11.54	11.5	
p	11.73	11.7	
q	12.26	12.3	
r	12.53	12.5	
s	12.64	12.6	
t	12.77	12.8	
u	13.44	13.4	

The light curve of VZ Sgr is characterised by a prolonged decline commencing near JD 2445780. The rise to maximum was interupted around JD 2446800 by a decline to mag. 12.5. By JD 2447000, VZ Sgr recovered to within 0.2-0.3 mag. of its normal magnitude at maximum light (mag. 10.3).

The observations of VZ Sgr are compiled in Appendix IIII.

RS TELESCOPII

Bateson (2) published light curves for RS Tel to JD 2443080. The light curve from JD 2443220-7000 is given in Figures 8 and 9.

The declines of RS Tel demonstrate the two types of declines that are observed in the RCB stars. In the decline commencing near JD 2445280, the magnitude of RS Tel fell from 10.0 to 13.0 in 250 day. In the decline commencing near JD 2446290, the magnitude fell from 10.0 to 13.0 in only 20 day. Qualitatively, the former decline can be understood as obscuration by a slowly expanding dust cloud covering only a part of the stellar disc. In the later decline, the dust shell expands rapidly, obscuring the entire stellar disc. The two types of declines have been discussed recently by Goldsmith and Evans (6). The latter type of decline are the most commonly observed, and are taken as one of the characteristic features of RCB behaviour.

The observations of RS Tel are compiled in Appendix V.

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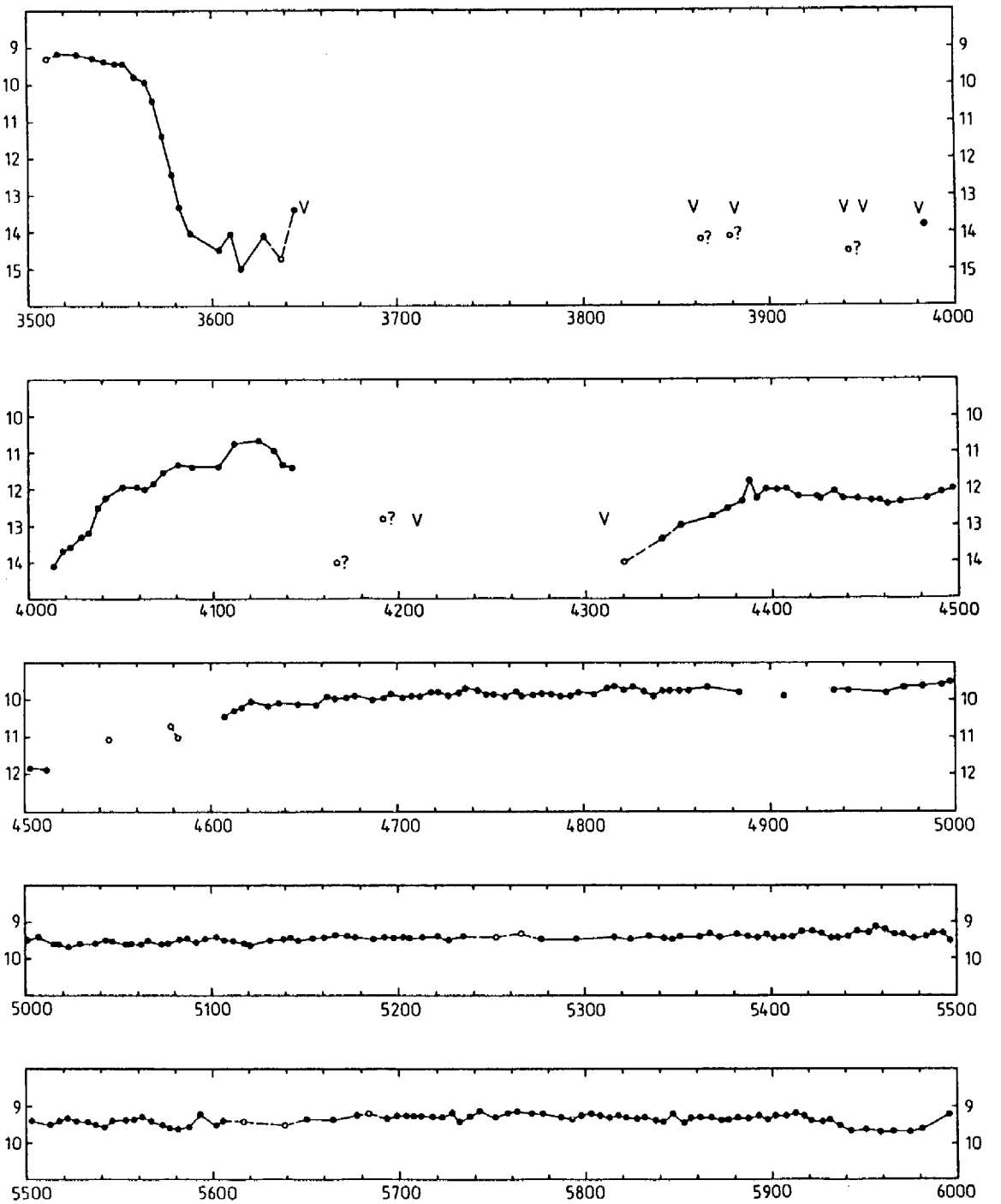

Figure 1. UW Centauri - light curve from JD 2443500-6000.

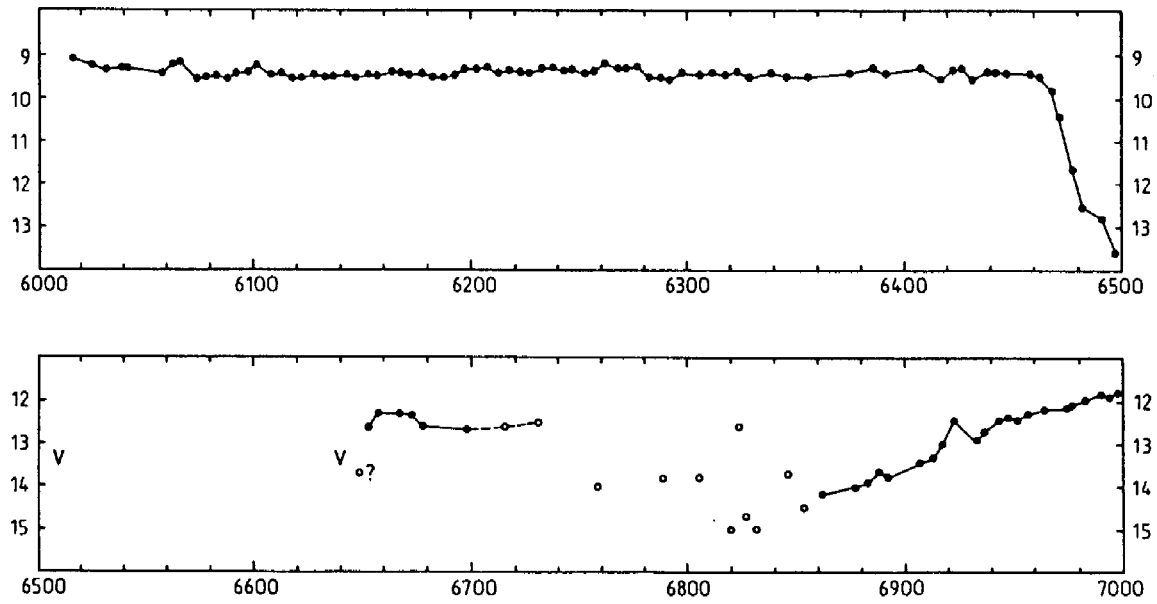

Figure 2. UW Centauri - light curve from JD 2446000-7000.

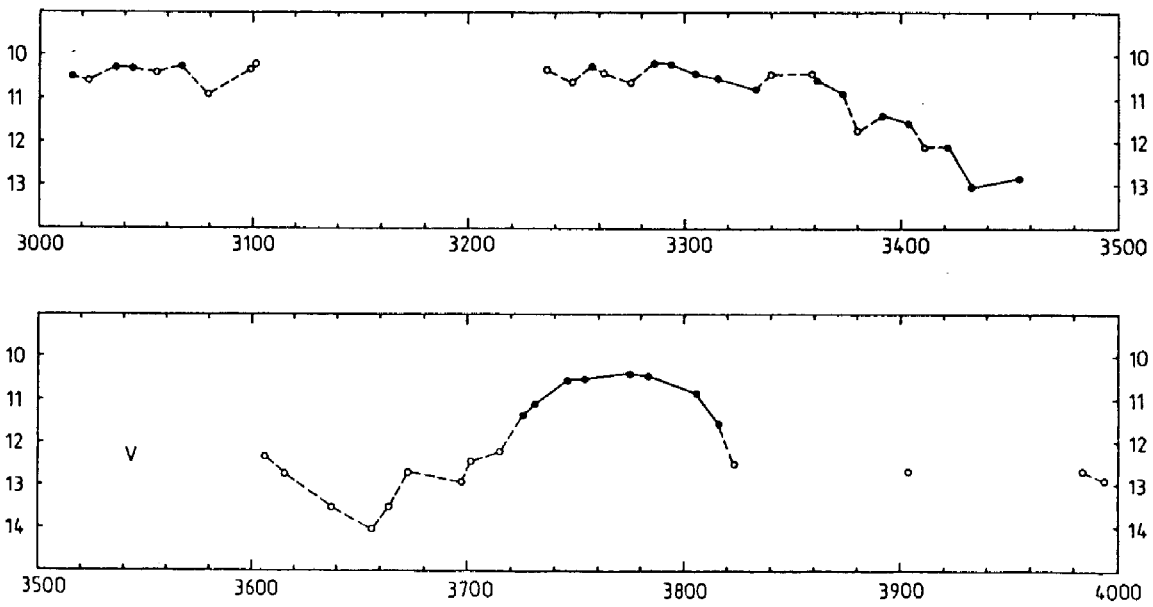

Figure 3. V Coronae Austrini - light curve from JD 2443000-4000.

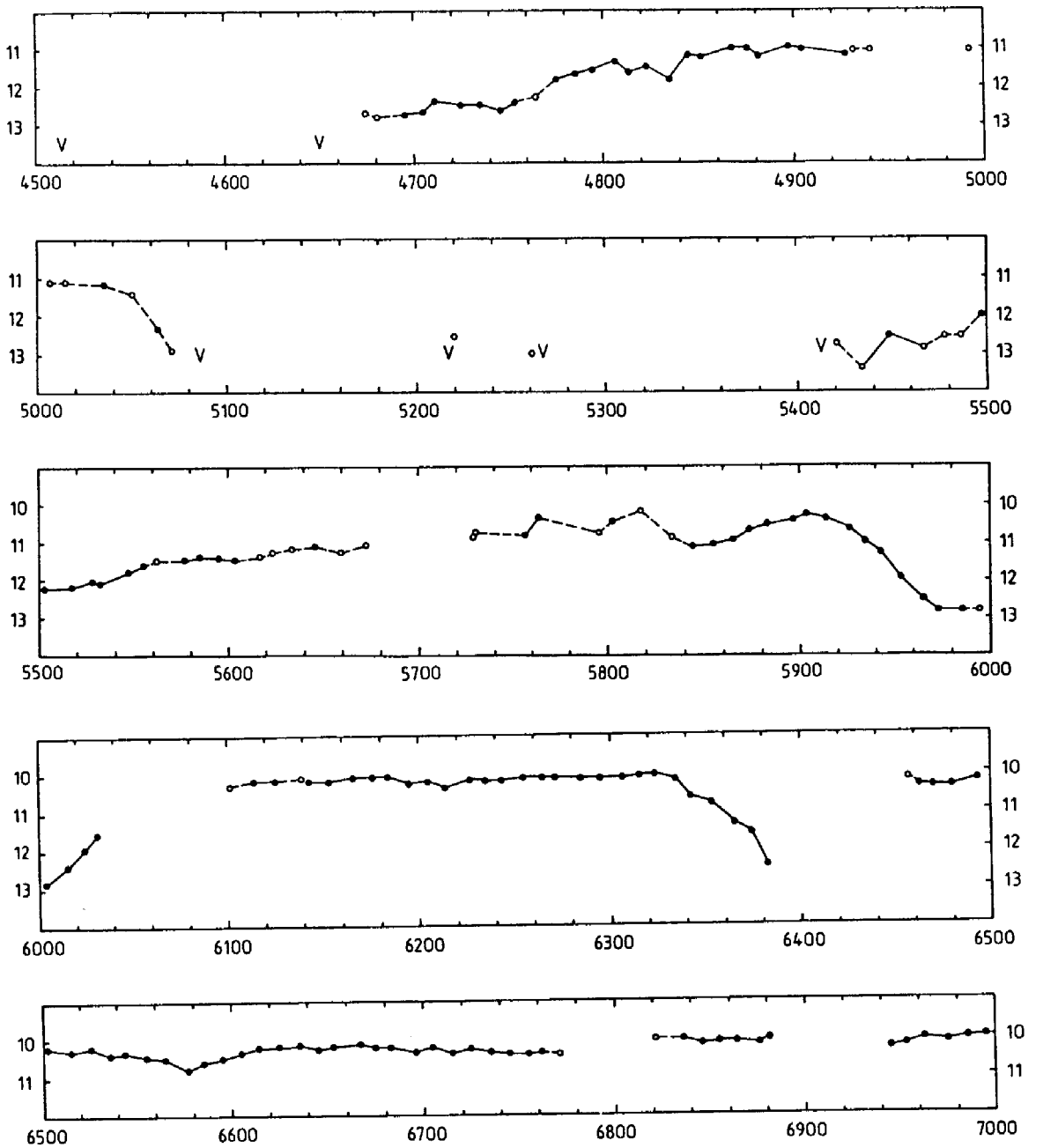

Figure 4. V Coronae Austrini - light curve from JD 2444500-7000.

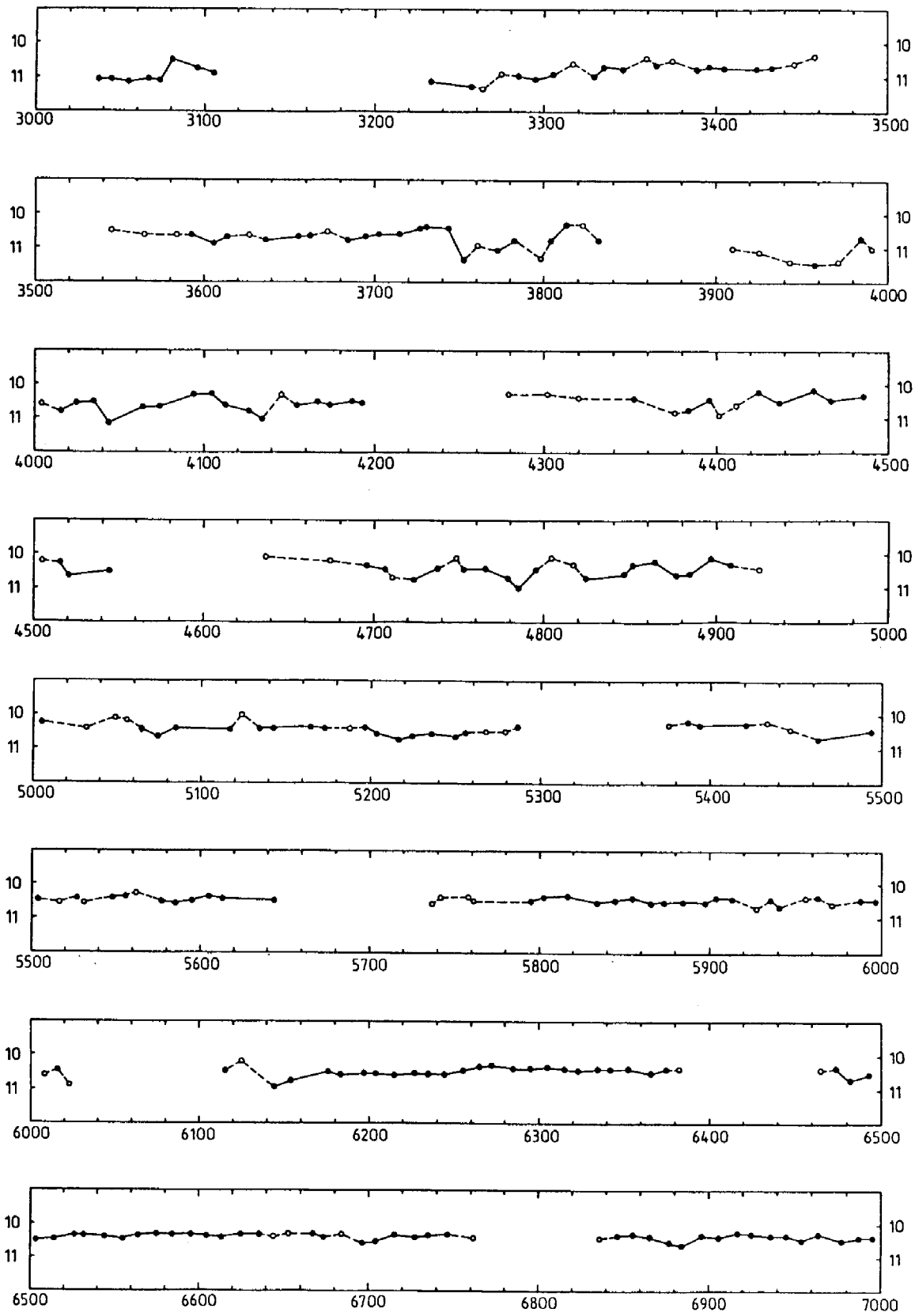

Figure 5. GU Sagittarii - light curve from JD 2443000-7000.

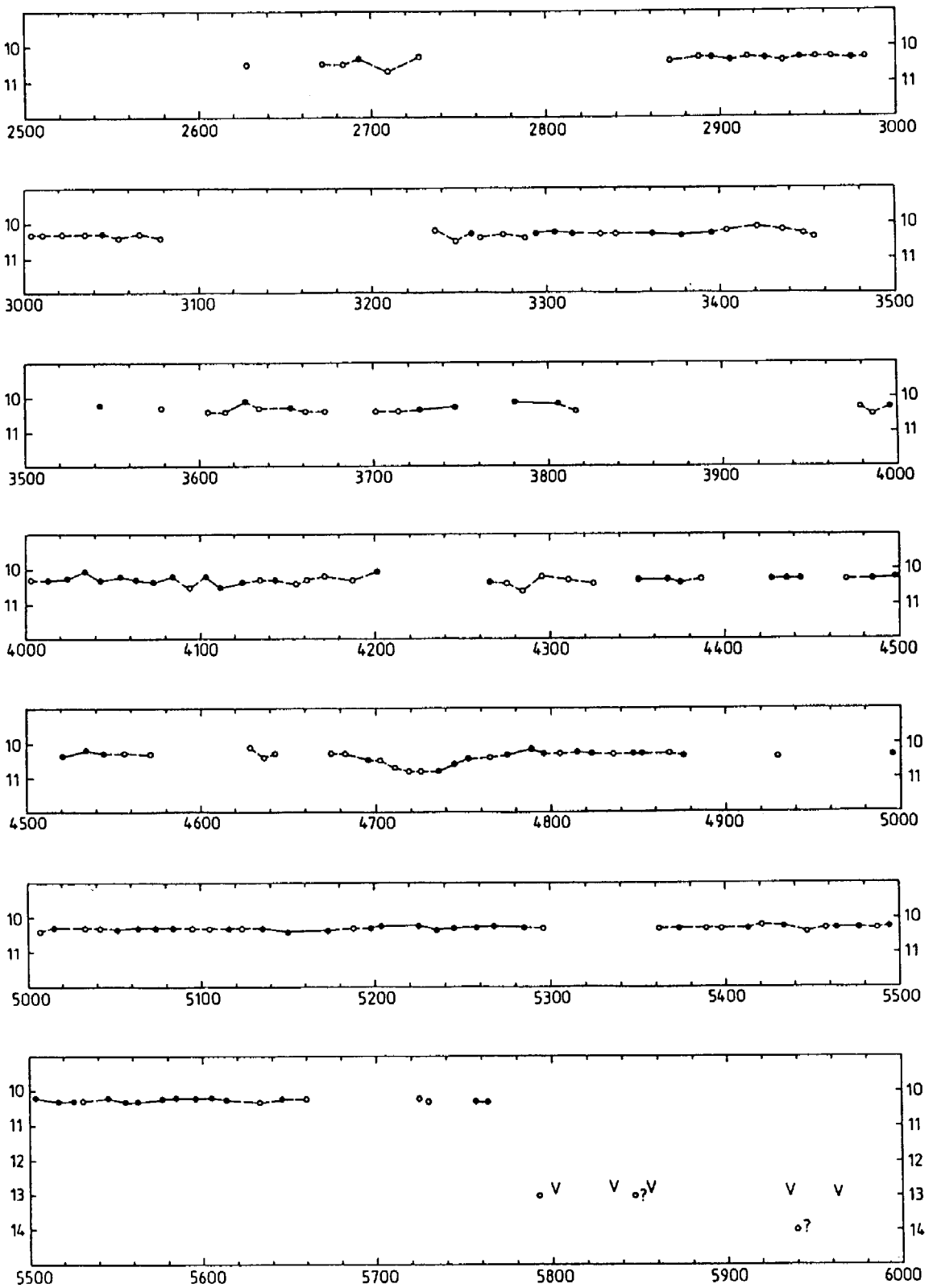

Figure 6. VZ Sagittarii - light curve from JD 2442600-6000.

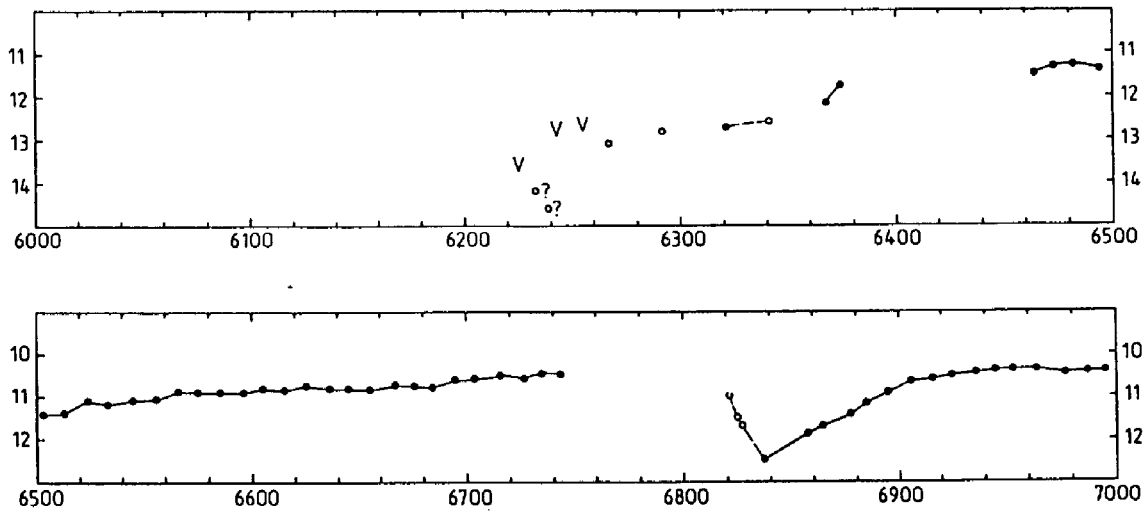

Figure 7. VZ Sagittarii - light curve from JD 2446000-7000.

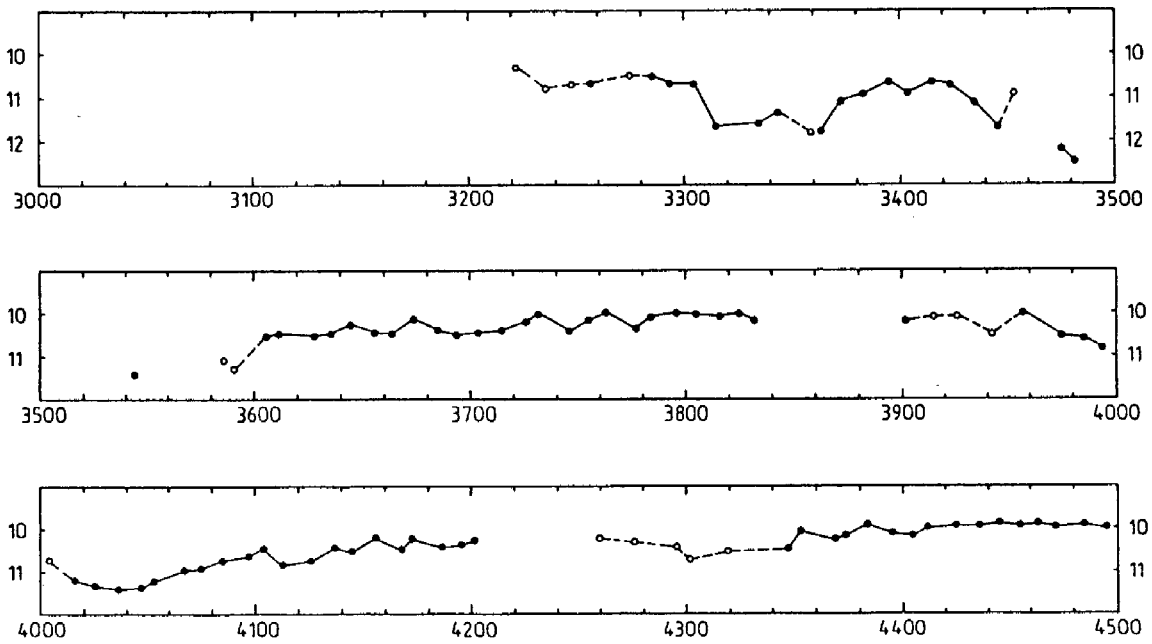

Figure 8. RS Telescopii - light curve from JD 2443200-4500.

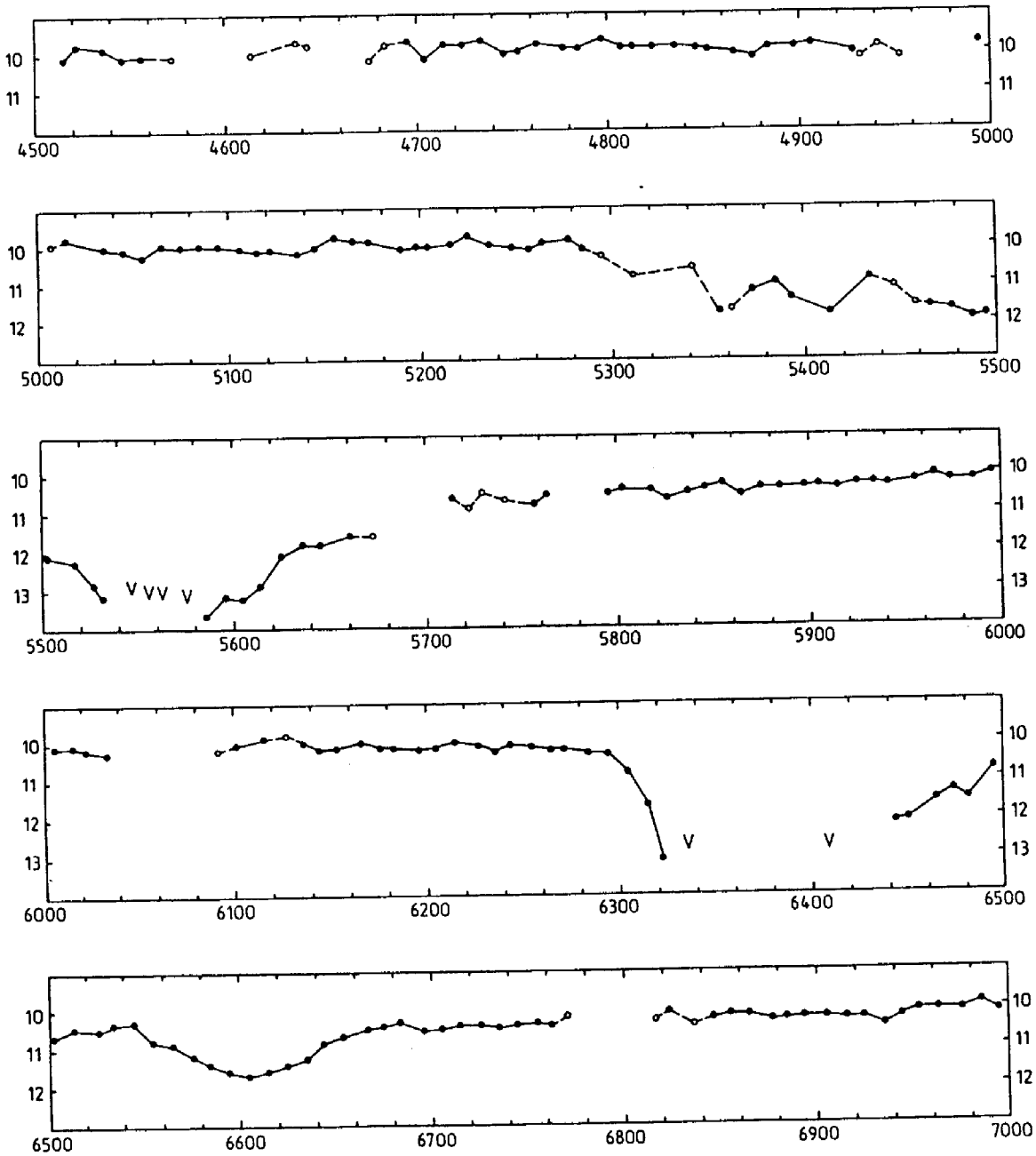

Figure 9. RS Telescopii - light curve from JD 2444500-7000.

Appendix I - UW CENTAURI

(column key = JD-2440000, mag., number of estimates)

3510.9	9.3	1	3949			4321.0	14.0	1	5818.0	9.23	7	5980.5	9.60	2	6168.0	9.40	13
3516.7	9.20	3	to	<13.5	44	4340.9	13.33	3	5821.6	9.30	4	5996.2	9.20	2	6172.3	9.46	9
3526.7	9.22	5	3981			4351.0	13.00	2	5827.9	9.34	8	6009.1	9.5	1	6178.2	9.43	12
3536.1	9.30	6	3982.9	13.8	2	4368.0	12.76	5	5832.4	9.30	6	6015.6	9.10	3	6182.9	9.48	19
3542.4	9.42	6	4013.6	14.1	3	4376.3	12.54	7	5838.0	9.36	11	6025.0	9.25	4	6187.8	9.51	7
3547.8	9.46	7	4019.1	13.70	4	4384.2	12.34	5	5842.0	9.39	7	6031.7	9.35	2	6192.9	9.45	14
3552.0	9.45	8	4022.8	13.58	8	4388.2	11.80	8	5847.4	9.21	8	6038.6	9.30	3	6197.4	9.31	9
3557.8	9.83	7	4028.9	13.29	8	4392.0	12.28	4	5852.9	9.43	16	6041.8	9.32	5	6202.5	9.32	16
3563.7	9.93	6	4032.9	13.20	3	4397.4	12.01	9	5857.0	9.31	9	6058.0	9.42	5	6207.7	9.28	14
3568.0	10.43	11	4038.4	12.53	7	4402.5	12.05	10	5862.2	9.30	7	6062.7	9.22	5	6212.9	9.39	16
3573.0	11.40	4	4041.9	12.23	10	4407.9	12.02	5	5868.3	9.30	4	6066.3	9.17	3	6218.3	9.35	4
3578.3	12.44	10	4050.6	11.93	7	4414.3	12.20	5	5873.1	9.36	12	6073.8	9.54	5	6222.8	9.39	7
3581.9	13.34	8	4059.4	11.93	6	4423.5	12.20	6	5876.9	9.35	11	6077.6	9.51	7	6227.1	9.41	9
3587.7	14.03	3	4062.7	12.00	11	4426.4	12.24	7	5882.4	9.28	12	6082.6	9.47	7	6232.2	9.31	8
3604.3	14.50	2	4067.6	11.86	7	4433.2	12.03	3	5887.5	9.32	13	6087.7	9.53	3	6237.7	9.30	8
3610.7	14.03	4	4072.8	11.55	11	4438.1	12.26	8	5893.0	9.25	4	6092.3	9.43	6	6243.3	9.34	8
3616.1	15.0	2	4080.5	11.34	7	4446.1	12.26	5	5897.9	9.36	18	6097.9	9.37	10	6247.2	9.33	6
3628.3	14.1	1	4088.7	11.40	5	4452.6	12.29	11	5901.5	9.24	10	6102.2	9.27	7	6252.6	9.39	15
3637.8	14.7	1	4103.0	11.38	8	4457.7	12.30	5	5907.7	9.24	17	6107.6	9.46	5	6257.3	9.35	12
3644.5	13.4	2	4112.3	10.76	8	4462.1	12.40	6	5912.6	9.21	16	6112.7	9.42	12	6262.1	9.20	9
3646			4125.1	10.68	6	4468.9	12.36	5	5917.8	9.26	15	6117.5	9.53	10	6267.5	9.32	10
to	<13.5	124	4132.7	10.95	6	4482.9	12.23	6	5922.1	9.37	10	6121.7	9.52	6	6271.9	9.27	6
3858			4138.2	11.34	5	4490.8	12.07	5	5928.3	9.40	13	6127.7	9.46	5	6277.2	9.26	5
3863.1	14.2?	1	4143.2	11.40	5	4497.4	12.00	2	5932.1	9.35	13	6132.8	9.52	5	6282.5	9.51	10
3879.2	14.1?	1	4167.2	14.0?	1	4502.9	11.85	2	5936.7	9.52	12	6137.2	9.48	9	6287.5	9.50	10
3881			4174.2	13.0	1	4511.9	11.90	2	5942.8	9.66	5	6142.7	9.44	14	6292.3	9.55	13
to	<13.5	45	4192.2	12.8?	1	4545.1	11.1	1	5951.2	9.59	7	6147.1	9.48	12	6297.9	9.40	9
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3943.3	14.1?	1	4320			4607.8	10.43	6	5975.2	9.67	3	6163.6	9.36	12	6317.7	9.45	4
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4631.3	10.17	6	4797.9	9.79	8	5047.2	9.52	12	6355.8	9.47	3	6698.2	12.65	4	6974.7	12.15	4
4637.2	10.10	4	4806.5	9.86	4	5053.5	9.60	6	6375.3	9.40	2	6716.2	12.6	1	6977.3	12.08	5
4646.7	10.09	7	4812.8	9.69	7	5057.1	9.57	13	6386.1	9.27	3	6731.2	12.5	1	6982.7	12.00	7
4657.2	10.16	7	4817.3	9.65	12	5061.9	9.60	5	6392.4	9.40	2	6758.2	14.0	1	6989.8	11.84	7
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4667.3	9.97	7	4827.2	9.65	4	5072.9	9.60	4	6416.6	9.55	2	6805.1	13.8	1	6998.0	11.81	7
4673.0	9.94	9	4832.5	9.73	4	5077.3	9.57	7	6423.4	9.35	2	6820.2	15.0	1			
4677.7	9.90	9	4838.0	9.88	4	5083.1	9.47	6	6426.9	9.30	2	6824.0	12.6	1			
4687.1	10.00	2	4843.2	9.73	10	5087.4	9.43	12	6432.1	9.55	2	6827.1	14.7	1			
4692.5	9.93	12	4847.1	9.72	6	5091.9	9.55	4	6438.8	9.37	3	6832.2	15.0	1			
4697.3	9.83	13	4852.2	9.76	7	5097.1	9.43	4	6442.8	9.42	5	6845.9	13.7	1			
4702.5	9.93	12	4857.4	9.75	2	5102.5	9.40	7	6447.6	9.42	5	6853.1	14.5	1			
4707.6	9.91	8	4867.0	9.64	5	5106.8	9.50	11	6458.5	9.43	7	6862.2	14.2	2			
4711.6	9.90	6	4884.0	9.77	3	5112.4	9.52	10	6462.8	9.49	11	6865.0	13.0	1			
4717.6	9.82	6	4907.7	9.90	2	5117.8	9.58	9	6468.8	9.80	14	6873.9	14.7	1			
4722.3	9.80	10	4934.9	9.75	2	5121.1	9.65	4	6472.2	10.43	22	6877.0	14.0	4			
4727.2	9.91	13	4942.9	9.74	5	5131.8	9.48	12	6478.3	11.67	7	6883.0	13.90	4			
4733.3	9.78	5	4963.3	9.82	6	5138.7	9.46	10	6481.6	12.55	6	6888.0	13.65	4			
4736.3	9.68	4	4972.7	9.63	3	5142.7	9.42	10	6491.4	12.80	2	6891.8	13.80	3			
4742.8	9.75	2	4982.7	9.62	5	5147.4	9.47	7	6496.7	13.6	3	6907.0	13.46	7			
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4752.3	9.86	9	4997.7	9.52	10	5161.2	9.41	10	6506			6918.0	13.03	3			
4758.4	9.87	3	5001.3	9.47	6	5167.0	9.34	5	to	<13.5	177	6923.1	12.45	2			
4763.7	9.77	6	5007.4	9.40	3	5173.1	9.37	14	6648			6934.0	12.90	3			
4766.9	9.90	5	5014.6	9.58	5	5177.0	9.40	4	6648.9	13.7?	1	6937.4	12.73	3			
4772.5	9.87	3	5017.5	9.58	5	5187.1	9.44	5	6653.1	12.60	3	6943.9	12.49	3			
4778.0	9.83	15	5022.6	9.67	6	5193.2	9.40	9	6657.6	12.28	5	6948.1	12.39	7			
5203.1	9.40	7	5437.1	9.42	6	5594.1	9.20	5									
5205.8	9.43	4	5442.4	9.39	11	5602.4	9.50	6									
5212.8	9.40	3	5447.4	9.23	12	5606.4	9.37	3									
5221.2	9.38	6	5453.2	9.28	6	5616.8	9.4	1									
5226.6	9.50	5	5457.1	9.12	9	5639.1	9.5	1									
5235.3	9.37	3	5462.3	9.23	14	5650.7	9.35	2									
5252.9	9.4	1	5467.1	9.31	8	5664.5	9.37	3									
5266.2	9.3	1	5472.3	9.33	7	5678.1	9.25	2									
5276.1	9.45	2	5476.8	9.45	10	5684.6	9.2	1									
5295.7	9.44	7	5483.9	9.40	4	5693.8	9.33	3									
5316.3	9.40	2	5487.5	9.30	10	5698.5	9.23	3									
5324.8	9.44	5	5492.6	9.31	9	5703.7	9.25	4									
5335.2	9.36	5	5497.4	9.49	7	5707.6	9.26	5									
5342.5	9.43	6	5502.7	9.40	7	5712.3	9.24	5									
5347.6	9.43	4	5512.9	9.49	8	5718.1	9.26	5									
5352.4	9.38	4	5518.4	9.40	5	5722.5	9.30	6									
5361.5	9.41	9	5522.4	9.31	8	5727.8	9.17	6									
5367.9	9.30	4	5527.4	9.39	8	5737.3	9.42	5									
5373.1	9.39	10	5532.7	9.43	6	5743.0	9.12	5									
5381.1	9.32	13	5536.9	9.50	6	5751.4	9.31	11									
5387.9	9.38	5	5542.3	9.55	6	5758.0	9.20	5									
5393.1	9.42	6	5546.4	9.38	5	5762.5	9.14	5									
5398.1	9.33	7	5553.1	9.38	8	5770.5	9.19	10									
5401.8	9.44	7	5558.0	9.34	14	5777.4	9.17	7									
5407.0	9.39	8	5562.1	9.29	10	5786.6	9.32	5									
5412.2	9.40	8	5566.7	9.41	8	5792.9	9.34	7									
5416.7	9.26	5	5573.0	9.49	8	5797.8	9.24	5									
5422.9	9.26	5	5577.2	9.57	15	5802.9	9.20	6									
5427.5	9.30	8	5582.3	9.59	16	5807.6	9.25	8									
5433.4	9.43	8	5587.7	9.54	7	5812.5	9.28	16									

Appendix II - V CORONAE AUSTRINI

(column key = JD-2440000, mag., number of estimates)

3015	10.50	3	3455	12.8	1	4681	12.8	1	5050	11.4	1
3023	10.6	1	3544	<12.4	2	4695	12.75	2	5064	12.35	4
3036	10.27	3	3606	12.3	1	4705	12.66	5	5071	12.9	1
3044	10.30	4	3616	12.7	1	4711	12.40	2	5086		
3055	10.4	1	3628	<12.3	1	4725	12.50	3	to	<13.0	38
3067	10.25	2	3638	13.5	1	4735	12.48	6	5218		
3079	10.9	1	3657	14.0	1	4746	12.63	3	5220	12.6	1
3099	10.3	1	3664	13.5	1	4754	12.40	2	5261	13.0	1
3101	10.2	1	3673	12.7	1	4765	12.3	1	5279		
3236	10.3	1	3698	12.9	1	4776	11.80	4	to	<13.0	10
3248	10.6	1	3702	12.4	1	4786	11.68	5	5413		
3257	10.23	3	3715	12.2	1	4795	11.57	3	5421	12.8	1
3262	10.4	1	3726	11.33	3	4807	11.35	2	5434	13.4	1
3275	10.6	1	3731	11.10	2	4814	11.63	3	5446	12.43	3
3286	10.15	2	3746	10.54	5	4823	11.48	4	5467	12.9	1
3294	10.20	2	3754	10.53	3	4835	11.83	3	5478	12.6	1
3305	10.40	2	3775	10.40	3	4845	11.18	9	5487	12.6	1
3315	10.50	2	3783	10.45	2	4852	11.25	4	5498	12.05	2
3333	10.75	2	3806	10.85	2	4868	11.00	3	5503	12.25	2
3340	10.4	1	3816	11.55	2	4876	11.01	9	5517	12.20	2
3359	10.4	1	3823	12.5	1	4882	11.23	3	5528	12.03	3
3361	10.55	2	3831	<11.1	1	4898	10.98	5	5532	12.10	3
3373	10.85	2	3903	12.7	1	4905	11.08	9	5547	11.78	6
3380	11.7	1	3970	<14.5	1	4928	11.20	2	5555	11.63	9
3396	11.35	4	3984	12.7	1	4932	11.1	1	5562	11.5	1
3404	11.50	4	3994	12.9	1	4941	11.1	1	5577	11.46	7
3411	12.1	1	4014			4993	11.1	1	5585	11.43	6
3422	12.08	4	to	<13.5	117	5007	11.1	1	5595	11.44	5
3433	13.0	3	4651			5015	11.1	1	5604	11.48	9
3444	<12.4	2	4675	12.7	1	5035	11.15	2	5617	11.4	1
5624	11.3	1	6015	12.37	3	6375	11.60	9	6735	10.35	17
5634	11.2	1	6024	11.93	9	6383	12.45	4	6745	10.36	7
5646	11.14	5	6031	11.55	2	6458	10.2	1	6751	10.40	3
5660	11.3	1	6101	10.3	1	6464	10.37	3	6762	10.34	5
5673	11.1	1	6114	10.18	5	6472	10.33	3	6771	10.4	1
5729	10.9	1	6125	10.17	3	6481	10.40	2	6821	10.0	1
5730	10.8	1	6139	10.1	1	6494	10.23	8	6836	10.0	3
5757	10.85	2	6143	10.20	8	6503	10.20	7	6846	10.15	4
5764	10.40	2	6153	10.20	7	6515	10.30	3	6855	10.08	5
5796	10.8	1	6166	10.08	5	6526	10.20	9	6864	10.08	12
5803	10.47	4	6176	10.06	5	6536	10.37	3	6876	10.15	2
5818	10.2	1	6184	10.07	13	6544	10.32	5	6882	10.03	4
5834	10.9	1	6195	10.25	4	6555	10.45	11	6946	10.23	8
5845	11.13	6	6205	10.22	14	6565	10.49	14	6954	10.16	11
5856	11.09	10	6214	10.37	11	6577	10.74	5	6964	10.03	12
5866	10.95	4	6227	10.16	7	6585	10.57	11	6976	10.07	9
5875	10.68	12	6235	10.21	12	6595	10.48	17	6986	9.99	7
5884	10.53	7	6244	10.21	8	6605	10.34	9	6995	9.97	19
5898	10.42	6	6255	10.11	14	6614	10.21	16			
5905	10.28	8	6265	10.13	14	6625	10.17	19			
5915	10.41	12	6272	10.14	5	6636	10.14	10			
5927	10.67	3	6285	10.16	13	6645	10.23	7			
5935	11.00	16	6295	10.16	13	6653	10.17	6			
5943	11.30	5	6307	10.13	3	6667	10.10	5			
5954	11.95	2	6316	10.09	12	6675	10.21	14			
5965	12.50	4	6324	10.07	6	6683	10.22	9			
5973	12.80	4	6335	10.19	8	6696	10.35	16			
5986	12.80	4	6343	10.63	7	6705	10.22	13			
5995	12.8	1	6354	10.80	5	6715	10.37	12			
6004	12.83	3	6366	11.35	8	6725	10.24	10			

Appendix III - GU SAGITTARII

(column key = JD-2440000, mag., number of estimates)

3037	11.05	5	3565	10.6	1	3972	11.4	1	4425	10.20	2	4897	10.10	2
3045	11.06	5	3586	10.6	1	3985	10.70	2	4437	10.52	6	4909	10.30	2
3055	11.15	2	3593	10.60	2	3991	11.0	1	4457	10.15	2	4926	10.4	1
3067	11.05	4	3606	10.85	2	4004	10.6	1	4467	10.45	2	5005	10.25	2
3074	11.10	3	3614	10.65	2	4016	10.78	4	4486	10.30	3	5032	10.4	1
3081	10.47	3	3627	10.6	1	4025	10.55	2	4505	10.2	1	5049	10.1	1
3096	10.74	5	3637	10.75	2	4035	10.50	2	4516	10.25	2	5056	10.2	1
3106	10.90	2	3656	10.65	2	4044	11.13	3	4521	10.65	2	5063	10.43	3
3233	11.10	2	3663	10.63	3	4064	10.68	4	4545	10.50	2	5074	10.65	2
3257	11.23	3	3673	10.5	1	4074	10.66	5	4637	10.1	1	5085	10.37	3
3264	11.3	1	3685	10.75	2	4094	10.30	2	4675	10.2	1	5117	10.43	4
3275	10.9	1	3695	10.63	4	4105	10.27	3	4696	10.33	3	5124	10.0	1
3285	10.94	5	3703	10.57	3	4113	10.60	3	4707	10.45	2	5135	10.40	3
3295	11.05	2	3715	10.58	4	4127	10.77	3	4711	10.7	1	5143	10.38	4
3306	10.92	6	3727	10.40	3	4135	11.00	3	4724	10.75	2	5165	10.35	4
3317	10.6	1	3731	10.37	3	4146	10.3	1	4738	10.3	2	5173	10.40	3
3329	10.95	2	3744	10.40	3	4155	10.62	5	4749	10.1	1	5188	10.4	1
3335	10.68	4	3753	11.35	2	4167	10.50	3	4753	10.45	2	5197	10.37	3
3346	10.75	2	3761	10.9	1	4174	10.62	6	4766	10.40	4	5204	10.56	5
3360	10.4	1	3773	11.03	6	4187	10.50	3	4779	10.70	2	5217	10.75	2
3365	10.63	4	3783	10.76	5	4193	10.55	4	4786	10.98	4	5225	10.63	9
3373	10.5	1	3799	11.3	1	4279	10.3	1	4796	10.43	3	5236	10.55	4
3389	10.75	2	3805	10.75	6	4302	10.3	1	4805	10.1	1	5250	10.65	2
3396	10.66	5	3814	10.30	2	4320	10.4	1	4818	10.3	1	5256	10.50	5
3405	10.70	3	3823	10.3	1	4352	10.40	2	4825	10.70	2	5268	10.5	1
3424	10.74	10	3832	10.75	2	4376	10.8	1	4847	10.55	2	5279	10.5	1
3433	10.72	6	3910	11.0	1	4384	10.75	2	4852	10.30	3	5287	10.35	2
3446	10.6	1	3926	11.1	1	4396	10.43	4	4865	10.17	3	5376	10.3	1
3458	10.4	1	3944	11.4	1	4402	10.9	1	4877	10.60	2	5387	10.2	2
3545	10.5	1	3958	11.45	2	4412	10.6	1	4885	10.55	4	5394	10.30	2

5421	10.25	2	5885	10.53	3	6285	10.38	12	6646	10.4	1
5434	10.2	1	5898	10.55	4	6295	10.38	13	6653	10.3	1
5447	10.4	1	5904	10.38	6	6305	10.34	5	6667	10.30	4
5463	10.70	2	5914	10.43	4	6315	10.40	8	6673	10.40	7
5494	10.45	4	5928	10.7	1	6323	10.45	6	6684	10.3	1
5503	10.50	2	5936	10.45	4	6335	10.40	3	6696	10.56	9
5516	10.6	1	5941	10.67	3	6342	10.42	5	6704	10.51	9
5527	10.45	2	5957	10.4	1	6353	10.40	4	6715	10.30	7
5531	10.6	1	5964	10.40	4	6366	10.50	5	6727	10.38	6
5548	10.44	5	5972	10.6	1	6375	10.42	6	6735	10.35	11
5556	10.40	8	5988	10.47	3	6382	10.4	1	6746	10.30	4
5562	10.3	1	5997	10.50	2	6465	10.4	1	6761	10.4	1
5577	10.51	9	6008	10.6	1	6474	10.35	2	6836	10.4	1
5585	10.60	7	6016	10.45	2	6482	10.70	3	6846	10.30	2
5595	10.50	5	6023	10.9	1	6493	10.53	3	6855	10.28	4
5605	10.38	11	6115	10.45	2	6504	10.54	5	6865	10.33	8
5613	10.45	4	6125	10.2	1	6515	10.53	3	6877	10.50	2
5644	10.50	2	6144	10.95	6	6527	10.34	9	6884	10.60	3
5737	10.6	1	6154	10.73	3	6533	10.37	3	6896	10.30	3
5742	10.4	1	6176	10.50	5	6545	10.40	2	6906	10.35	2
5758	10.4	1	6183	10.58	8	6555	10.43	7	6917	10.21	7
5761	10.5	1	6197	10.53	3	6565	10.34	11	6925	10.29	9
5795	10.50	2	6204	10.53	13	6576	10.30	7	6936	10.34	10
5803	10.40	5	6215	10.58	8	6585	10.32	9	6945	10.34	12
5817	10.35	2	6227	10.54	11	6595	10.33	13	6954	10.47	10
5834	10.55	2	6235	10.54	9	6605	10.35	4	6964	10.30	10
5845	10.50	4	6244	10.56	5	6614	10.42	11	6977	10.48	4
5855	10.44	5	6255	10.45	10	6625	10.31	9	6987	10.40	3
5866	10.55	2	6265	10.34	12	6636	10.31	7	6995	10.39	12
5874	10.54	8	6272	10.30	4	6644	10.37	3			

Appendix IIII - VZ SAGITTARII

(column key = JD-2440000, mag., number of estimates)

2628	10.5	1	3275	10.3	1	3781	10.13	3	4311	10.3	1	4764	10.4	1
2672	10.5	1	3288	10.4	1	3806	10.30	2	4325	10.4	1	4775	10.33	3
2684	10.5	1	3294	10.30	2	3816	10.4	1	4351	10.30	2	4788	10.15	2
2693	10.35	2	3305	10.25	2	3980	10.3	1	4368	10.30	2	4796	10.30	2
2710	10.7	1	3315	10.30	2	3986	10.6	1	4375	10.40	2	4805	10.3	1
2728	10.3	1	3331	10.3	1	3996	10.30	2	4387	10.3	1	4815	10.25	2
2871	10.4	1	3340	10.3	1	4004	10.3	1	4427	10.30	2	4823	10.30	2
2888	10.3	1	3361	10.30	2	4014	10.30	3	4436	10.30	3	4836	10.2	1
2895	10.33	3	3378	10.35	2	4025	10.25	2	4454	10.30	2	4847	10.30	3
2906	10.40	2	3395	10.30	2	4035	10.05	2	4470	10.3	1	4852	10.30	2
2916	10.3	1	3404	10.2	1	4044	10.30	2	4485	10.30	2	4868	10.3	1
2926	10.35	2	3421	10.1	1	4055	10.20	2	4498	10.25	2	4876	10.35	2
2936	10.4	1	3436	10.2	1	4064	10.30	2	4522	10.35	2	4930	10.3	1
2946	10.30	2	3448	10.3	1	4074	10.35	2	4535	10.20	2	4995	10.35	2
2955	10.3	1	3454	10.4	1	4085	10.20	2	4545	10.30	2	5007	10.4	1
2964	10.3	1	3544	10.20	2	4095	10.5	1	4557	10.3	1	5015	10.30	2
2975	10.35	2	3579	10.3	1	4104	10.20	2	4572	10.3	1	5032	10.3	1
2983	10.3	1	3606	10.4	1	4112	10.50	3	4629	10.1	1	5042	10.3	1
3005	10.3	1	3616	10.40	2	4125	10.35	2	4637	10.4	1	5052	10.35	2
3012	10.3	1	3628	10.1	1	4135	10.3	1	4643	10.3	1	5064	10.30	4
3023	10.3	1	3636	10.30	2	4144	10.30	2	4675	10.3	1	5074	10.30	2
3036	10.3	1	3654	10.30	3	4156	10.4	1	4683	10.3	1	5084	10.30	3
3046	10.30	2	3662	10.4	1	4162	10.3	1	4696	10.47	3	5095	10.3	1
3055	10.4	1	3673	10.4	1	4172	10.2	1	4703	10.5	1	5105	10.3	1
3067	10.3	1	3702	10.4	1	4188	10.3	1	4711	10.7	1	5116	10.30	2
3079	10.4	1	3715	10.4	1	4202	10.05	2	4719	10.8	1	5124	10.3	1
3236	10.2	1	3727	10.45	2	4266	10.35	2	4726	10.8	1	5135	10.30	3
3248	10.5	1	3730	10.2	1	4276	10.4	1	4736	10.80	2	5150	10.40	2
3257	10.30	2	3747	10.28	5	4285	10.6	1	4745	10.60	2	5173	10.35	2
3262	10.4	1	3750	10.4	1	4296	10.2	1	4753	10.45	2	5188	10.3	1

5198	10.30	2	5585	10.19	9	6321	12.75	2	6727	10.58	6
5204	10.23	4	5596	10.19	7	6341	12.6	1	6735	10.47	7
5225	10.23	6	5605	10.18	9	6367	12.15	1	6744	10.50	5
5235	10.35	2	5614	10.25	2	6374	11.76	5	6821	11.0	1
5245	10.30	2	5634	10.3	1	6464	11.50	4	6824	11.5	1
5258	10.27	3	5646	10.23	3	6473	11.35	2	6827	11.7	1
5268	10.25	2	5660	10.2	1	6482	11.30	2	6837	12.50	2
5285	10.27	3	5725	10.2	1	6494	11.37	3	6845	<12.3	1
5296	10.3	1	5730	10.3	1	6503	11.43	3	6857	11.88	4
5362	10.3	1	5757	10.30	2	6513	11.38	4	6864	11.68	11
5373	10.30	2	5764	10.30	2	6524	11.10	10	6877	11.43	3
5389	10.3	1	5793	13.0	1	6533	11.17	3	6885	11.13	9
5398	10.3	1	5795			6545	11.10	2	6895	10.87	7
5413	10.30	2	to	<13.0	15	6556	11.06	10	6906	10.63	7
5421	10.2	1	5843			6566	10.88	8	6916	10.56	10
5434	10.25	2	5847	13.0?	1	6575	10.90	8	6925	10.52	9
5447	10.4	1	5851			6585	10.92	11	6936	10.46	10
5458	10.3	1	to	<13.0	34	6596	10.88	16	6945	10.42	14
5464	10.30	2	5938			6605	10.83	7	6953	10.38	12
5477	10.30	2	5940	14.0?	1	6615	10.86	14	6964	10.36	12
5487	10.3	1	5962			6625	10.76	13	6977	10.46	5
5494	10.25	2	to	<13.4		6636	10.79	9	6987	10.43	3
5504	10.20	2	6225			6645	10.81	7	6995	10.40	11
5517	10.30	2	6233	14.2?	1	6655	10.85	2			
5526	10.27	3	6239	14.6?	1	6667	10.73	4			
5531	10.3	1	6241			6676	10.75	11			
5546	10.20	2	to	<12.8	22	6684	10.79	7			
5556	10.30	3	6265			6695	10.62	5			
5563	10.30	2	6267	13.1	1	6704	10.57	6			
5577	10.22	7	6292	12.8	1	6716	10.53	6			

Appendix V - RS TELESCOPII

(column key = JD-2440000, mag., number of estimates)

3222	10.3	1	3636	10.51	7	4016	11.18	4	4384	9.90	4	4763	9.80	3	5115	10.10	4
3236	10.8	1	3645	10.27	3	4025	11.32	6	4395	10.10	9	4777	9.88	6	5122	10.05	2
3248	10.7	1	3656	10.46	10	4036	11.38	5	4405	10.15	4	4785	9.93	7	5136	10.18	6
3257	10.70	2	3664	10.51	7	4047	11.33	4	4412	9.97	3	4797	9.67	3	5145	10.02	6
3275	10.5	1	3674	10.16	5	4053	11.20	3	4425	9.93	9	4807	9.87	3	5155	9.75	4
3286	10.50	4	3685	10.44	5	4067	10.93	4	4436	9.93	8	4813	9.90	6	5165	9.84	5
3294	10.70	2	3694	10.53	3	4075	10.90	6	4445	9.85	2	4824	9.90	7	5173	9.89	7
3305	10.70	2	3704	10.50	7	4085	10.73	3	4455	9.91	8	4835	9.90	3	5190	10.05	2
3315	11.65	2	3715	10.43	8	4097	10.60	2	4464	9.88	5	4846	9.94	12	5198	10.00	5
3335	11.56	5	3726	10.23	8	4104	10.40	5	4472	9.96	3	4852	9.98	4	5204	10.02	9
3344	11.35	2	3732	10.05	4	4113	10.80	2	4485	9.88	13	4866	10.07	7	5216	9.93	4
3359	11.8	1	3746	10.44	7	4126	10.72	5	4495	9.96	8	4876	10.16	8	5225	9.71	14
3364	11.77	3	3755	10.20	6	4137	10.40	3	4515	10.10	7	4884	9.91	7	5236	9.95	4
3373	11.10	2	3763	10.03	3	4145	10.48	4	4522	9.75	4	4897	9.90	5	5248	10.03	4
3383	10.93	3	3777	10.38	6	4156	10.18	5	4536	9.84	5	4906	9.85	8	5257	10.08	6
3395	10.65	2	3784	10.14	7	4168	10.43	4	4546	10.10	3	4928	10.05	2	5264	9.90	4
3404	10.90	3	3796	10.03	4	4173	10.20	5	4556	10.05	2	4932	10.2	1	5278	9.83	3
3415	10.65	2	3805	10.05	11	4187	10.38	5	4572	10.1	1	4941	9.9	1	5285	10.10	2
3424	10.78	6	3816	10.10	7	4196	10.34	5	4614	10.0	1	4953	10.2	1	5295	10.3	1
3435	11.12	5	3825	10.03	4	4202	10.23	3	4637	9.7	1	4994	9.80	2	5311	10.8	1
3446	11.70	2	3832	10.20	5	4260	10.2	1	4643	9.8	1	5007	9.9	1	5342	10.6	1
3454	10.9	1	3902	10.20	2	4276	10.3	1	4675	10.2	1	5015	9.75	2	5356	11.75	2
3476	12.20	2	3915	10.1	1	4296	10.4	1	4683	9.8	1	5035	10.00	2	5362	11.7	1
3482	12.50	3	3926	10.1	1	4302	10.7	1	4695	9.70	2	5045	10.07	3	5373	11.20	2
3544	11.40	2	3942	10.5	1	4311	10.8	1	4704	10.15	2	5055	10.23	3	5385	10.97	3
3586	11.1	1	3957	10.00	2	4320	10.5	1	4714	9.77	3	5065	9.93	3	5393	11.40	3
3591	11.3	1	3975	10.55	2	4347	10.45	2	4724	9.80	2	5075	9.97	3	5413	11.80	2
3606	10.55	4	3985	10.62	6	4353	10.03	3	4734	9.70	3	5085	9.95	4	5434	10.90	3
3612	10.50	4	3994	10.82	5	4369	10.23	3	4746	10.03	3	5095	9.95	2	5447	11.1	1
3628	10.55	2	4004	10.7	1	4374	10.13	3	4753	9.98	5	5106	10.03	4	5458	11.6	1

5466	11.65	2	5837	10.48	4	6183	10.15	15	6565	10.88	13	6894	10.24	8
5477	11.70	2	5846	10.38	9	6196	10.20	5	6576	11.19	9	6906	10.24	7
5488	11.95	2	5855	10.30	17	6205	10.15	15	6585	11.39	14	6916	10.27	14
5495	11.89	7	5865	10.57	6	6215	9.99	12	6595	11.58	20	6925	10.29	14
5503	12.10	2	5875	10.36	18	6227	10.08	8	6605	11.66	8	6936	10.46	15
5517	12.25	2	5885	10.41	8	6236	10.25	10	6615	11.57	16	6945	10.24	16
5527	12.83	7	5898	10.36	8	6244	10.06	8	6625	11.43	18	6954	10.08	13
5532	13.15	2	5905	10.34	15	6255	10.14	19	6635	11.26	13	6964	10.08	13
5547	<13.0	8	5915	10.41	13	6265	10.22	17	6644	10.84	9	6976	10.10	8
5556	<13.1	17	5925	10.26	5	6272	10.21	7	6654	10.66	10	6986	9.94	7
5576	<13.2	11	5934	10.33	21	6285	10.30	13	6667	10.47	7	6995	10.15	18
5586	13.65	2	5941	10.35	4	6295	10.35	17	6675	10.41	14			
5596	13.15	4	5956	10.25	4	6305	10.93	7	6684	10.29	9			
5605	13.21	14	5966	10.11	8	6315	11.67	13	6696	10.52	16			
5614	12.86	5	5974	10.23	9	6322	13.07	6	6705	10.47	11			
5625	12.10	2	5986	10.23	10	6336			6715	10.39	9			
5636	11.84	5	5996	10.09	14	to	<13.0	40	6726	10.41	8			
5645	11.86	5	6005	10.10	6	6409			6735	10.44	20			
5661	11.60	4	6015	10.07	3	6444	12.15	2	6745	10.38	6			
5673	11.6	1	6022	10.20	3	6454	11.85	2	6755	10.35	2			
5714	10.65	2	6033	10.30	3	6465	11.60	4	6763	10.43	3			
5723	10.9	1	6091	10.2	1	6474	11.36	5	6771	10.2	1			
5730	10.5	1	6101	10.05	2	6481	11.60	2	6816	10.3	1			
5742	10.7	1	6115	9.87	6	6494	10.69	7	6823	10.10	3			
5757	10.80	2	6127	9.8	1	6503	10.67	6	6836	10.4	1			
5764	10.55	2	6136	10.00	2	6514	10.45	4	6846	10.23	3			
5796	10.50	3	6144	10.18	9	6527	10.46	10	6855	10.17	7			
5803	10.40	5	6153	10.14	7	6535	10.33	4	6865	10.17	9			
5818	10.44	8	6166	9.98	6	6545	10.30	3	6877	10.30	2			
5826	10.67	3	6176	10.14	8	6555	10.80	10	6885	10.27	12			

A LIGHT CURVE FOR RU SCORPII - A MIRA VARIABLE STAR.

by

A.W.Dodson
Variable Star Section, R.A.S.N.Z.

1. INTRODUCTION.

The work presented here is a computer generated plot taken from Variable Star Section ledger entries. The original programmme was written and supplied by Ranald McIntosh and has been restructured by the author to run on an Amstrad CPC 464 or 6128 personal computer. All observations have been made by using chart No. 37. (1).

2. OBSERVATIONS.

Observations cover the interval JD 2434540 (1953 June 11) to JD 2446571 (1985 May 20). Contributions from individual observers are listed in table 2. All observations were made visually. There was generally good coverage of both maxima and minima up to 1962 but from thence onwards minima was less well observed mainly for two reasons.

(i) Experienced observers shifted their attention other more important stars.

(ii) Minima started to co-incide with the star's conjunction with the Sun (mid December).

3. THE LIGHT CURVE.

The light curves, plotted from 10 day means, are shown in figures 1a to 1n. The symbols in figure 2. indicate the number of observations in each mean which range from 1 to 11. Julian dates are shown at the bottom of each scale and the beginning of each calendar year is shown at the top. Magnitudes ranges are shown at the left and right hand sides of the scales. Each graph covers the period of 1,000 days. The periodic overlap on some scales is due to memory limitations of the computer. A line has been drawn through the mean range of the 10 day plots giving due consideration to the weighting of observations.

Wher maxima and minima obviously occur outside the range of recorded observations, times and magnitudes have been carefully scaled from the curve drawn through the plotted points with magnitudes taken to the nearest 1/10th.

4. DISCUSSION.

Details of observed minima and maxima are given in Table 1. Columns show the following details:

Column No.	Details.
1.	Allocated cycle numbers.
2.	JD of observed maxima.
3.	Observed mean magnitude of maxima.
4.	Interval in days from previous maxima starting from cycle 0.
5.	O-C residuals in accordance with the elements given below.
6.	JD of observed minima.
7.	Observed mean magnitude of minima.
8.	Interval in days from the previous minima starting from cycle 0.

O-C values are plotted in figure 3. There appears to be some case for a second order period here but no attempt has been made to analyse results.

The following elements have been derived from the observed maxima and minima:

Epoch Maximum:	JD 2440360
Period:	369.375 days
Mean Maximum Magnitude:	8.487
Range in magnitude at maximum:	7.9 - 9.3
Mean minimum magnitude:	13.787
Range in magnitude at minimum	13.5 - 14.0

5. CONCLUSIONS.

RU Scorpii is a Mira type variable star with a maximum brightness that can vary up to 0.9 magmitudes from one cycle to another. Brightness at observed minima is fairly consistent varying by not more than 0.5 magnitudes between one cycle to the next. The light curves exhibit a somewhat uniform saw-tooth form, staying at maxima for a very short period before declining to minima. On some cycles, there appears to be a pause in the rate of brightening on the rising slope of the curve at magnitude 11.

6. ACKNOWLEDGEMENTS.

I wish to thank all observers for their records. I am also grateful to Dr. Frank Bateson for his guidance an assistance and to Mr. Ranald McIntosh for supplying the initial computer programme used to generate the light curves.

(1). Bateson, F.M. & Jones, A.F.: Charts for Southern Variable Stars (Series 2.)

TABLE 1.

173543 RU SCORPII.

OBSERVED MAXIMA AND MINIMA.

Cycle No.	JD Maximum	Mv. Max.	Int. days	O-C	JD Minimum	Mv. Min.	Int. days
-15	2434801	8.6	369	-0	2434981	13.4	356
-14	5170	8.5	395	+26	5337	13.9	371
-13	5565	9.0	361	-8	5708	13.9	392
-12	2435926	8.3	368	-1	2436100	13.8	372
-11	6294	8.5	379	+10	6472	14.0	354
-10	6673	9.2	367	-2	6826	13.9	373
-9	2437040	8.5	337	-32	2437199	13.5	371
-8	7377	8.5	377	+8	7570	13.6	357
-7	7554	8.5	386	+17	7927	13.8	382
-6	2438140	8.5	359	-10	2438309	13.8	-
-5	8499	8.6	352	-17	-	-	-
-4	8881	8.6	351	-18	-	-	-
-3	2439232	8.2	390	+21	-	-	-
-2	9622	8.7	359	-10	9787	13.8	-
-1	9981	8.0	379	+10	-	-	-
0	2440360	8.1	0	0	-	-	-
+1	2440746	8.0	386	+17	-	-	-
+2	1134	8.3	388	+19	-	-	-
+3	1500	9.3	366	-3	2441683	13.9	-
+4	2441864	8.3	364	0	2442054	14.0	371
+5	2243	8.2	379	+10	2437	13.6	383
+6	2607	8.9	364	-5	2800	13.9	363
+7	2442980	8.6	373	+4	-	-	-
+8	3352	8.3	372	-7	-	-	-
+9	3710	8.8	358	-11	-	-	-
+10	2444080	8.2	370	+1	-	-	-
+11	4446	7.9	366	-3	-	-	-
+12	4809	8.8	363	-6	-	-	-
+13	2445182	8.4	373	+40	-	-	-
+14	5539	8.3	357	-12	-	-	-
+15	5902	8.3	363	-6	-	-	-
+16	2446260	8.7	358	-12	-	-	-

TABLE 2.

RU SCORPII - OBSERVERS TOTALS

Aj	32	MN	28
Bt	51	Mt	34
Cj	42	Nk	27
Cl	20	Ov	115
Cm	22	Pk	32
Cy	28	Rg	35
Dd	76	SF	32
Gh	52	Tr	32
Hl	78	Ty	98
Hn	20	Ve	223
Jo	373	Wk	25
Jn	166	Wu	63
Ld	28	Wy	85
Mf	54		
56 Observers with less than 20 observations each			259
	TOTAL		2,130

FIGURE 2. NUMBER OF OBSERVATIONS PER 10 DAY MEAN.

0 1 to 3 observations
+ 4 to 6 observations
× 7 to 9 observations
Δ 10 or more observations.

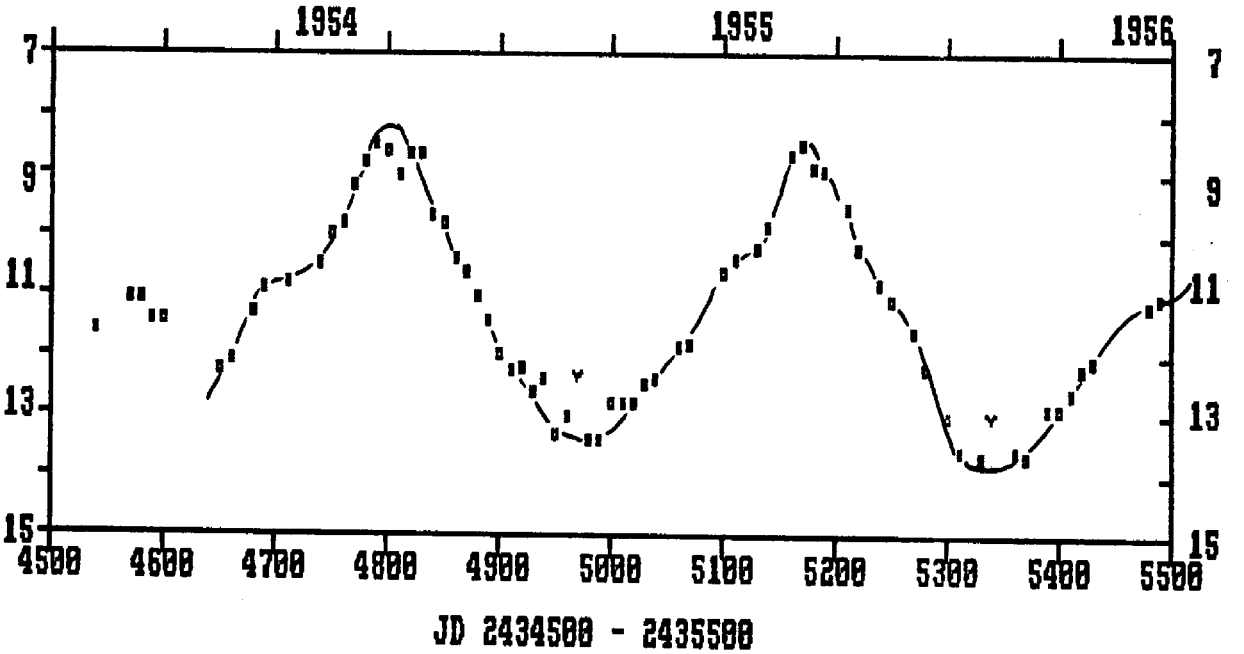

Figure 1a

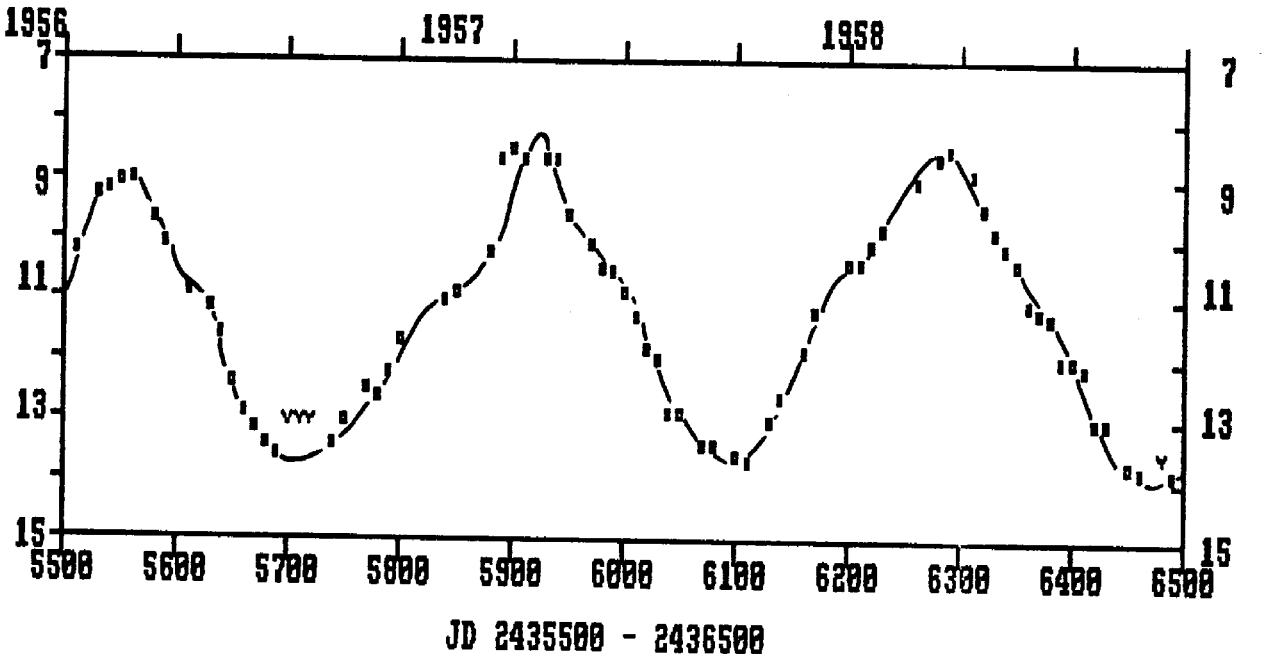

Figure 1b.

173543 RU SCORPII - LIGHT CURVES.

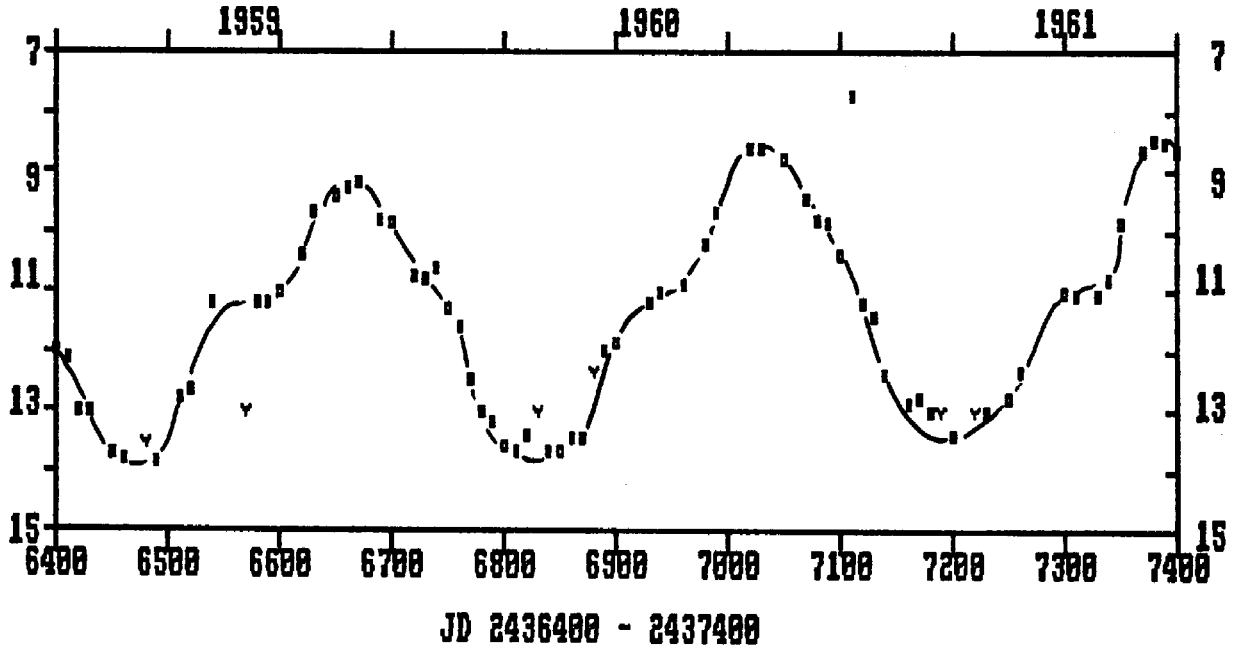

Figure 1c.

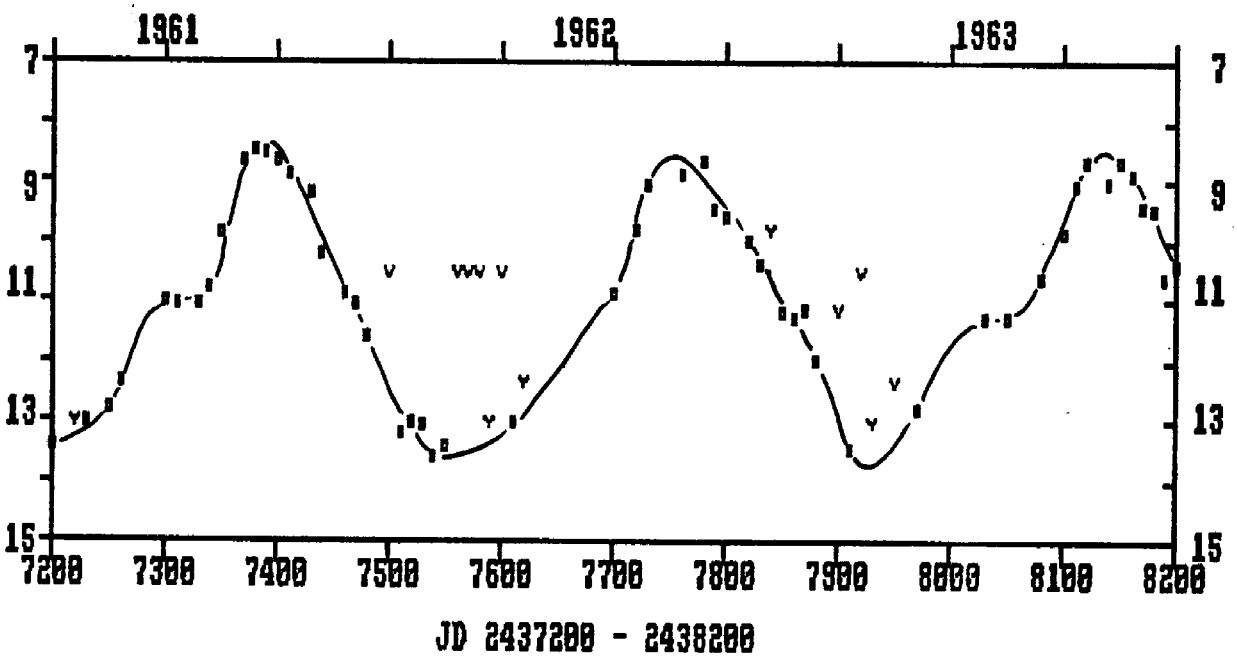

Figure 1d.

173543 RU SCORPII - LIGHT CURVES

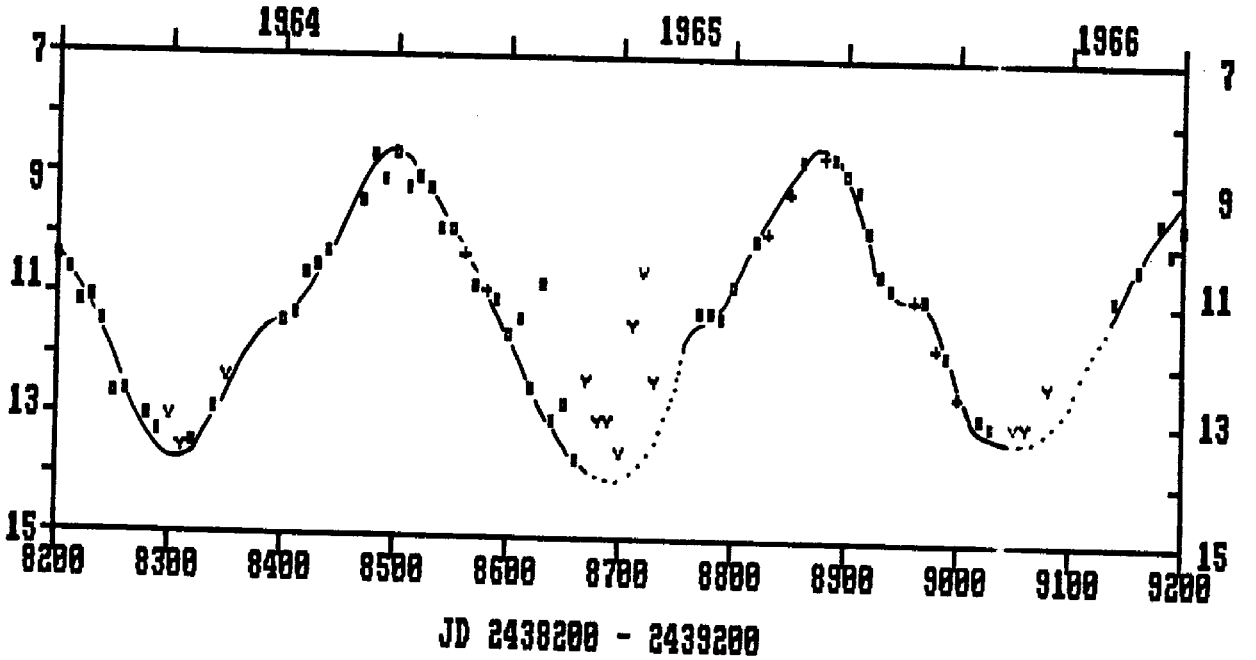

Figure 1e

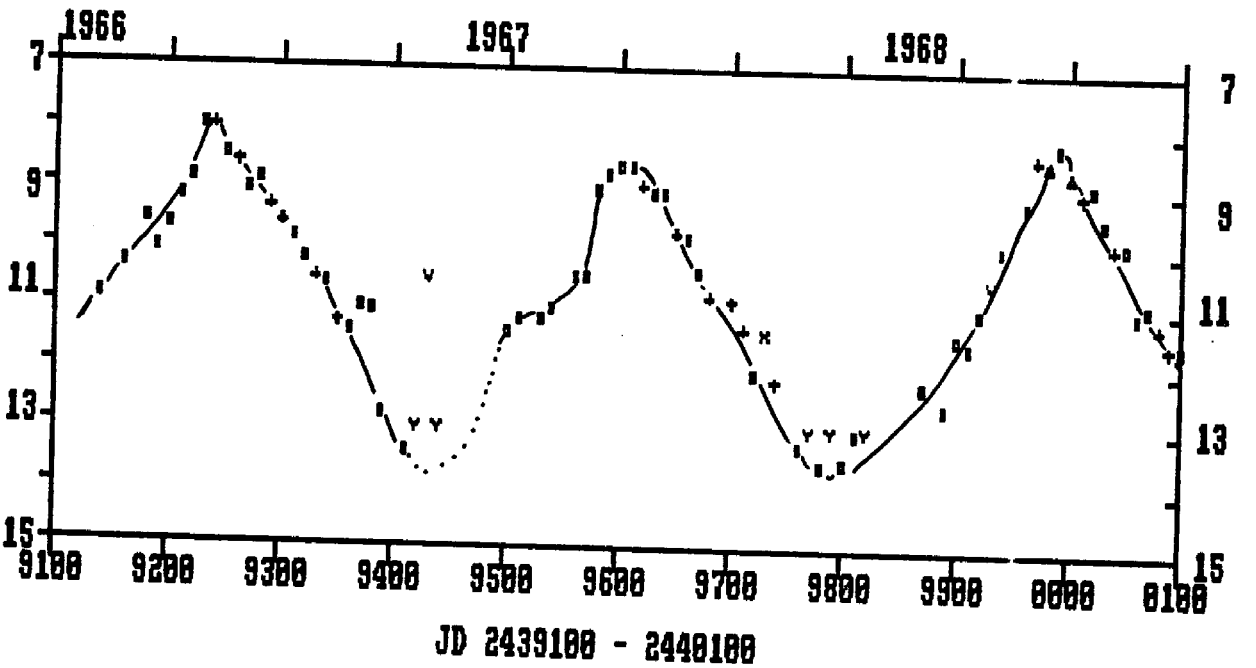

Figure 1f.

173543 RU SCORPII - LIGHT CURVES.

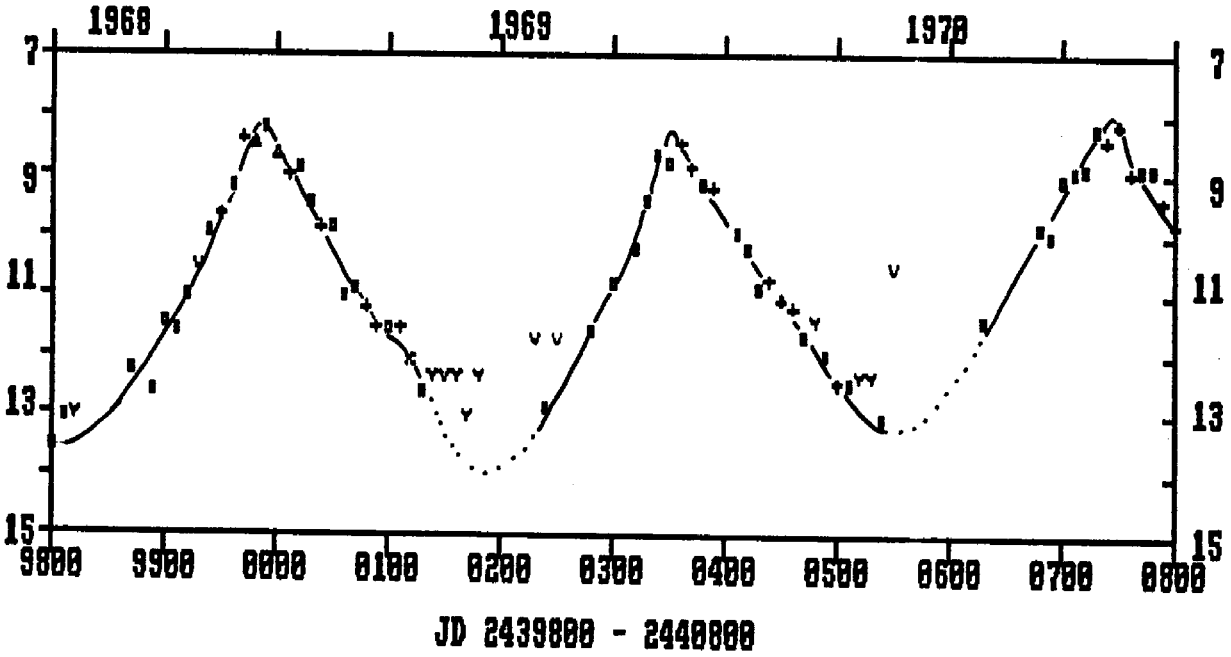

Figure 1g.

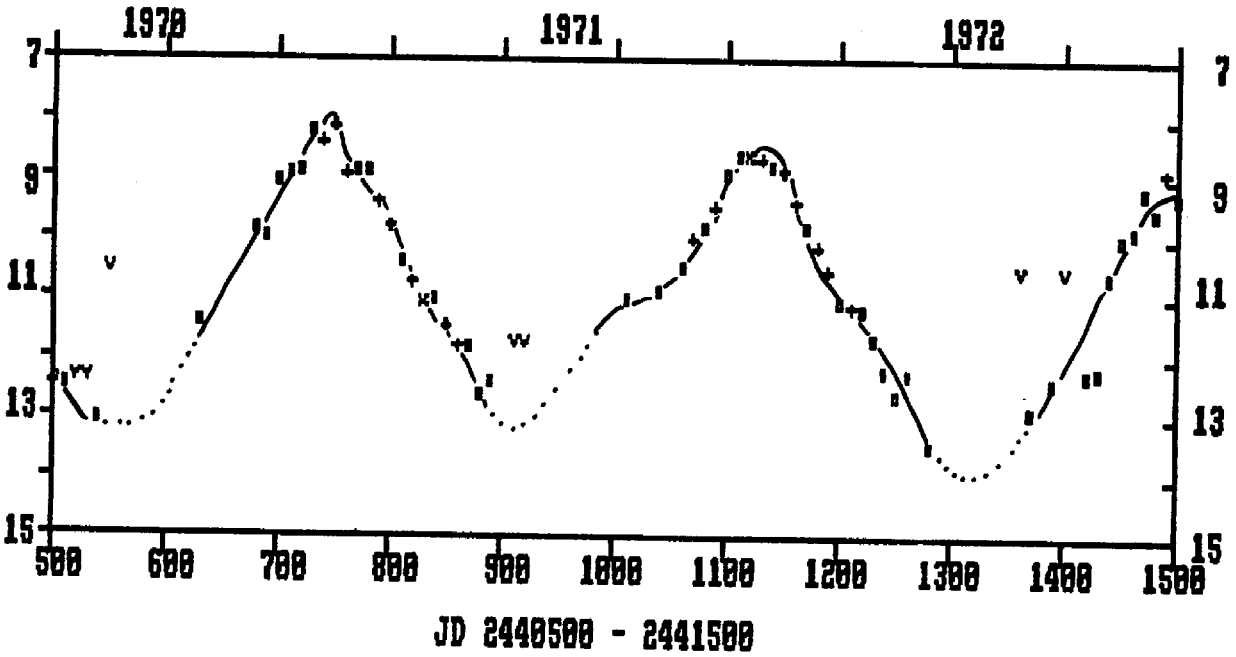

Figure 1h.

173543 RU SCORPII - LIGHT CURVES.

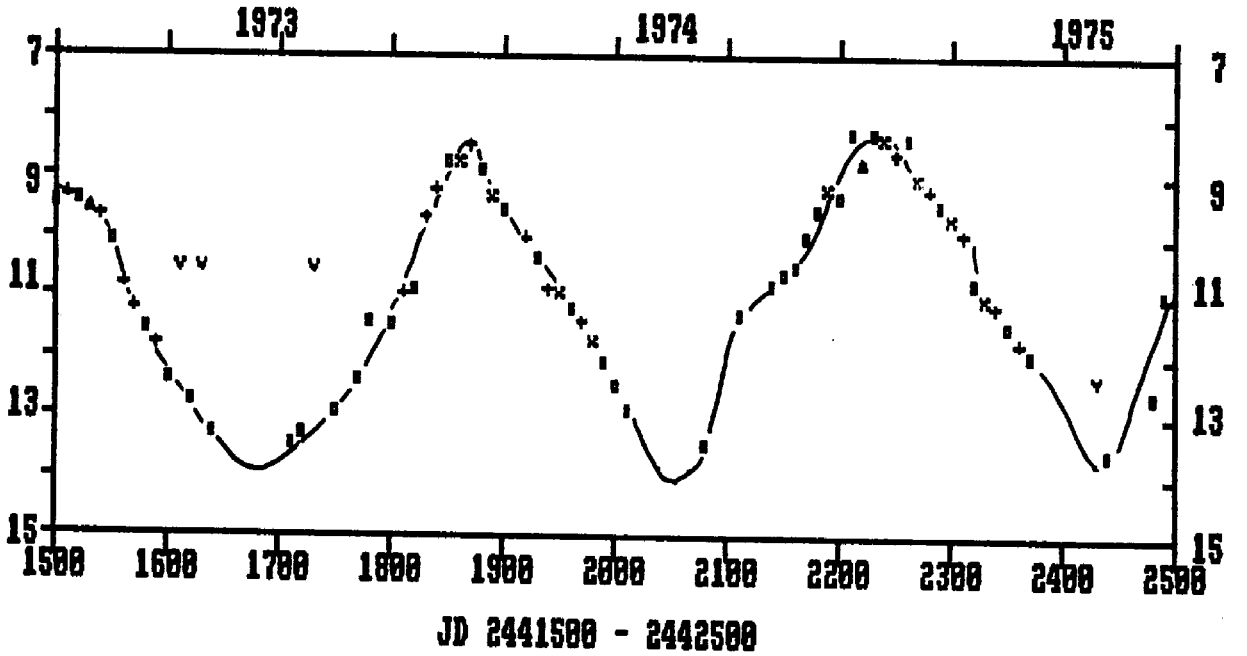

Figure 1(i).

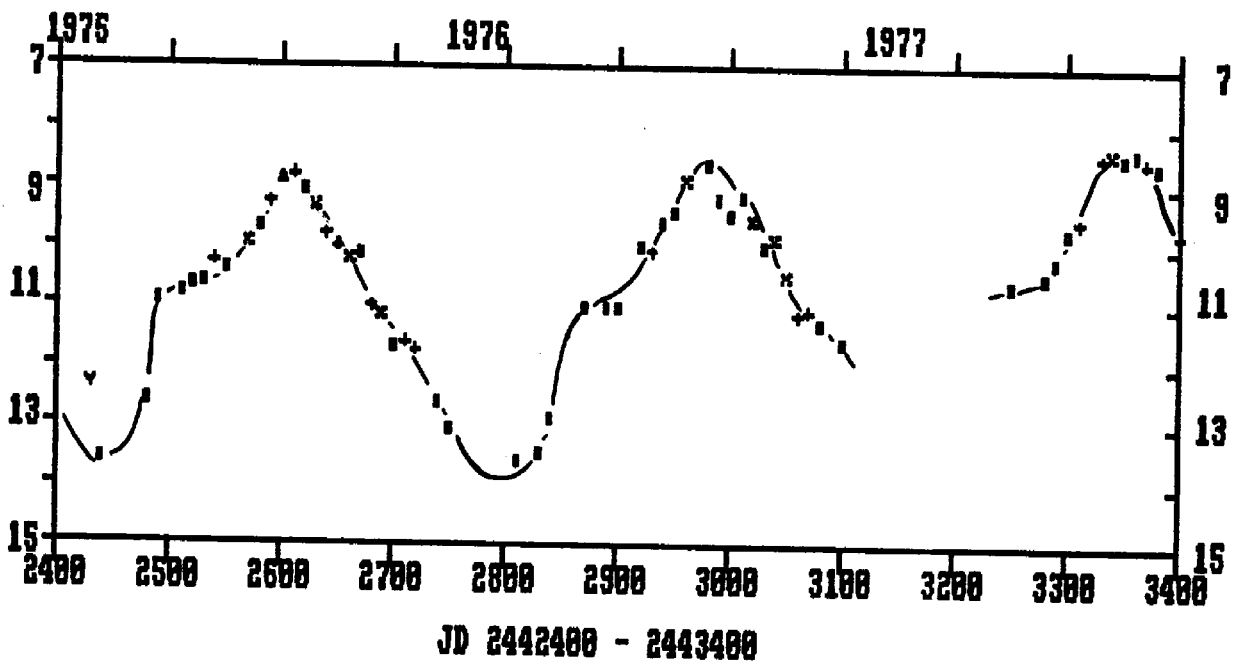

Figure 1 j.

173543 RU SCORPII - LIGHT CURVES.

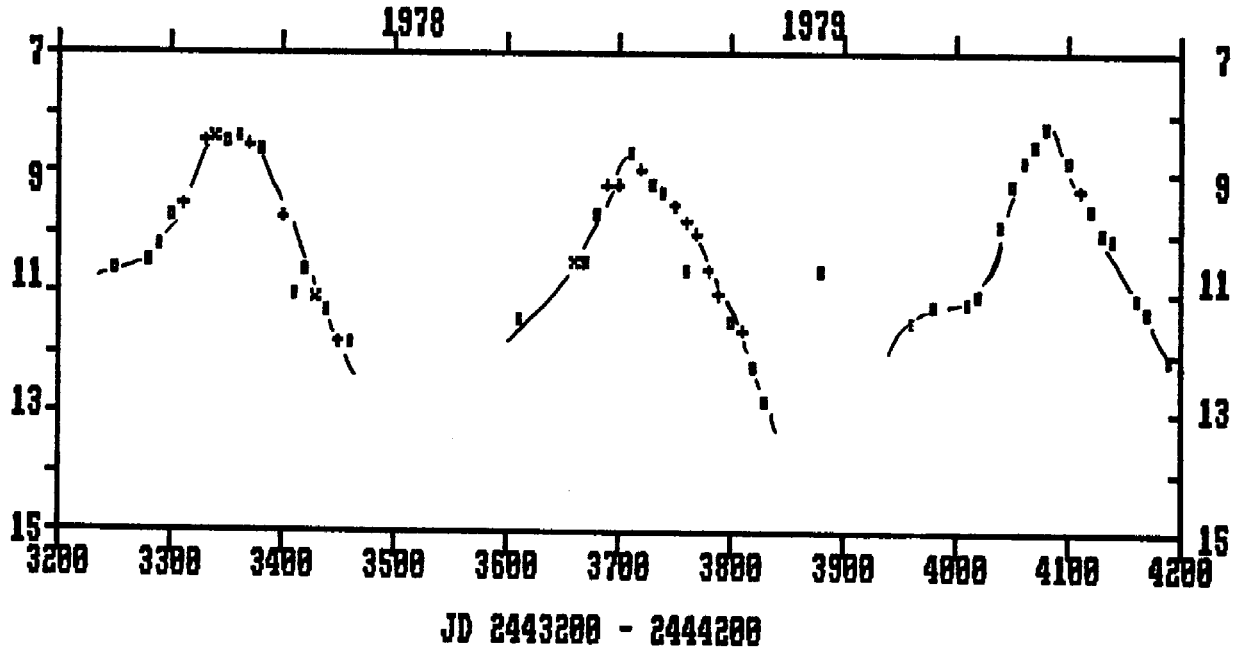

Figure 1k.

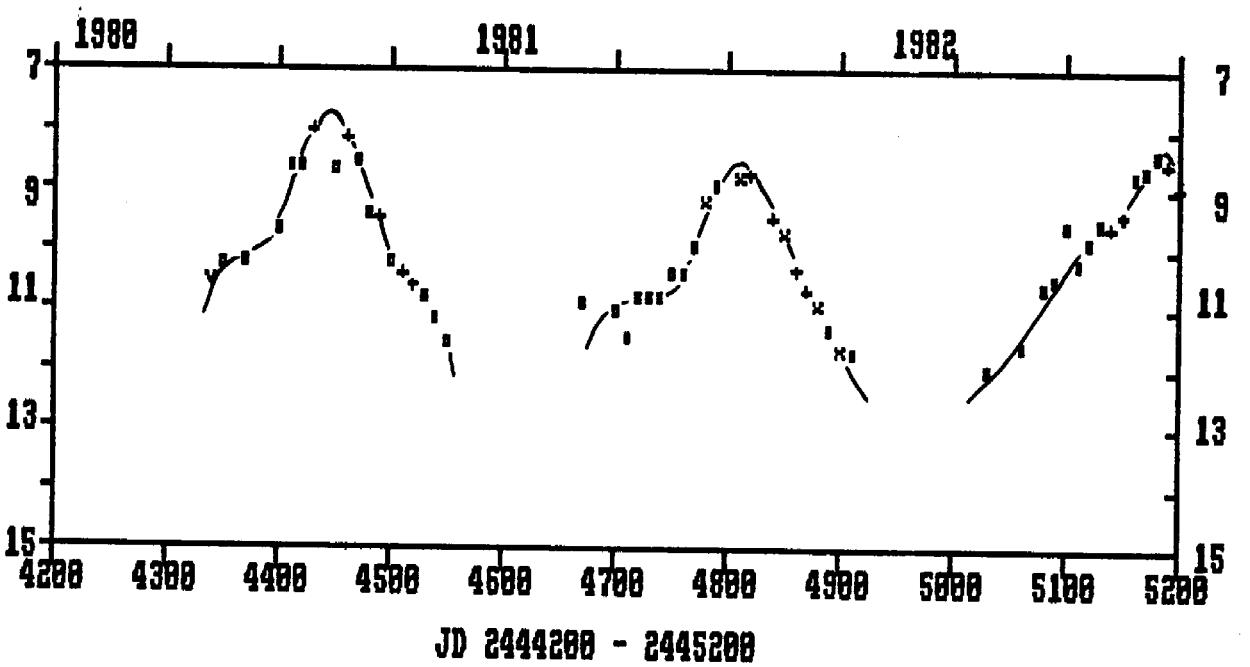

Figure 1(l)

173543 RU SCORPII - LIGHT CURVES.

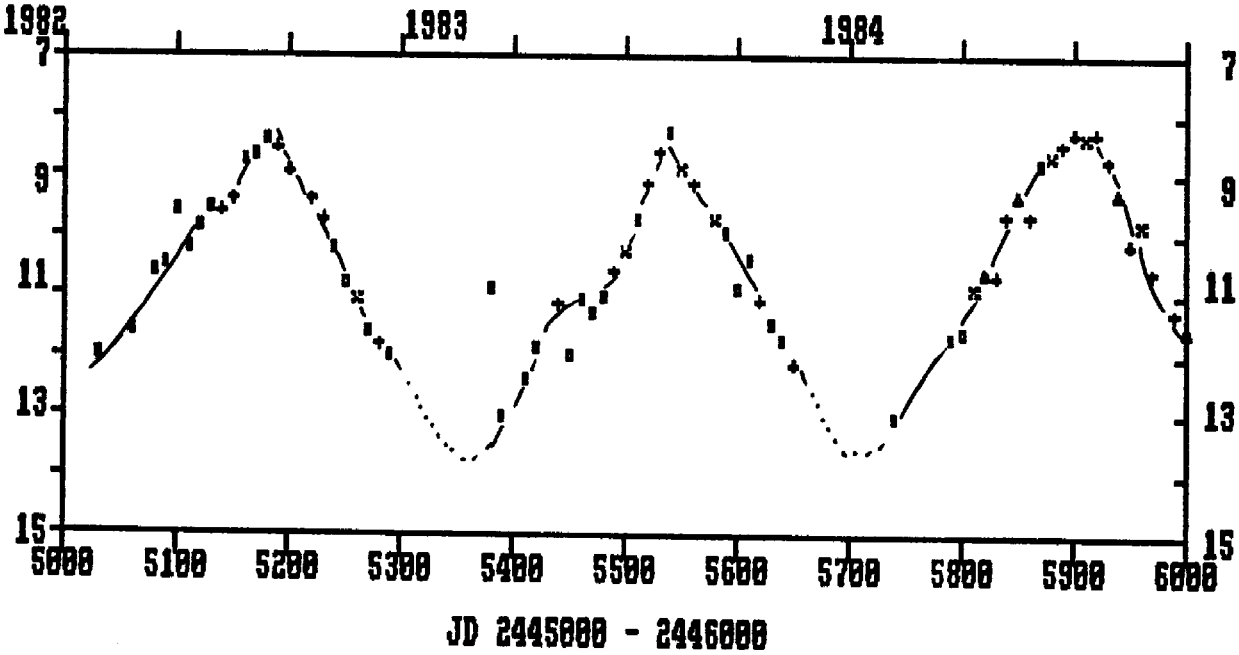

Figure 1m.

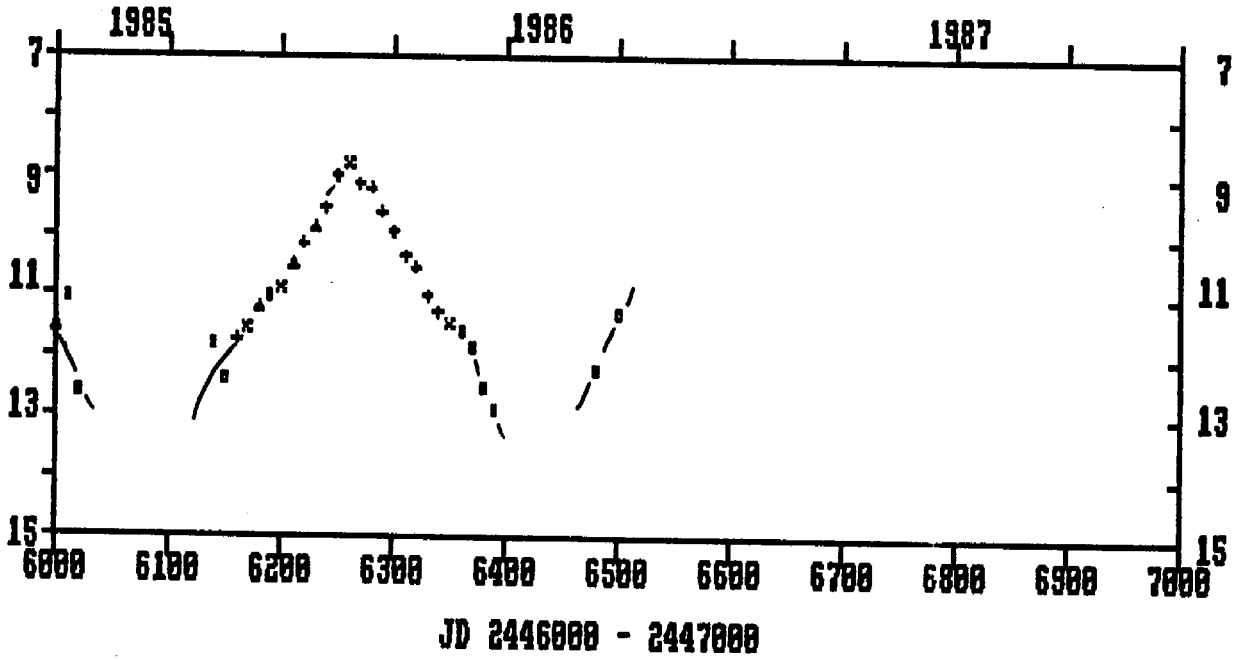

Figure 1n.

173543 RU SCORPII - LIGHT CURVES.

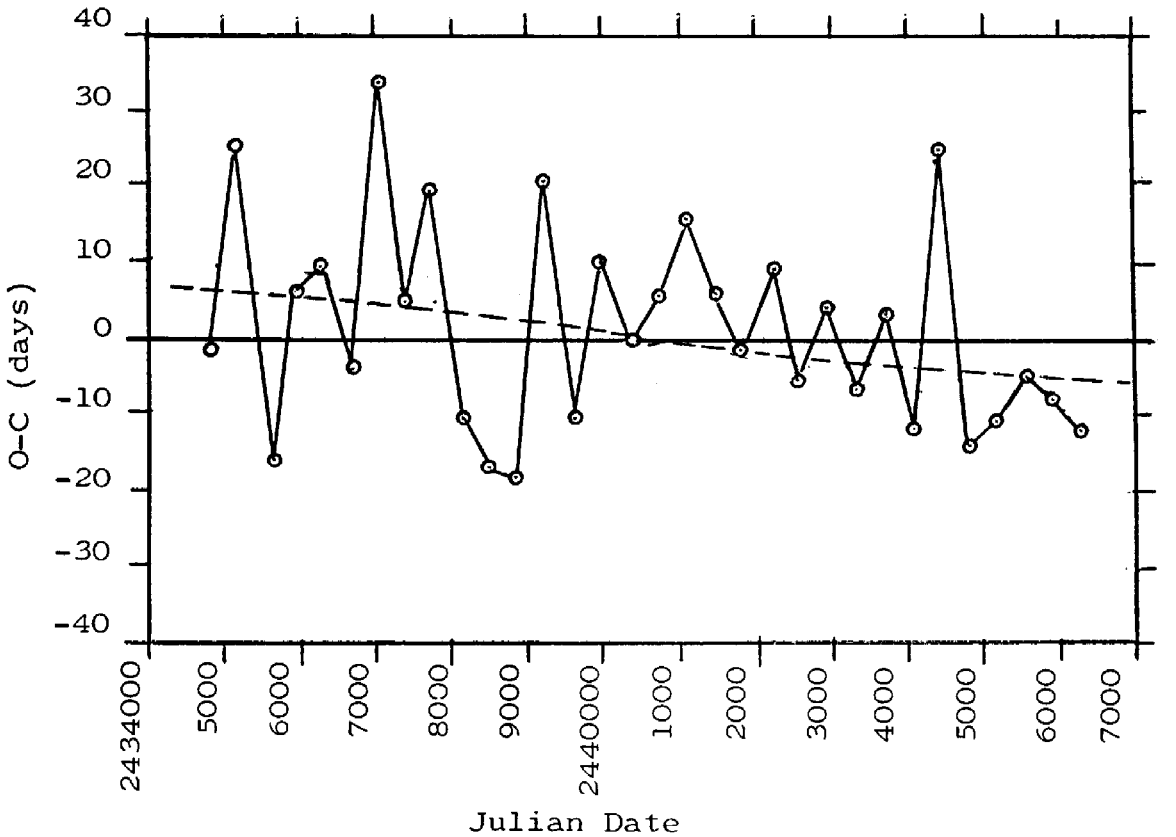

Figure 3.

RU Scorpii - O-C Residuals for Epoch Maximum JD 2440360 ± 369.375 days

ETA CARINAE

Frank M. Bateson (1), Ranald McIntosh (2) and D. Brunt (3).

(1) Director, V.S.S. R.A.S.N.Z.
(2) Director, Computing Section, R.A.S.N.Z.
(3) Member V.S.S., R.A.S.N.Z.

SUMMARY: A visual light curve is presented from 1952 April 3 to 1988 August 26. Small irregular variations appear to occur but the difficulties in observing Eta Car visually are discussed.

. . . . .

1. INTRODUCTION

Eta Car is a massive young star of S Dor type. Its history is well recorded, e.g. Prager (1), Schneller (2), Payne-Gaposchkin (3) and references therein.

2. OBSERVATIONS

Visual observations made by members of the Variable Star Section, R.A.S.N.Z. are plotted in Figures 1 to 5 as ten day means. The average number of observations in each mean was two in 1952-1960; seven in 1961-1980 and 14 in 1981-1988. Morel (4) published V magnitudes for the sequence stars. These are shown on charts 460 and 461 (5). Observations prior to 1978 were made using chart 25(6) on which the magnitudes of comparison stars differed from the V values from $0^{m}.0$ to $0^{m}.3$.

3. DISCUSSION

The purpose of close visual monitoring of Eta Car is so that any abrupt change in magnitude can be detected promptly and the astronomical community alerted to this change. Eta Car has an expanding envelope with condensations and is surrounded by nebulosity. These facts make visual observations difficult. Ideally all estimates should be made with the same instrument and under the same sky conditions. That ideal is obviously impossible to attain. However, such estimates must be treated with caution, because it is all too easy to give too much weight to apparent small variations made of an object like Eta Car.

Bateson in several issues of the Monthly Circulars, V.S.S., R.A.S.N.Z. has pointed out that the observers fall into two groups. One group systematically estimates Eta Car about $0^{m}.4$ brighter than the other group. No one group dominates the observations, especially from 1981 onwards.

The observations commenced shortly after the epoch of maximum given by Feinsetin & Marraco (7), who gave a period of 1110 days. The star in 1952 April was rising from magnitude seven. It appears that marked fluctations followed (see Fig.1), but whilst these may be genuine we consider that until the end of 1960 there are too few observations in each mean to give much weight to these variations.

From 1961 onwards the number of estimates in each mean increased. Small, irregular variations are apparent (Fig. 2 to 5). It is quite easy to fit many of the maxima to the 1110 day period. However, it is just as easy to fit them to a shorter period of around 250 days. Our opinion is that they are irregular.

It is obvious that from 1952 to 1988 Eta Car has increased very slowly in brightness. This can be seen clearly from an inspection of the figures.

4. CONCLUSIONS

We conclude that Eta Car had small, irregular variations over the interval covered by the observations. There has also been an extremely slow but definite increase in its mean brightness from 6.8 to 6.0. We believe that this rise is real and not due to the refinement of the magnitudes of the comparison stars.

ACKNOWLEDGEMENTS

We thank all observers for their valuable observations. The senior author wishes to thank Don Brunt for tabulating the ten day means and Ranald McIntosh for producing the computer light curves.

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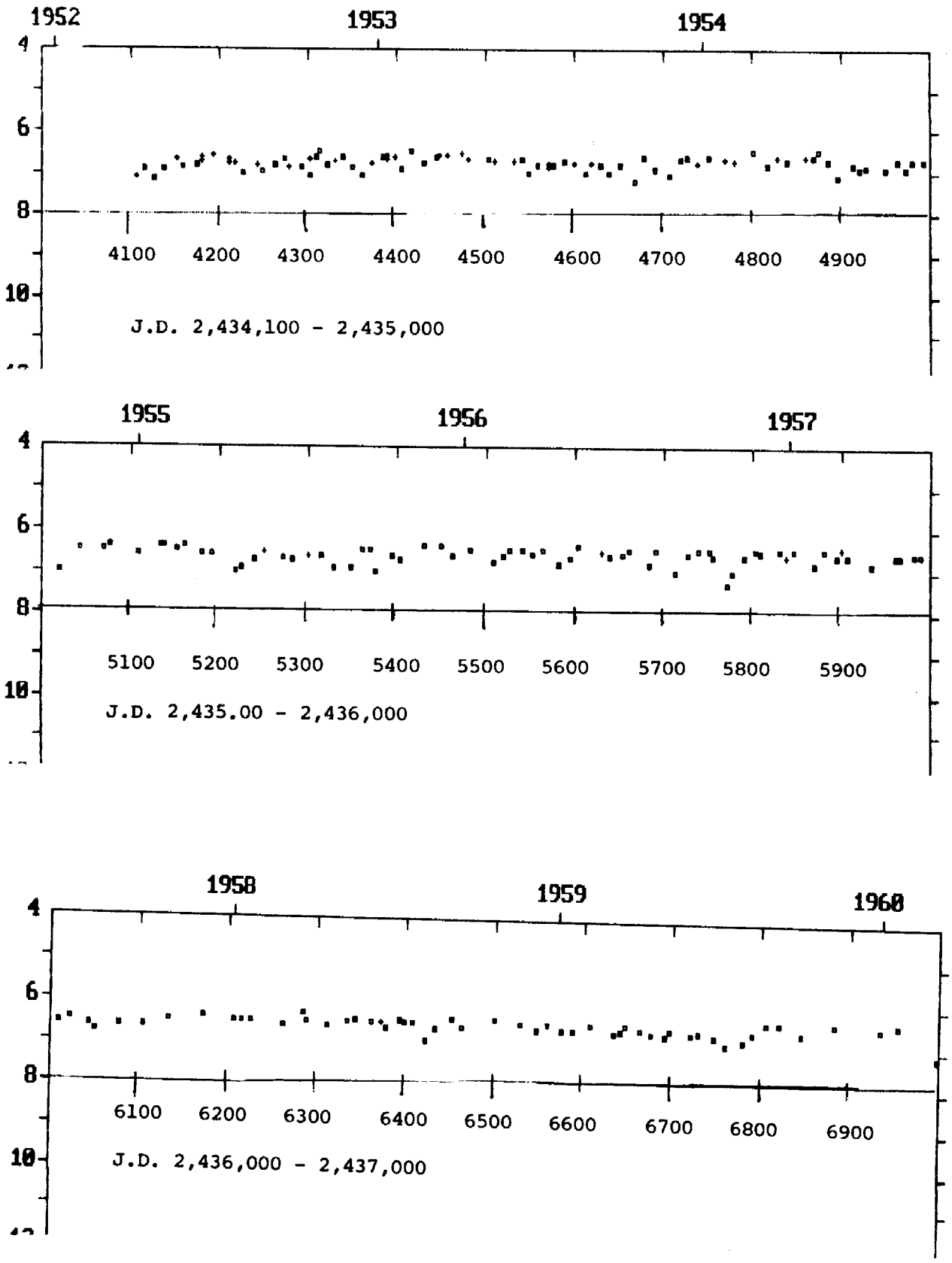


Figure. 1. Eta Carinae. Light curve from ten day means.
J.D. 2,434,100 - 2,437,000

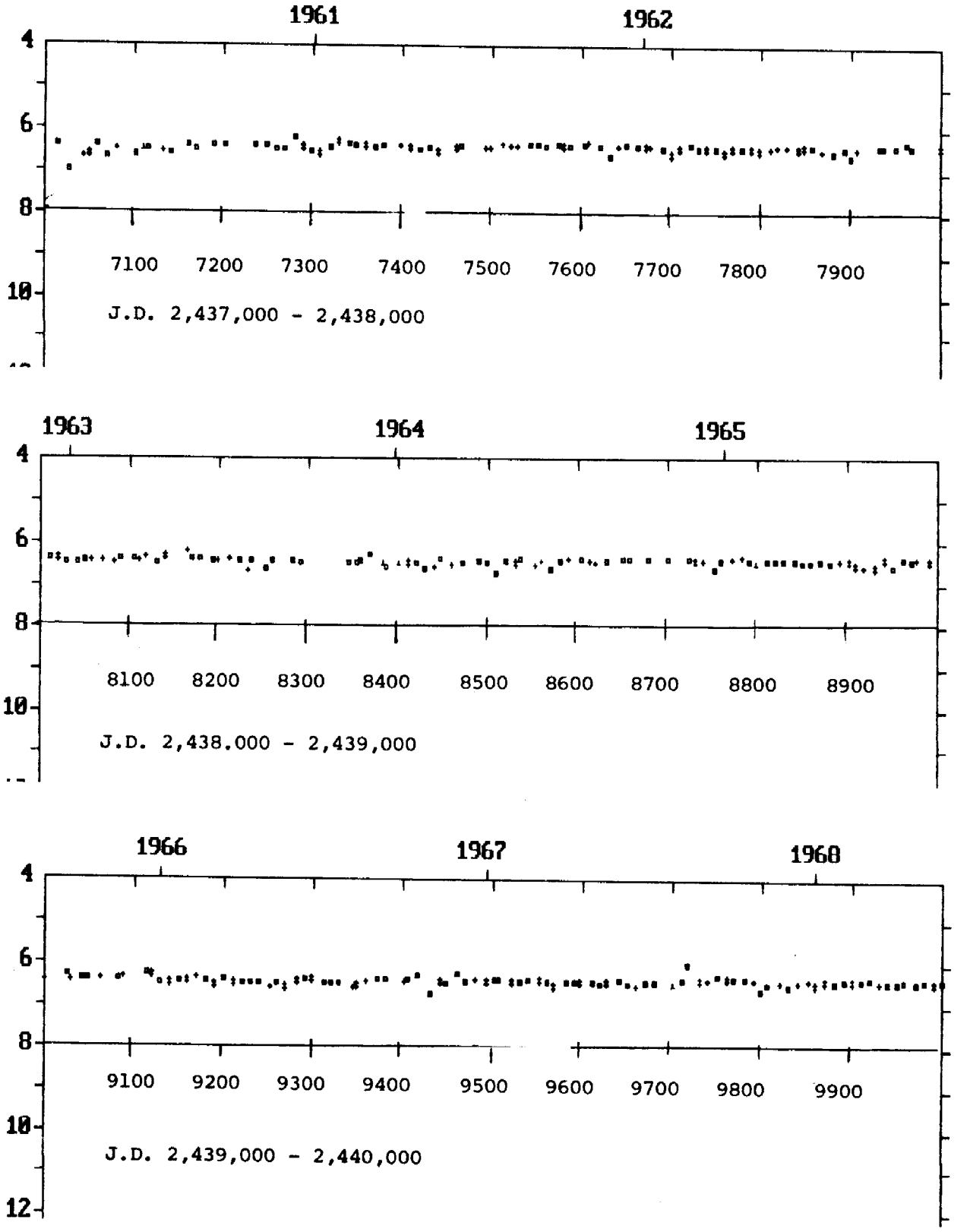


Figure 2. Eta Carinae. Light Curve from ten day means.
J.D. 2,437,000 - 2,440,000

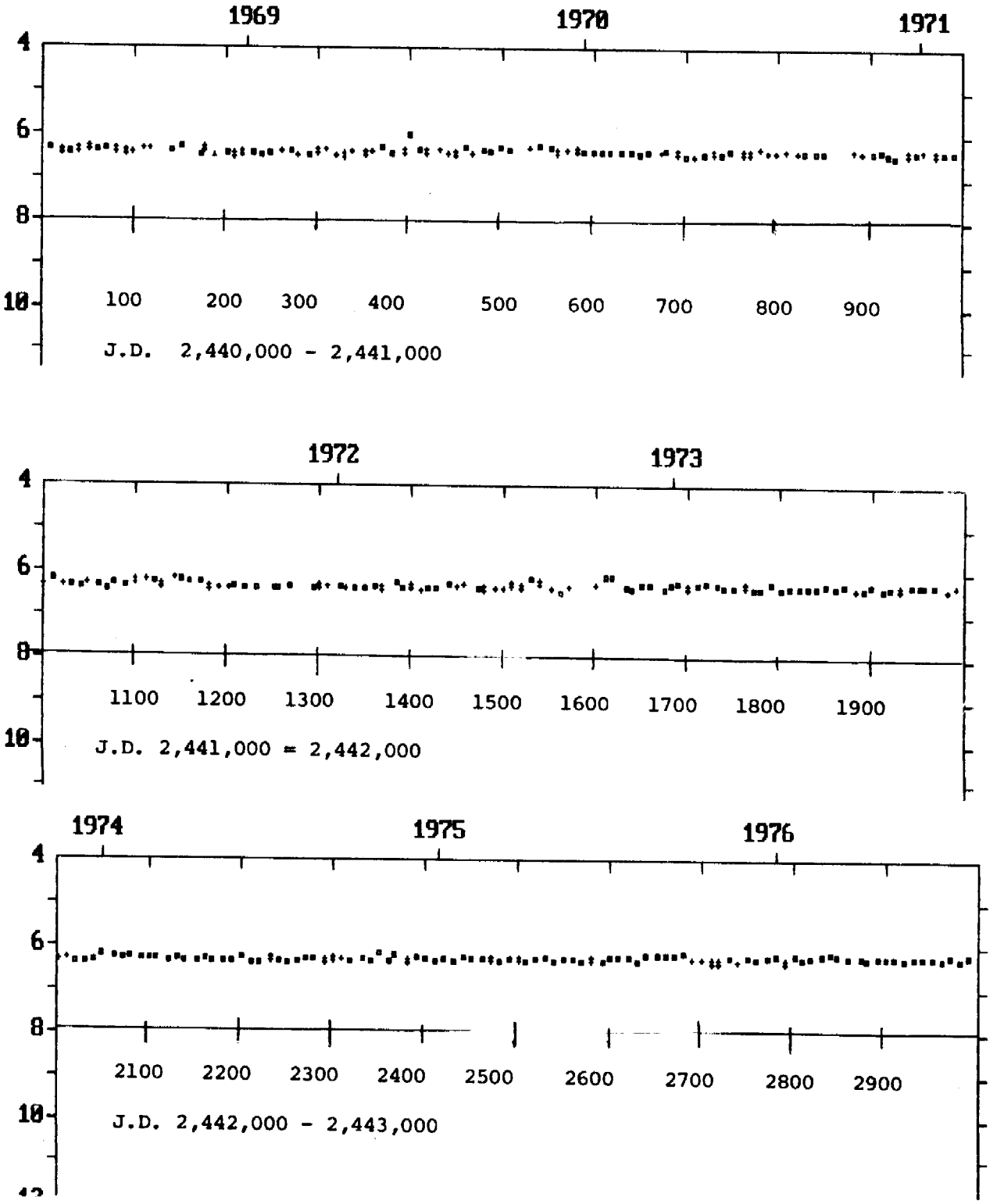


Figure 3. Eta Carinae. Light curve from ten day means.
J.D. 2,440,000 - 2,443,000

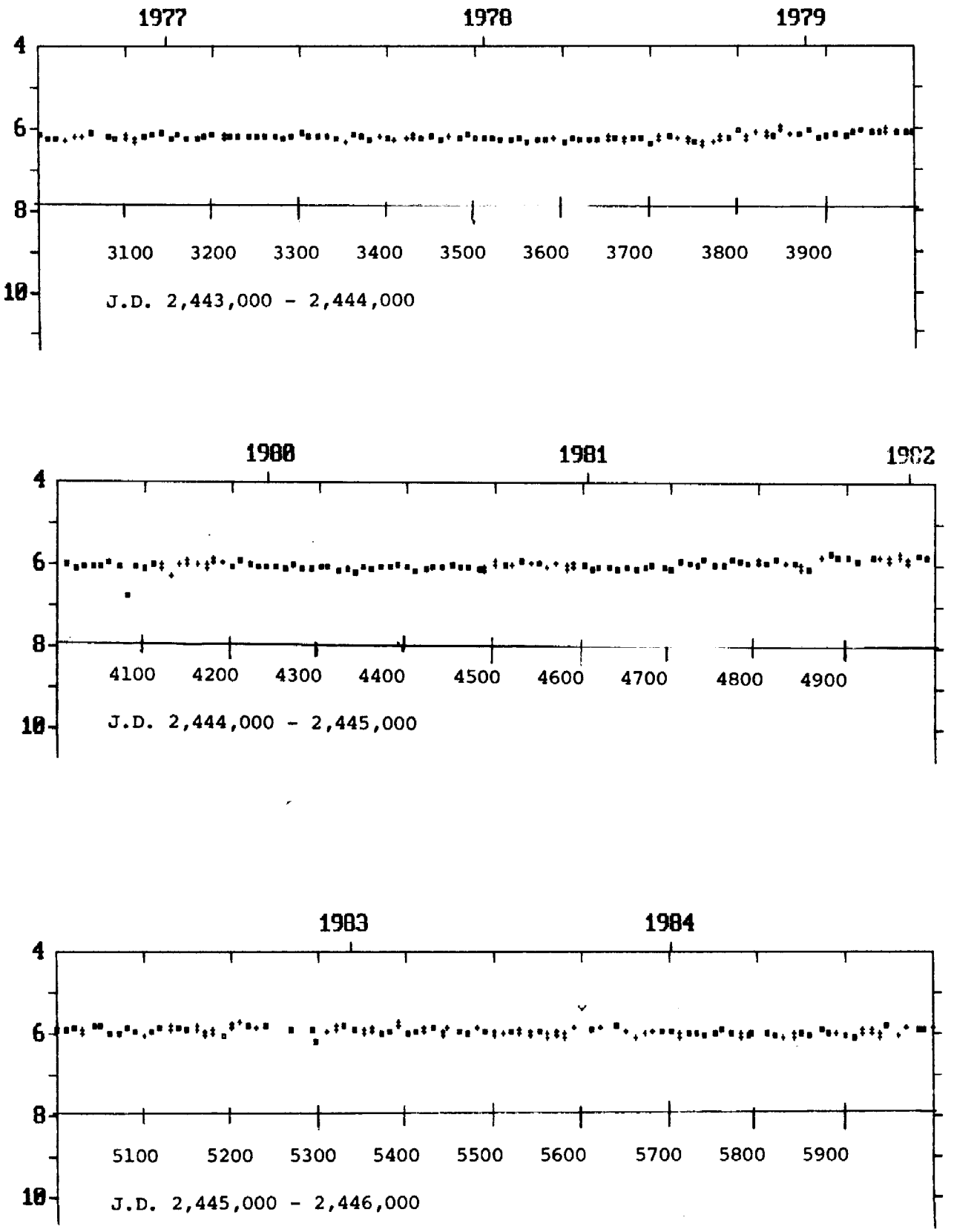
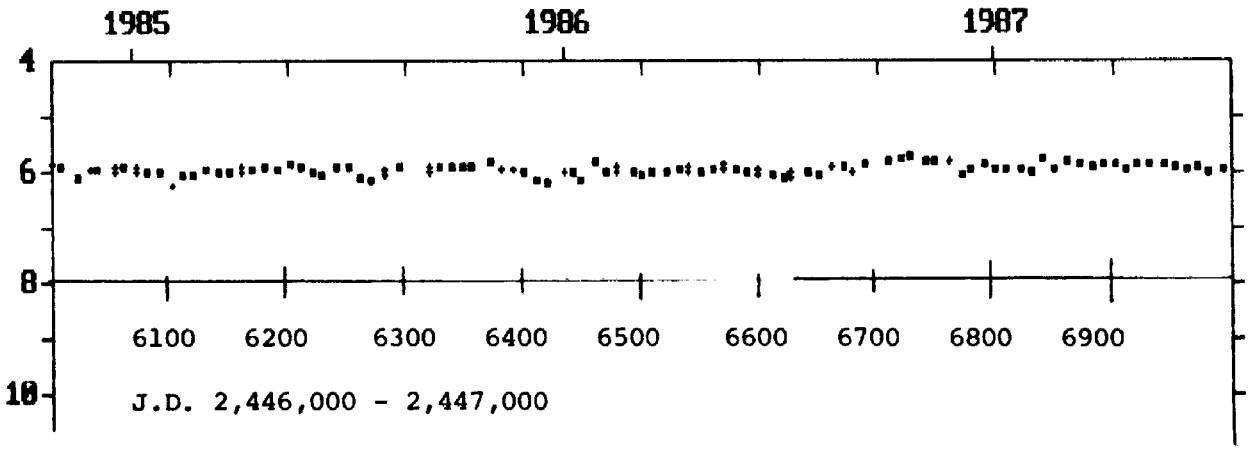


Figure 4. Eta Carinae. Light curve from ten day means

J.D. 2443,000 - 2,446,000



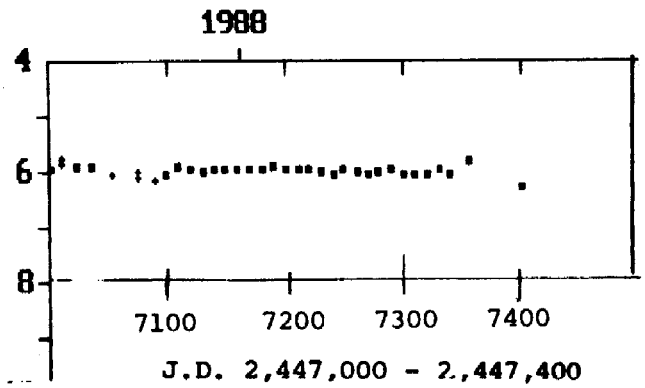


Figure 5. Eta Carinae. Light curve from ten day means.

J.D. 2,446,000 - 2,447,400

PHOTOELECTRIC SEQUENCES FOR VZ AQR, AR Pav AND V3795 SGR

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SUMMARY: Photoelectric UBV data are given for comparison stars in the fields of the three southern variable stars VZ Aqr (SS Cyg type), V3795 Sgr (RCB) and AR Pav (eclipsing Z And type),

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1. INTRODUCTION

The "Charts for Southern Variables" give finding charts for selected southern variable stars together with recommended comparison star sequences in each field. In some cases, photoelectric photometry does not exist for the comparison stars and these are identified by letters. At the request of Dr.F.M. Bateson, photoelectric UBV data have been obtained for the comparison stars to the variables VZ Aqr, AR Pav and V3795 Sgr from charts 567, 579/80 and 633/4 respectively, in Series 13 and 14 of the "Charts for Southern Variables" (1,2).

2. OBSERVATIONS

The data were obtained mostly with the 1m telescope of the South African Astronomical Observatory at Sutherland, though a few observations were made with the 0.5m telescope at the same site. The observing and reduction procedures have been briefly described in a previous paper (3) and all data were reduced to the 'E-region' standard UBV system (4),

Mean results for the comparison sequences are listed in Table 1 which uses the same convention to indicate accuracy as previous papers (see reference 3, for example). A few comments on individual stars follow the Table.

The general field of V3795 Sgr contains many very faint stars and these have undoubtedly contributed to the scatter in the results for that sequence by contaminating both 'star' and 'sky' observations, even though an image intensifier was used to select areas for sky measurement.

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TABLE 1

Star	sequence letter	V	(B-V)	(U-B)	n	Notes
VZ Aqr	b	10.004	1.050	0.820	2	
212503	d	12.936	0.546	0.016	2	
	f	14.728	0.936		2	
	g	15.57:	0.57:		2	
	h	15.471	0.68		2	
AR Pav	a	9.981	0.256	0.162	3	
181066	b	9.147	1.654	1.906	2	
	c	10.498	0.780	0.370	3	(1)
	d	9.542	0.535	0.04	2	
	e	10.091	1.040	0.819	2	
	f	10.875	1.016	0.74	2	
	g	12.255	0.490	0.006	2	
	h	12.412	1.508	1.77:	3	
	m	16.48	1.09		1	
	n	16.27	0.79::		2	
	o	14.83:	0.72		2	
	p	14.39	0.99		1	
V3795 Sgr	a	10.696	1.163	0.911	4	CoD-25° 12893 (9.0)
180725	b	11.68	0.494	0.226	3	CoD-25° 12887 (10)
	c	12.11:	0.19	0.072	3	CoD-25° 12888f
	d	12.049	0.36	-0.052	3	
	e	12.20:	0.895	0.51:	3	(2)
	f	12.398	0.94	0.41	2	
	g	12.70::	0.67:	0.46	2	
	h	13.62::	0.72::	0.18	2	(3)

V 3795 Sgr is CoD -25° 12888p

Notes

(1) close double; both stars included in aperture

(2) suspected variable but there are many very faint stars in the field which could cause problems

(3) as note (2); a faint star ~10 arcsec away could have caused poor results.

NOTE FOR VISUAL OBSERVERS

The above V magnitudes, rounded off to tenths, should be used for your estimates.

LIGHT CURVE OF THE SEMI-REGULAR VARIABLE, R SCULPTORIS

F,M. Batesin (1), R. McIntosh (2) & W.Goltz(3)

(1) Director, VSS,RASNZ.
(2) Director, Computing Section, RASNZ.
(3) Member, VSS RASNZ.

SUMMARY: It is shown that the semi-regular variable, R Sculptoris, has a persistent period with an amplitude that varies from one cycle to another. The light curve is illustrated and a Table of observed maxima and minima given. It is suggested that R Scl belongs to the SRA type of variables.

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1. INTRODUCTION

R Scl is classified as a SRB variable (1). Charts 76 & 77 were published in "Charts for Southern Variables", Series 3.(2). These were traced from a Harvard photograph with comparison star magnitudes from Campbell & Pickering(3). Some additional comparison star magnitudes were SP_V from the Cape (4).

2. OBSERVATIONS

The interval covered by the observations is J.D. 2,431,259 to 2,444,194.All observations were made visually using the same sequence(3,4). The light curve, from ten day means, is shown in Figs. 1 to 14. The average number of observations in each mean is two, but ranges from 1 to 9. The number of observations varied from one year to another but the coverage was generally adequate for this type of variable.

3. DISCUSSION

The observed dates of maxima and minima are listed in Table 1, for which the indivual estimates were also used, giving greater weight to those from experienced observers. Values in Table 1 which we considered doubtful are followed by a question mark.

The values derived from Table 1 are:

MEAN PERIOD FROM 33 MAXIMA: 373.8 days (Range 352^d to 410^d)
MEAN PERIOD FROM 27 MINIMA: 374.6 days (Range 347^d to 410^d)
MEAN VISUAL MAGNITUDE AT MAXIMUM: 6.47 (34)
MEAN VISUAL MAGNITUDE AT MINIMUM: 8.50 (29)
RANGE OF VISUAL MAGNITUDES AT MAXIMUM: 5.9 to 7.4
RANGE OF VISUAL MAGNITUDES AT MINIMUM: 8.0 to 9.1

Maxima tend to be usually flatter than minima, which are sharp and definite as a rule. The amplitude changes from one cycle to another, but a definite period is always present.

4. CONCLUSIONS

The mean period of R Scl is 374 days with extreme values differing from the mean by about nine percentwhilst most cycles differ much less from the mean. The mean range in magnitude is 6.5 to 8.5 with extreme values of 5.9 to 9.1.

We consider that R Scl belongs to the SRA type of variables, because it has a persistent period and differs only from Miras in its smaller amplitude.

We have not investigated whether there is a secondary period nor tabulated the O-C residuals for the period because the main purpose of this paper is to direct the attention of observers with small instruments to R Scl. It is one of the stars on the Hipparcos programme and observers can make a valuable contribution to that programme by monitoring R Sch consistently.

ACKNOWLEDGEMENTS

We wish to thank all observers for their observations.

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TABLE 1.

R Scl---OBSERVED MAXIMA AND MINIMA J.D. 2,431,259 to 2,444,194.

	MAXIMA			MINIMA		
No.	J.D. Max.	INT_d	MAG_v	J.D. MIN	INT_d	MAG_v
1				2431,385	...	8.4
2	2431,552	...	6.0	758	373	8.8
3	943	391	6.7	2432,118	360	9.1
4	2432,329	386	6.0	505	387	8.9
5	681	352	6.9	888	383	8.4
6	2433,070	389	6.6	2433,260	372	8.4
7	472	402	6.9	650	390	8.5
8	803	331	6.5	2534,032	382	8.6
9	2434,190	387	7.0	417	385	8.9
10	600	410	7.3	770	353	8.6
11	966	366	6.9	2435,138	368	8.4
12	2435,353	387	7.3	518	380	8.4
13	713	360	6.7	880	362	8.2
14	2436,100	387	6.8	2436,277	397	8.4
15	498	398	6.8	687	410	8.4
16	864	366	6.7	2437,058	371	8.1
17	2437,260	396	7.4	405	347	8.4
18	615	355	7.2	790	385	8.1
19	997	382	6.7	2438,155	365	8.6
20	2438,357	360	6.9	537	382	8.2
21	715	358	6.8	898	361	8.4
22	2439,077	362	7.2	2439,263	365	8.5
23	443	366	6.7	621	358	8.5
24	818	375	6.3	2440,001	380	8.8
25	2440,199	381	6.7	382	381	8.8
26	572	373	6.5	740	358	8.8
27	918	346	6.5	2441,101?	361?	8.0?
28	2441,302	384	5.9	466?	385?	8.2?
29	688	386	6.1	853?	367?	8.7?

TABLE 1 (cont)

	MAXIMA			MINIMA		
No	J.D. Max.	INT_d	MAG_v	J.D. MIN.	INT_d	MAG_v
30	2442,062	375	6.3	2442,253?	400?	8.7?
31	418	355	6.4	555?	302?	8.2?
32	770	352	6.5	991?	436?	8.0?
33	2443,150	380	6.0	2443,370	379	8.0
34	517	367	6.7	751	381	8.3
35	888	371	6.2	2444,100?	349?	8.7?

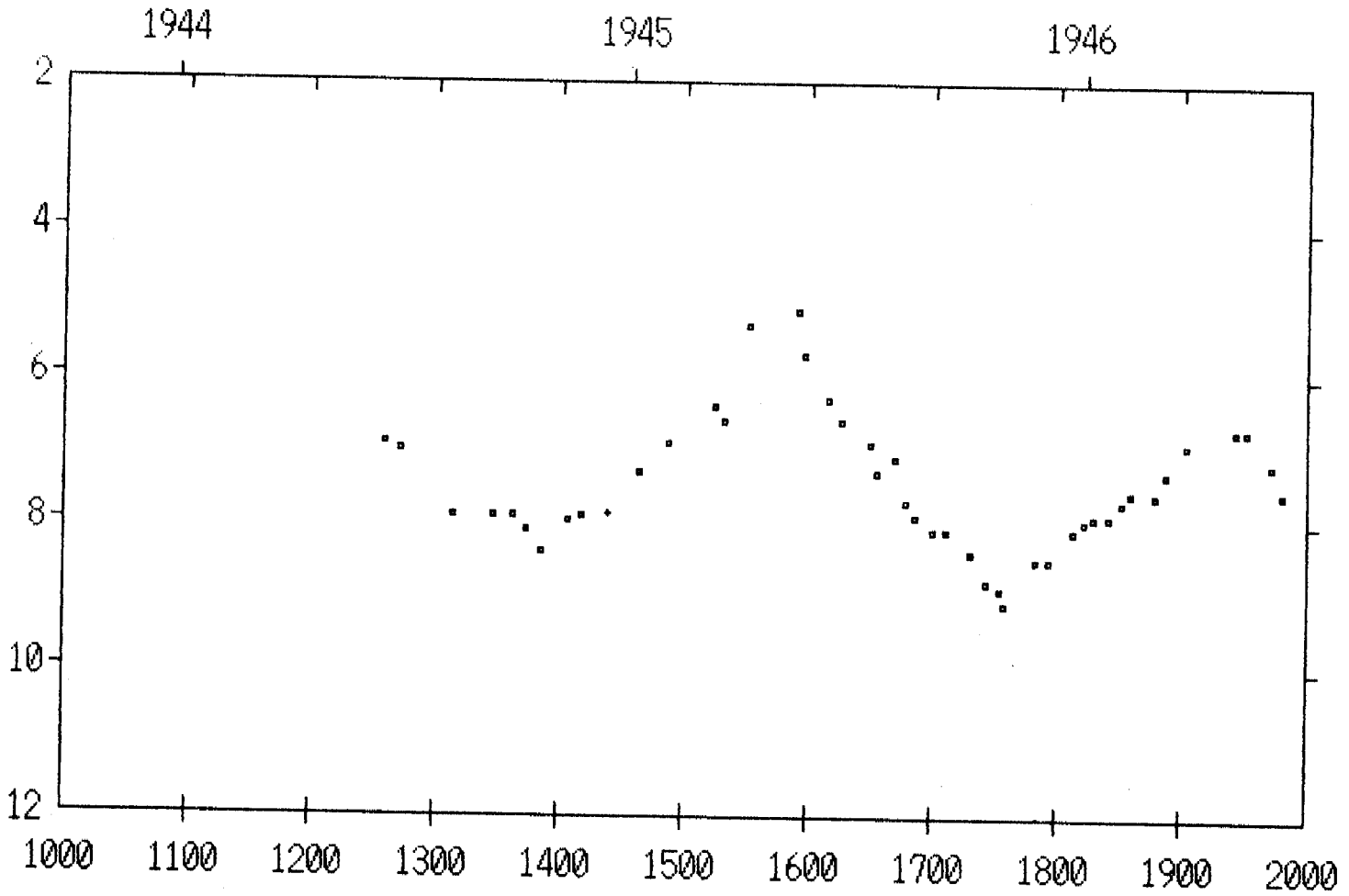


FIG. 1--R Scl . Light Curve J.D. 2,431,000 to 2432,000 from ten day means

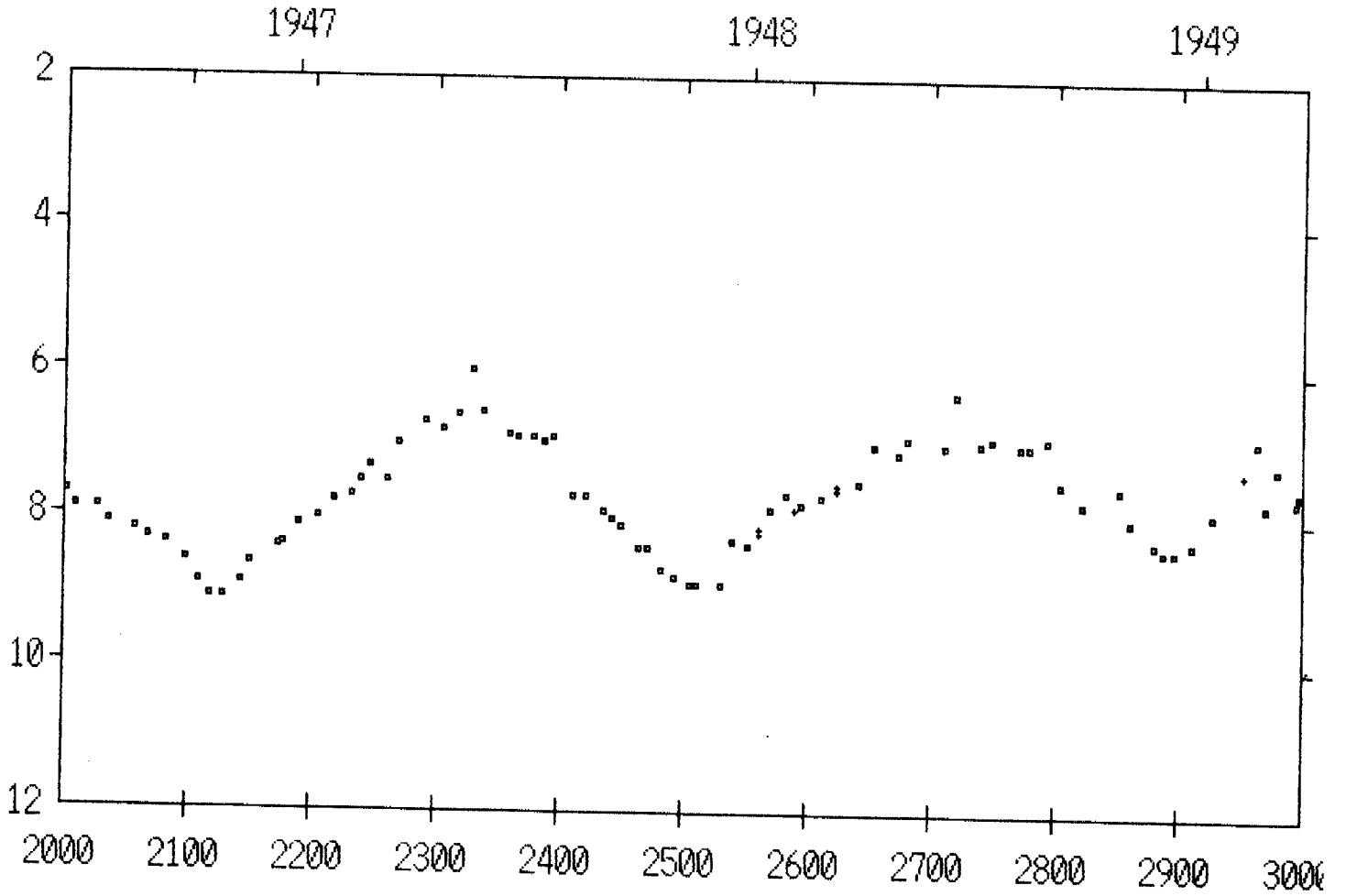


Fig.2. R Scl. Light Curve J.D. 2432,000 to 2,433,000 from ten day means.

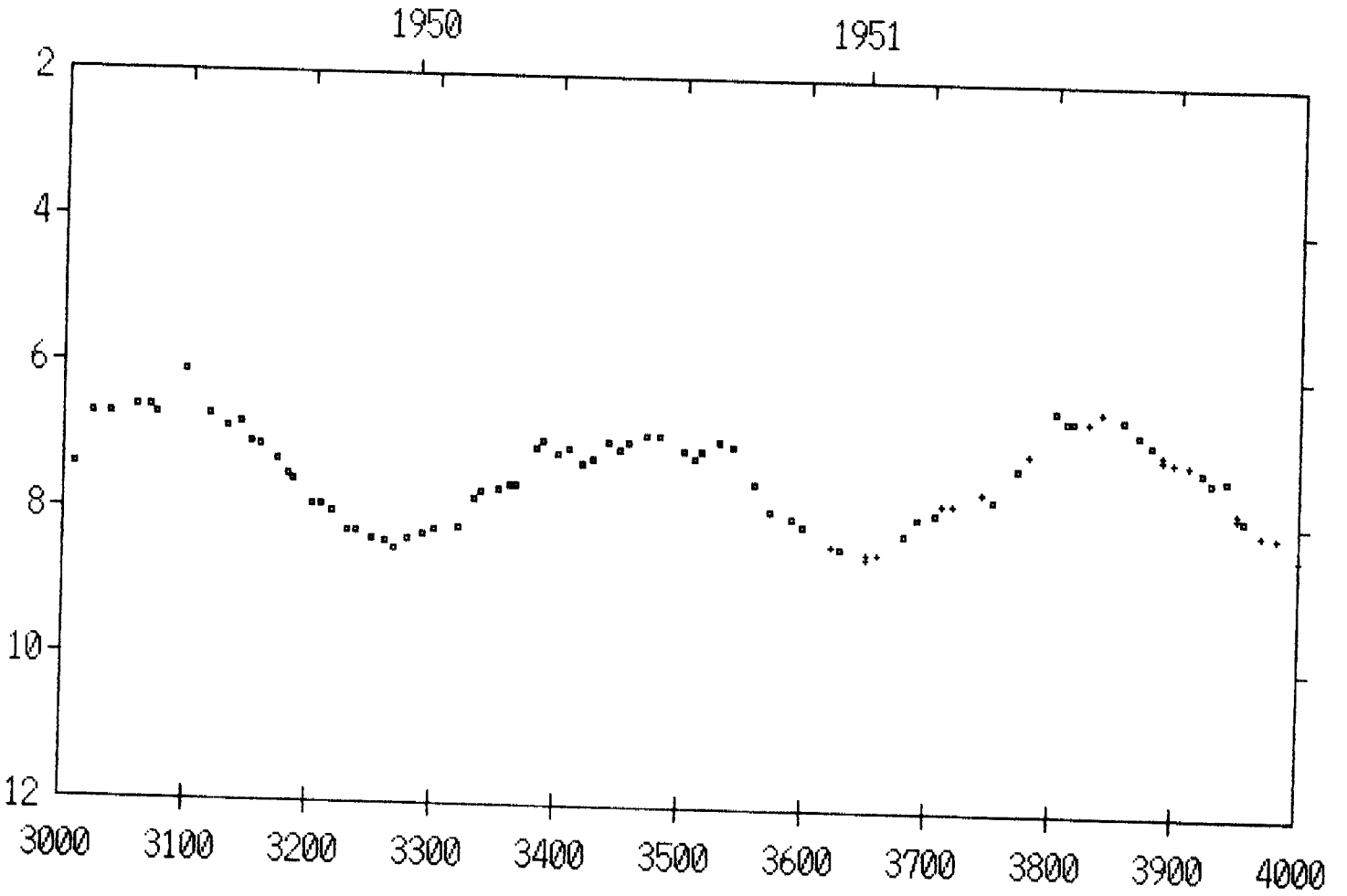


Fig.3. R Scl. Light curve. J.D. 2433,000 to 2434,000 from ten day means

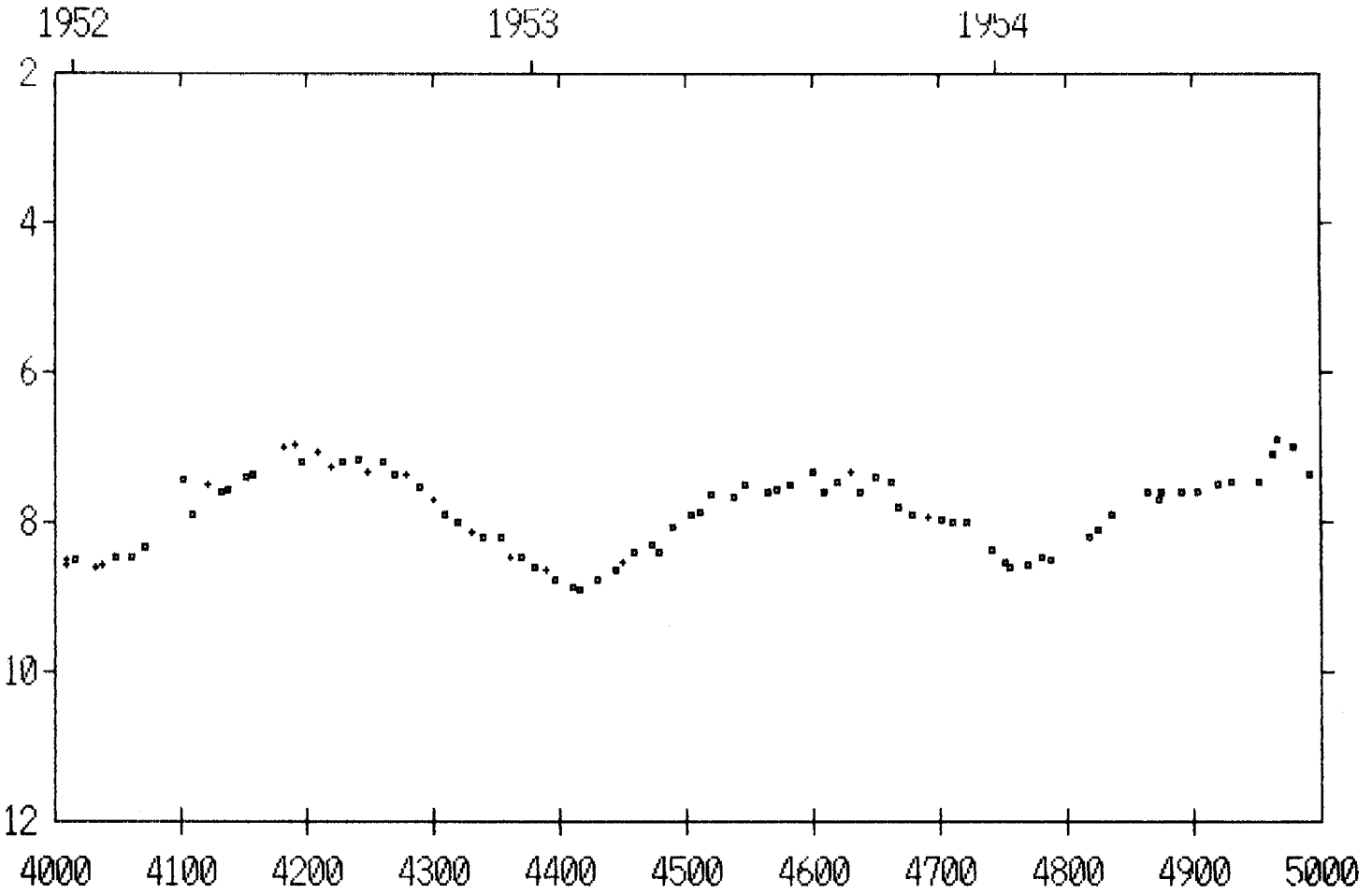


Fig. 4. R Scl. Light curve J.D. 2434,000 to 2435,000 from ten day means

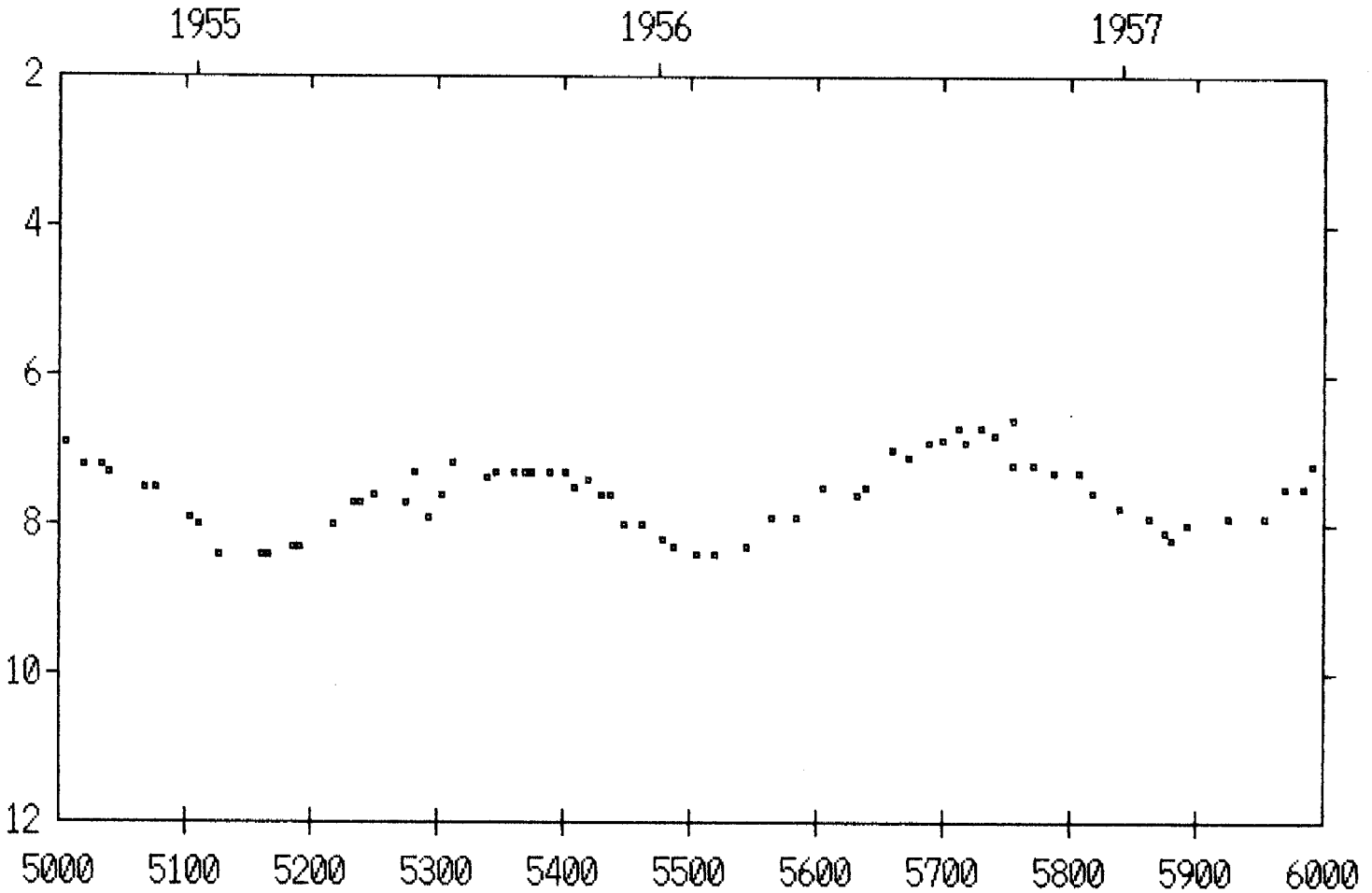


Fig.5. R Scl. Light curve J.D. 2435,000 to 2436,000 from ten day means.

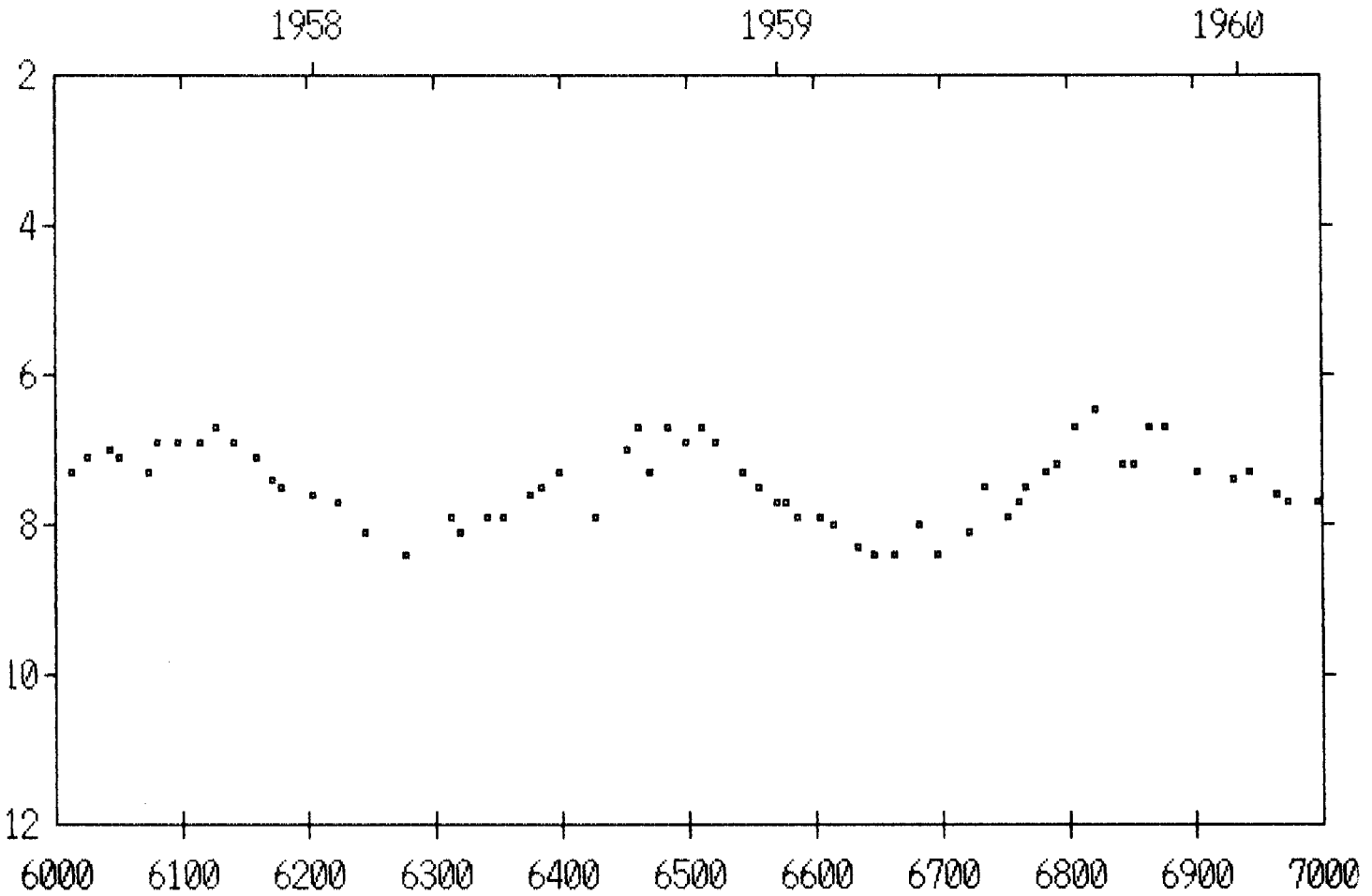
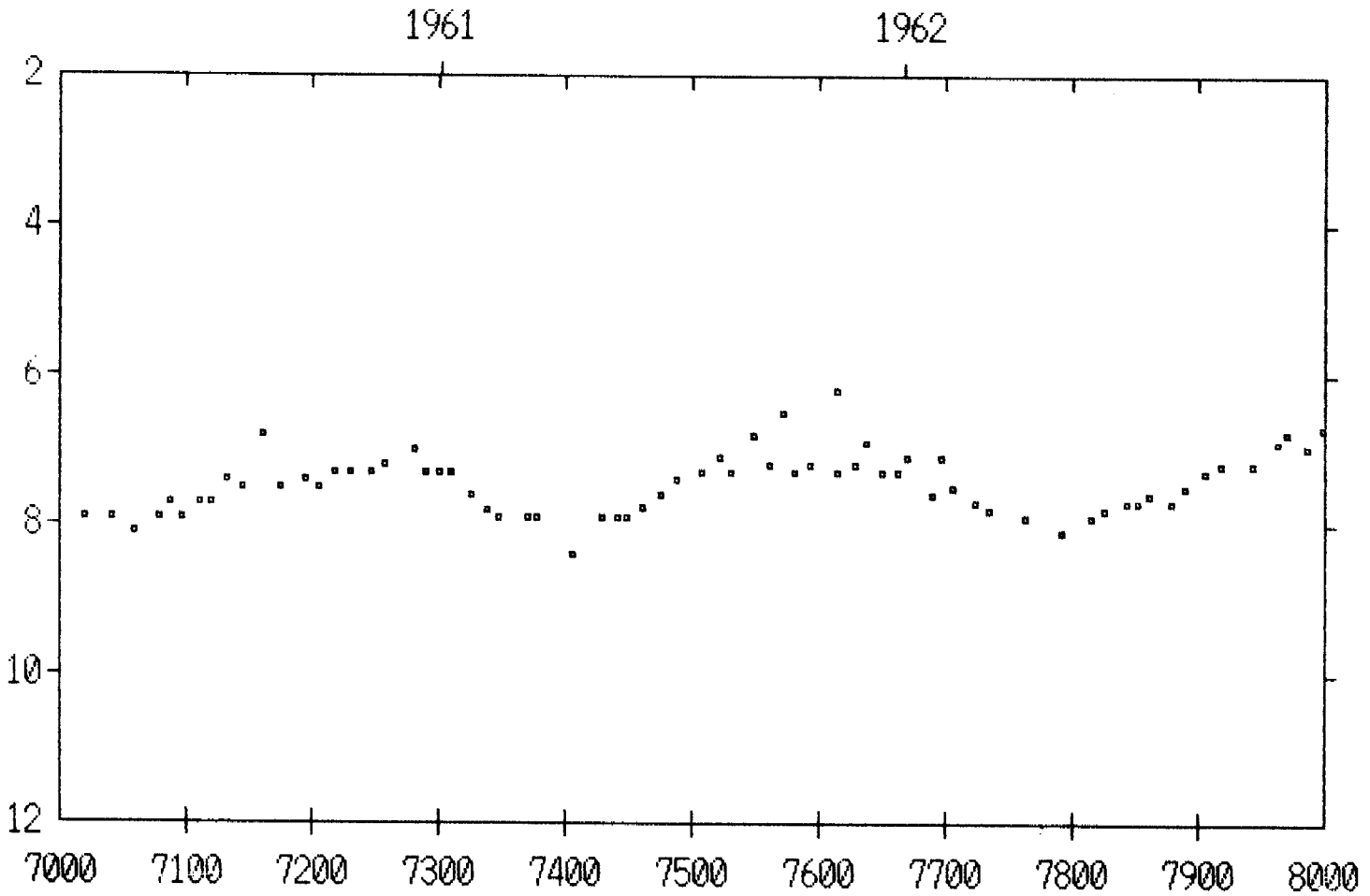


Fig.6. R Scl Light curve J.D. 2436,000 to 2437,000 from ten day means



Fig,7. R Scl Light curve J.D. 2437,000 to 2438,000 from ten day means

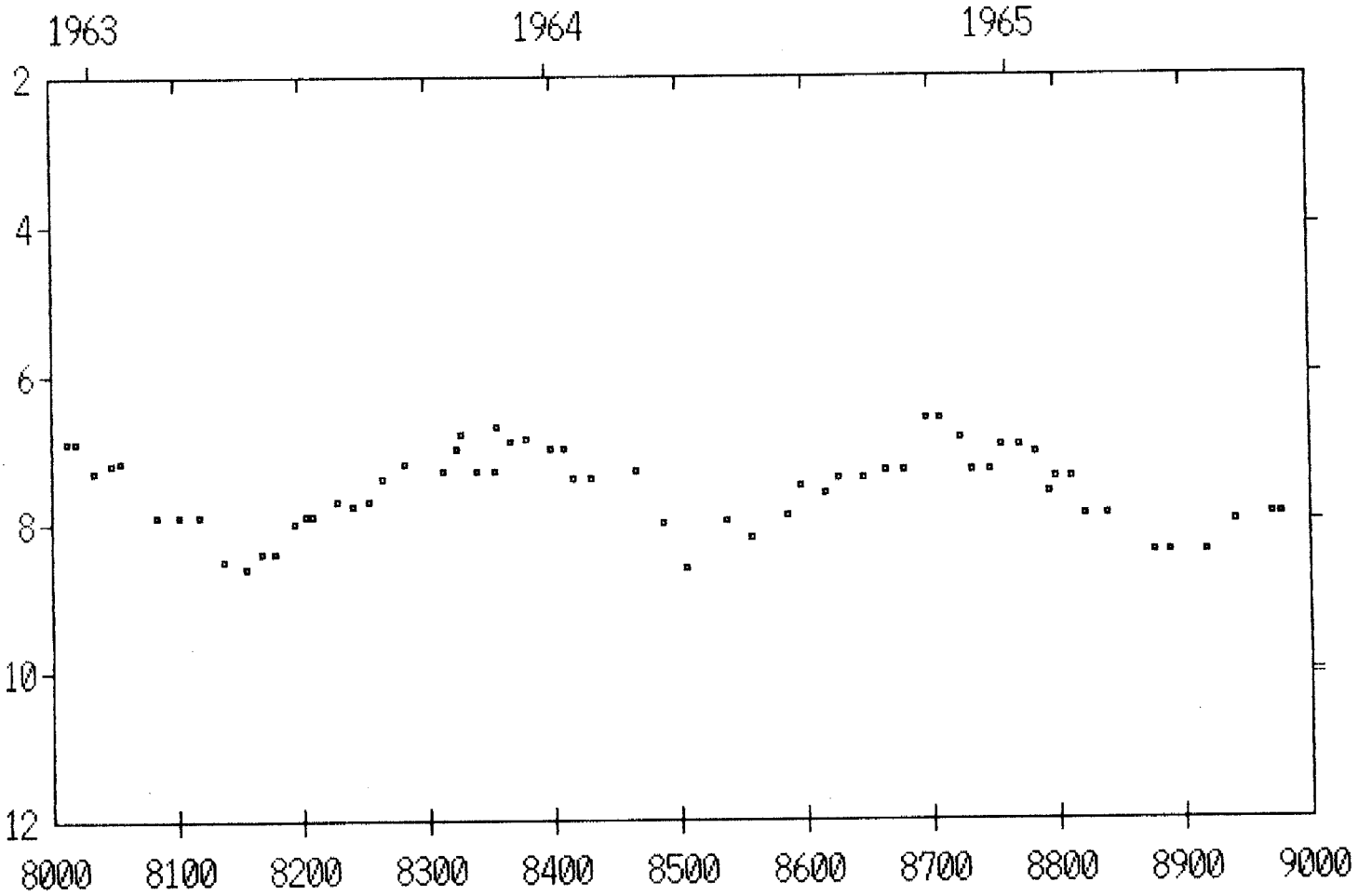


Fig. 8. R Scl Light curve J.D. 2438,000 to 2,439,000 from ten day means.

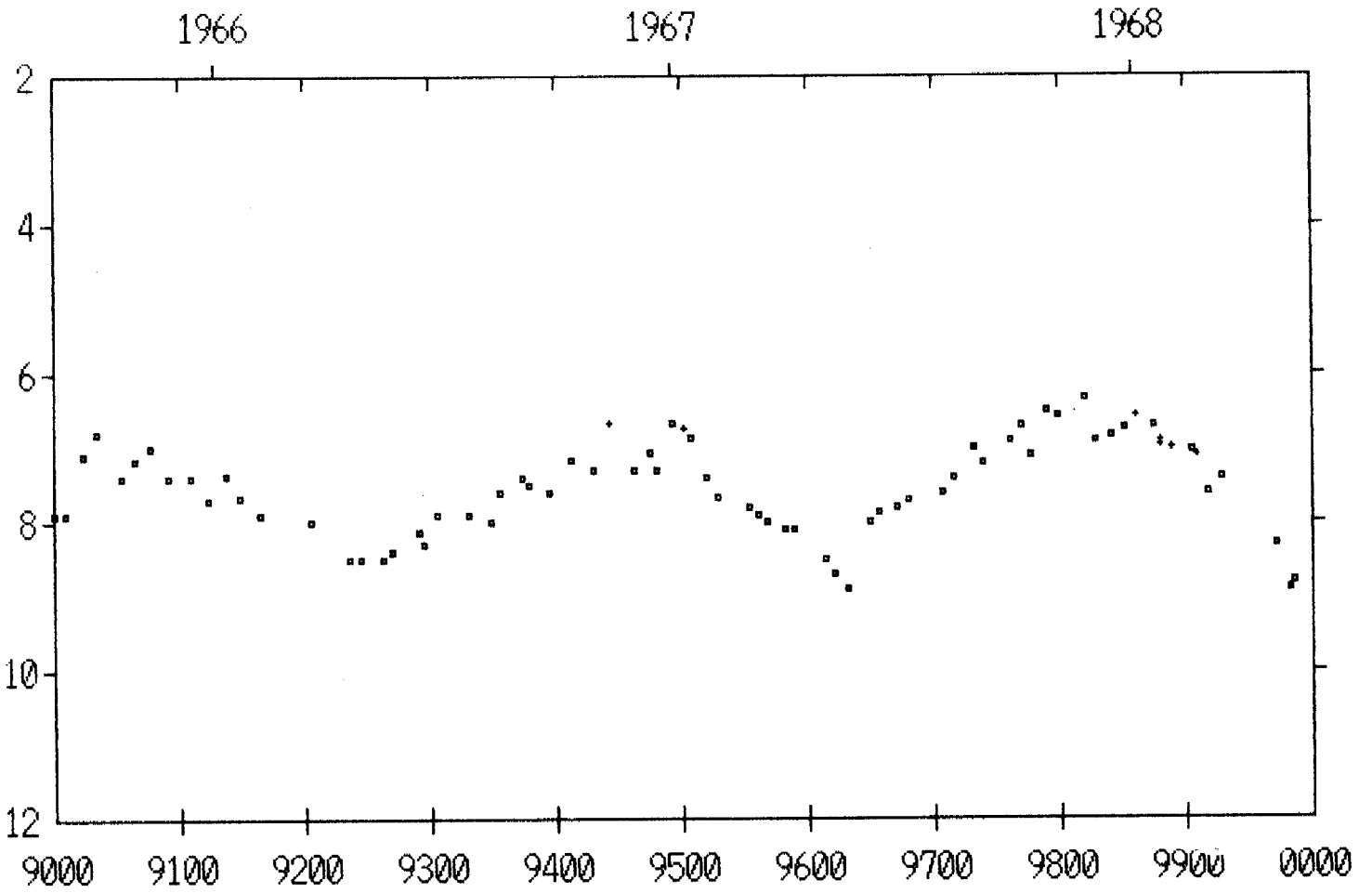


Fig. 9. R Scl Light curve J.D. 2439,000 to 2440,000 from ten day means

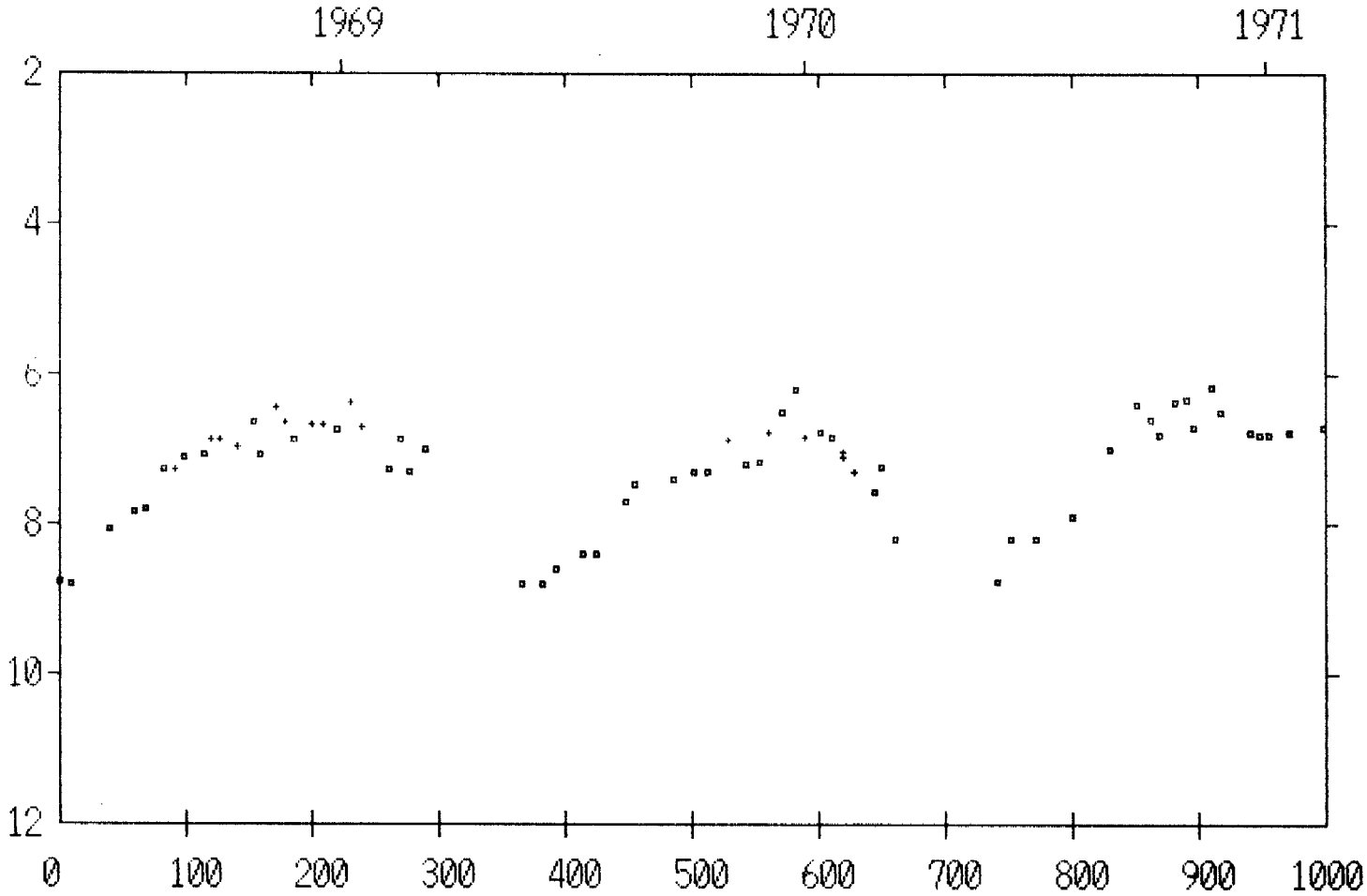


Fig.10. R Scl Light curve J.D. 2440,000 to 2441,000 from ten day means

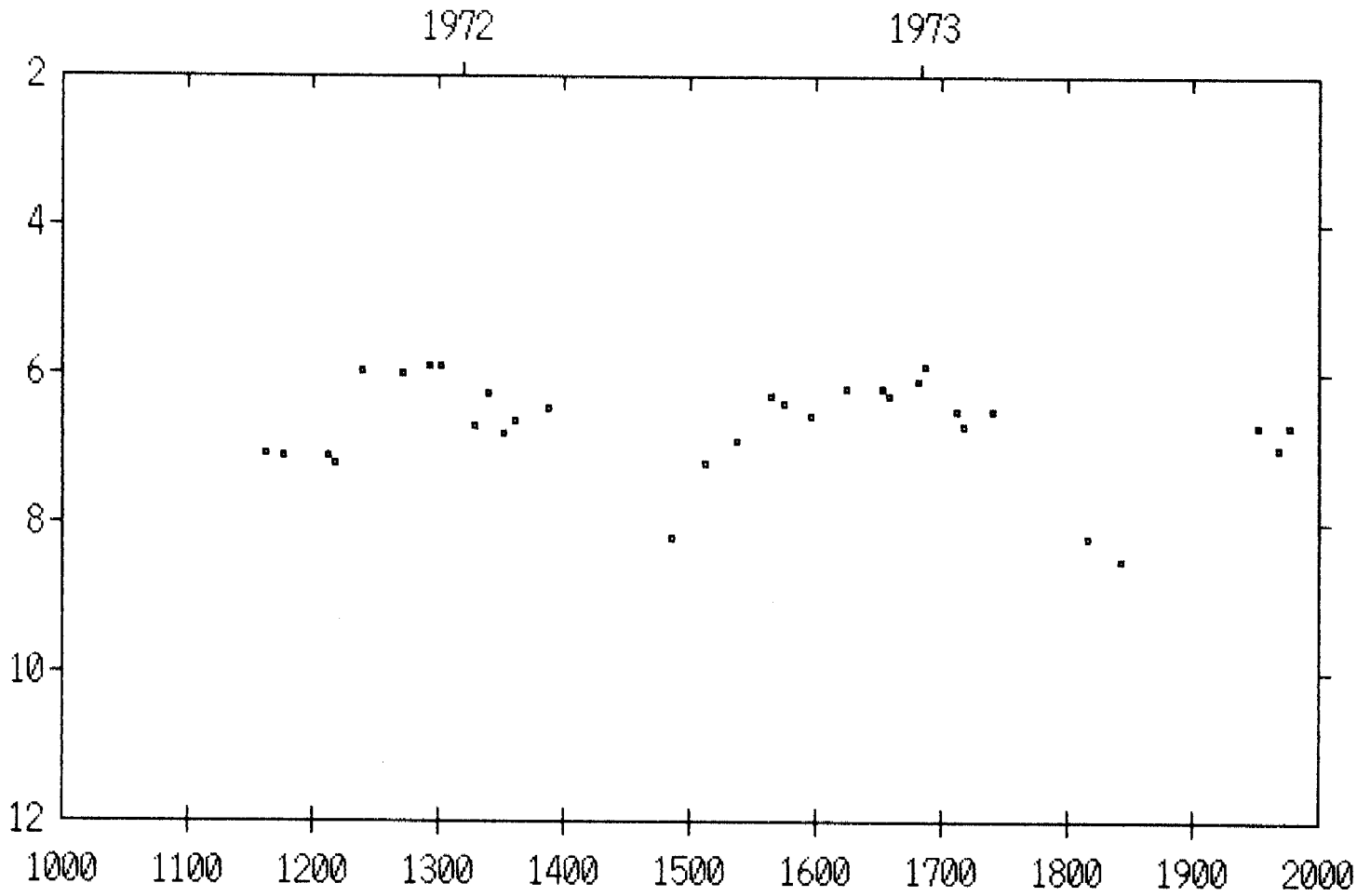


Fig.11. R Scl Light curve J.D. 2441,000 to 2,442,000 from ten day means

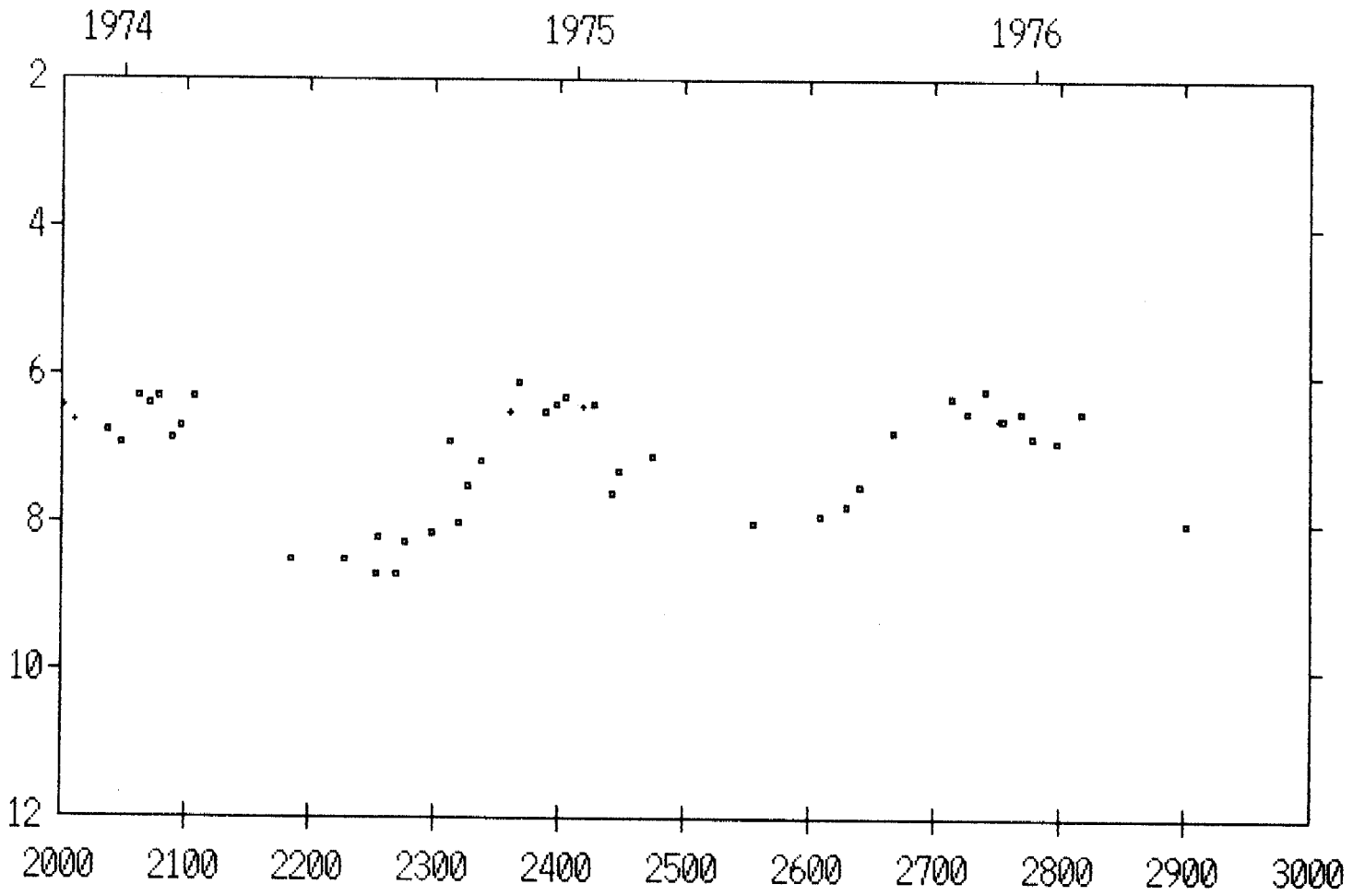


Fig. 12. R Scl Light curve J.D. 2442,000 to 2443,000 from ten day means

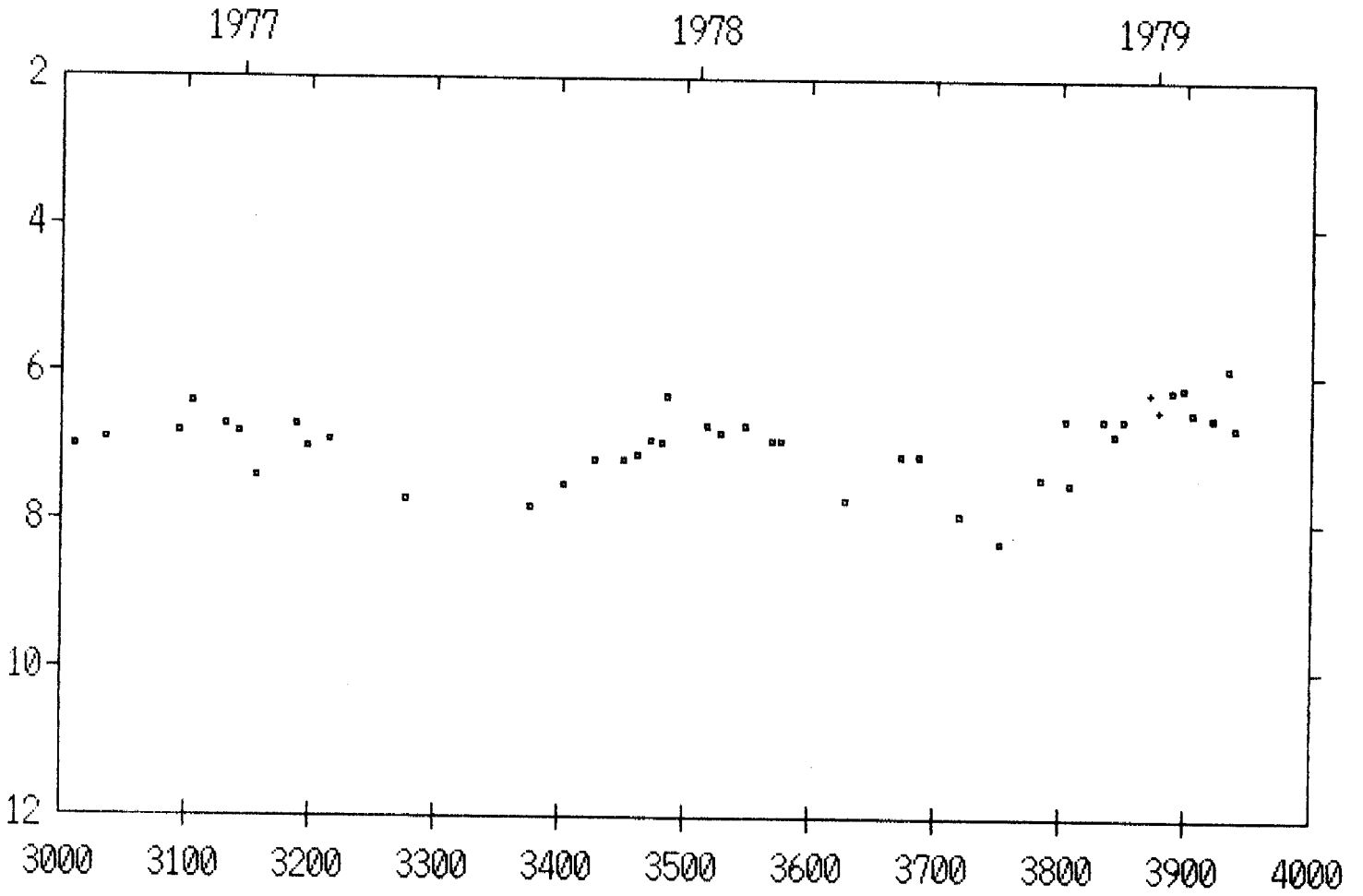


Fig. 13. R Scl Light curve J.D. 2443,000 to 2444,000 from ten day means

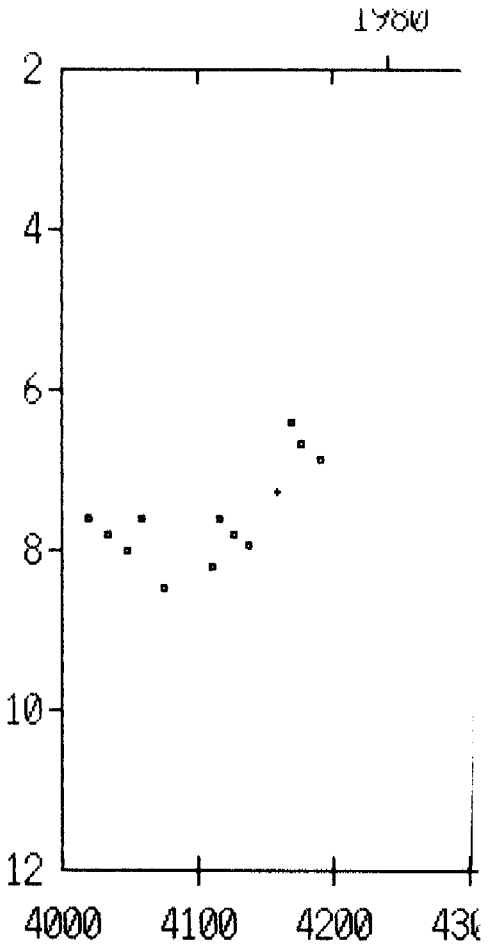


Fig. 14. R Scl.

Light Curve

J.D.2,444,000 - 2,444,200

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A LIGHT CURVE FOR SUPER NOVA 1987A

F.M. Bateson & R. McIntosh.

SUMMARY: The light curve of SN 1987A from discovery to J.D. 2,447,700 is shown as plotted from ten day means.

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1. INTRODUCTION

The independent discovery of SN 1987Aby A.F. Jones was announced in IAU Circular 4316 and in the Special Circular, VSS,RASNZ dated 1987 February 26. Since then the Monthly Circulars, VSS,RASNZ each month to No. M89/2 have contained a summary of the daily means of the visual observations.

2. OBSERVATIONS

Visual observers have submitted a total of 4,575 estimates of SN 1987A. These are shown in Figures 1 to 3 as ten day means. Any scatter that was apparent in the indivual observations is eliminated in the ten day means owing to the volume of estimates. There were very few nights on which no observations were made so that the means give an excellent picture of the main features of the light curve, i.e. (a) the initial slow rise; (b) the more rapid rise from magnitude 4.o to maximum; (c) the maximum plateau; (d) initial rapid decline and (e) the long slow decline of

about $0^{m}.01$ per day.The number of observations in each mean generally exceed those reported in the Monthly Circulars because of late observations arriving after the Circulars were published. Observers may find it interesting to compare their observations with these means.

ACKNOWLEDGEMENTS

We would like to congratulate all observers on their consistent monitoring of this Super Nova, and we thank them for their observations.

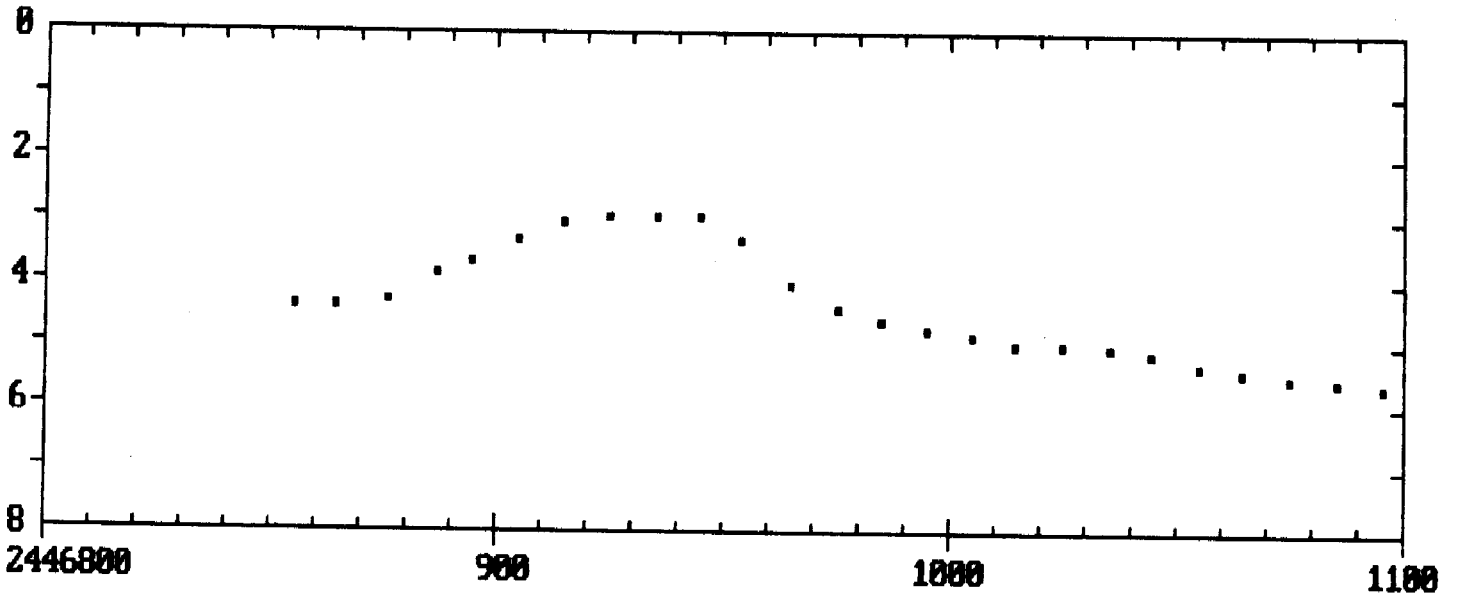

Figure 1. SN 1987A. Light curve from ten day means. J.D. 2446,850 to 2447,100

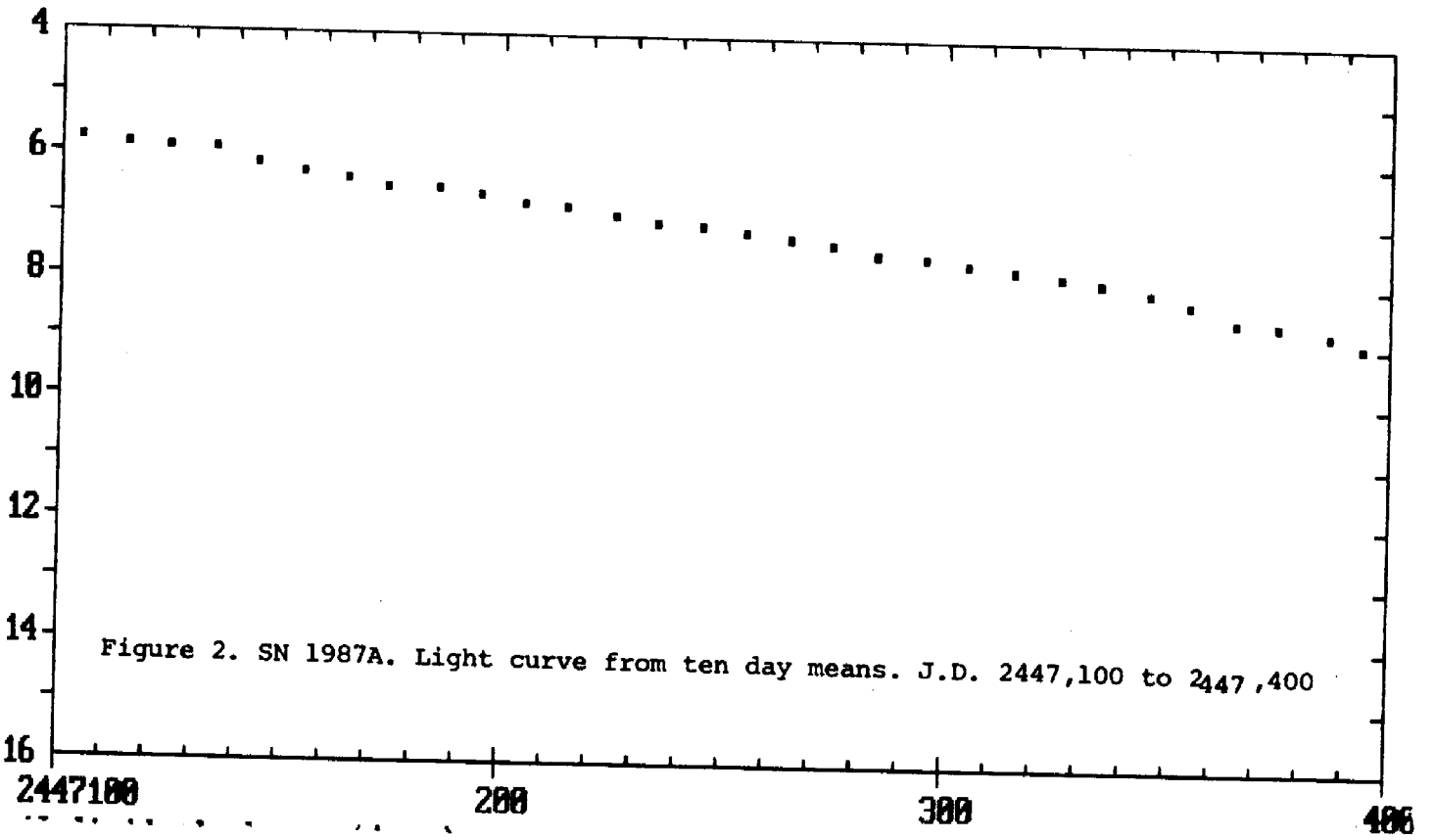

Figure 2. SN 1987A. Light curve from ten day means. J.D. 2447,100 to 2447,400

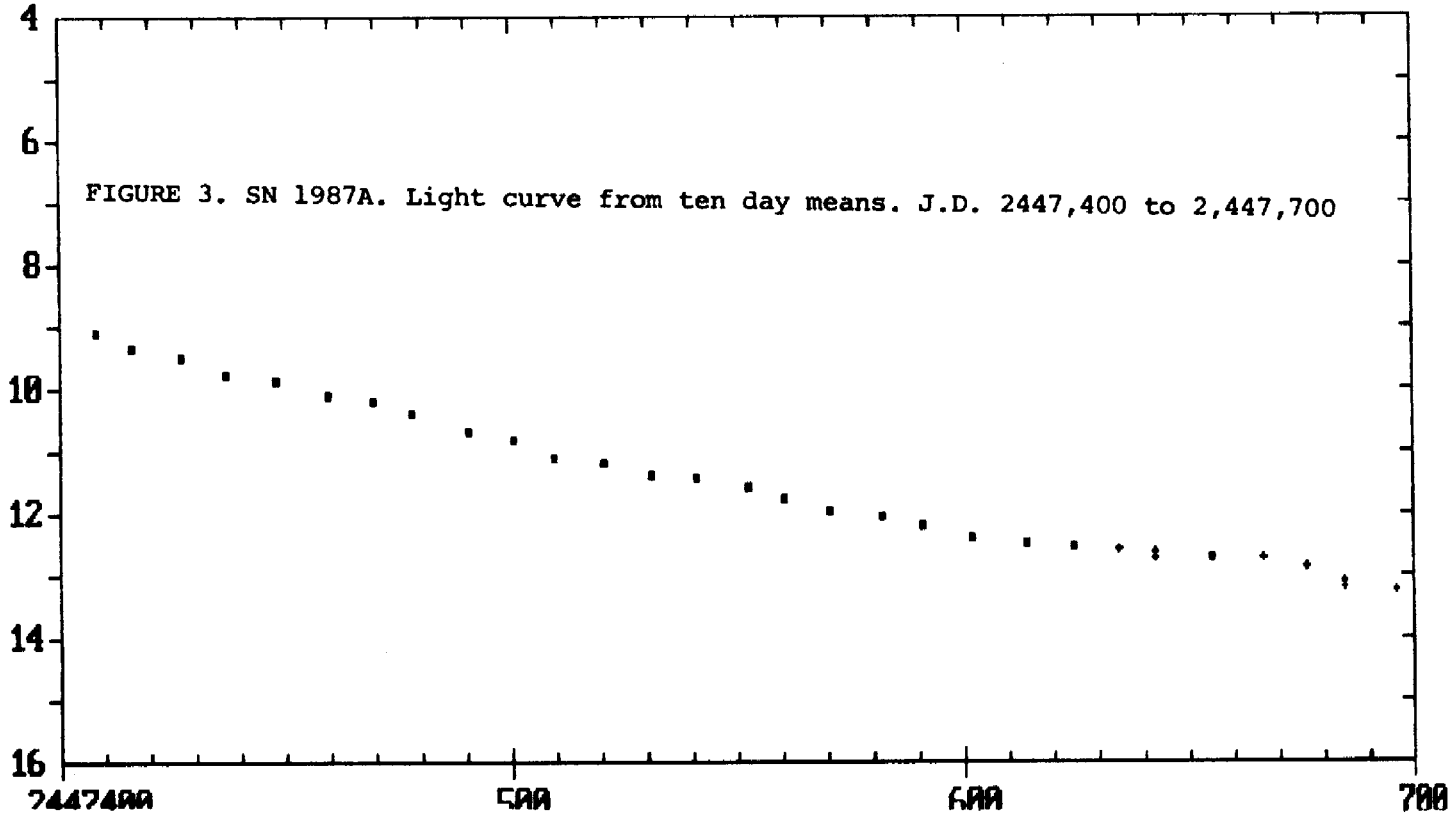

FIGURE 3. SN 1987A. Light curve from ten day means. J.D. 2447,400 to 2,447,700

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ANNOUNCEMENT.

A VISUAL ATLAS OF THE SMALL MAGELLANIC CLOUD by M. Morel.

This atlas and catalogues of objects for the Small Magellanic Cloud is now available. 39 square degrees of sky are charted, centred on the SMC, to a limiting magnitude of 14.0 (visual).

The atlas-catalogue consists of the following:

1 - explanatory booklet,containing five appendices,
  (i) catalogue of plotted clusters and nebilae
  (ii) catalogue of named variable stars and Hv stars
  (iii) index of listed HV stars
  (iv) catalogue of suspected variable stars
  (v) table of corrections for precession in R.A. and Declination.

2 - Master charts A and B. Scale 60"/mm. Covers the SMC region from 00h 15m to 01h 45m in R.A., -70° to -76° in Declination.

3 - Ten large-scale charts showing, in detail, certain complex areas of the SMC. Scale 5"/mm. Each chart spans 12' in declination and about 2 minutes of R.A.

GENERAL. All NGC and IC objects are plotted, plus other clusters and nebulae from modern catalogues. The total is 125 clusters and nebulae.

241 variable stars are plotted, including all of those with a mean magnitude of 14.5 or brighter.

Photoelectric V magnitudes are shown where possible, rounded to one decimal place with decimal point omitted. All charts are marked with co-ordinate grid for 1950.o.

PRICE $Australian 17.00 per copy. New Zealand orders can be placed with Frank Bateson at the N.Z. dollar equivalent plus postage. Outside of New Zealand orders should be sent to M. Morel, 18 Elizabeth Cook Drive, Rankin Park, N.S.W. 2287. Australia

A VERY RED VARIABLE IN CRUX

Frank M. Bateson

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SYMMARY: A very red star in Crux was identified as RX Crucis, An accurate position is given and a light curve from visual observations.

. . . . .

1. INTRODUCTION

RX Cru is listed as 136.1906 = HV 1250 (1).It was catalogued as having a range of 15.0 to 16.0p, type "?" with the source for this listed as from E. Pickering in Harvard Circular 120 (1906) (2).

Its 1950 position was given (3) as:

12h 46m 34s -61° 29'.9

with the same range as previously catalogued, but type Lb: and the spectrum as C (N:)EA.

2. ACCURATE POSITIONS

K.M. Harrison (4) wrote to me on May 29,1985 advising that he had photographed a deep red stellar object in Crux, which he had been unable to identify in any catalogue or atlas available to him. He estimated its approximate magnitude as 8.5ptg and gave its approximate position for 1950 as 12h 45m -61° 30 . He supplied prints from a photo taken on May 25, 1985 with a 135mm f/2 lensusing Hyper senstised Fuji 400 film. He also advised that Bruce Tregaskis, of the Astronomical Society of Victoria (Australia) had confirmed recording a red image in the same approximate position on a photo taken in February 1985 with a 50mm f/1,4 lens. The magnitude was estimated as 10.5.

I concluded, after examining the prints, that this object was RX Cru. However, in order to get an accurate position the prints were sent to P.M. Kilmartin, Mount John University Observatory, who advised that she could only measure negatives and not prints.

P.M. Kilmartin (5) also stated, "I found in the Carter Observatory's field plate, collection which we have here, five astrograph plates of Kappa Crucis, which includes the region of RX Cru. On four of these, the red star which appears on the prints, is apparent as a fuzz, rather like a comet with no central condensation. Nearby is Beta Cru with a very faint red star beside it. This shows up on the astrograph plates as the same sort of fuzz. These red stars are very much out of focus for the Carter Observatory astrograph,which is corrected for blue light."

"I measured the smallest image, on a plate taken 1973 Feb. 15, emulsion Agfa Scientia 68A56 (yellow sensitive), exposure 30 minutes. The reduced position is:

(1950). 12^{h} 46^{m} $33^{s}.34$ -61° 29' 53".7

This made the identification with RX Cr most likely."

The Carter astrograph plates were taken on 1972 July 30 2 plates; 1973 Feb. 15 2 plates. The fifth on 1972 Feb 7 did not show anything in this position, but it was on Ilford Zenith, which is not as sensitive as Agfa Scientia. It was impossible for Kilmartin to estimate a magnitude for RX Cru on these plates.

Kilmartin did have a badly trailed photo of this region, taken with the Gilmore astrograph, the Wray lens stopped to 18cm, a ten minute exposure on FP4, 1979 April 14. RX Cru stood out bright and sharp (although trailed). She estimated its approximate magnitude was 10 by comparison with SAO 252086, whose photographic magniture is given as 9.97.

R. McNaught kindly supplied a copy of this field from a Schmidt plate taken on 1985 August 31. He commented that RX Cru was faint on the B plate; bright on the J and R plates and very bright on the I plate. He found that RX Cru was not visible on the Canterbury Atlas and very faint (limit) on Vehrenberg's Photographic Star Atlas, Map 397. He noted that RX Cru was very red and determined the position as:

$$(1950) \quad 12^h\ 46^m\ 34^s \quad -61^\circ\ 29'.9$$

3. PAST HISTORY.

There have been a number of investigations of the southern coalsack in Crux --see for example, Westerlund (6); Blanco & Munch (7); Hidjat (8) and references. These papers and others were examined in an endeavour to obtain some idea of the magnitude of RX Cru. Any identification of RX Cru in these papers had to be considered doubtful because of the small scale of any charts, whilst in other cases the charts did not include the area around RX Cru.

Bkanco & Munch include star No. 172 with a note "RX Cru?" and state it is CD -53° 2962. Obviously this star is not RX Cru, which is not listed in the CD and the 1875 position they give does not agree with that for RX Cru. The regions examined by Westerlund are adjacent to, but outside, the position of RX Cru. There is a large print in this paper on which there is a possible image of RX Cru but this has to be regarded as very doubtful Hidajat lists his star No. 40 as west of RX Cru but does not include the latter.

There is a very faint image on Union Observatory chart -64° No.44 which may possibly be RX Cru. M. Hazen (9) informed me that she had examined some Harvard plates taken in 1985 March and had failed to find any object that had brightened in this region at that time.

It appears, as far as can be ascertained, that RX Cru has remained faint photographically in the past.

4. OBSERVATIONS

Chart 854 (10) was distributed to observers with the request that they observe RX Cru. Plots of the resultant individual observations are shown in Figures 1-5. These observations were all made visually by members of the VSS,RASNZ.

The observations are limited in number at times (see for example Fig.3). There is also some scatter in the estimates, which is normal for such a red star. RX Cru has varied, during the interval of the observations, between visual magnitudes 9.5 and 12.0.

There was a very definite maximum around J.D. 2446,730, with others, less distinct at 2446,470; 2447,o5o and 2447,340.

5. CONCLUSIONS

The spectrum of RX Cru shows it is a carbon star (type C) and has H_α emission. It is extremely red and therefore visual observations are liable to show some scatter. It appears that it has brightened, but whether this was due to a sudden outburst or a slow rise cannot be stated. There is probably considerable inter-stellar reddening in this region.

RX Cru has varied, during the interval it has been observed, in the visual range of 9,5 to 12.0. The variations appear to be slow and with differing amplitudes. The time this star has been observed is short but there is an indication that it may have a period of around 290 days.

The nature of the variations so far observed indicate that RX Cru could be classed as either Type Lb or SRb. I think that the latter is correct.

ACKNOWLEDGEMENTS

My grateful thanks are due to Ken Harrison for first drawing attention to this star; to Pam Kilmartin and Rob McNaught for kindly providing precise positions and details from plates and to Martha Hazen for checking Harvard plates. I also would like to thank the observers for their observations and for the computer produced light curve I am indebted to Ranald McIntosh.

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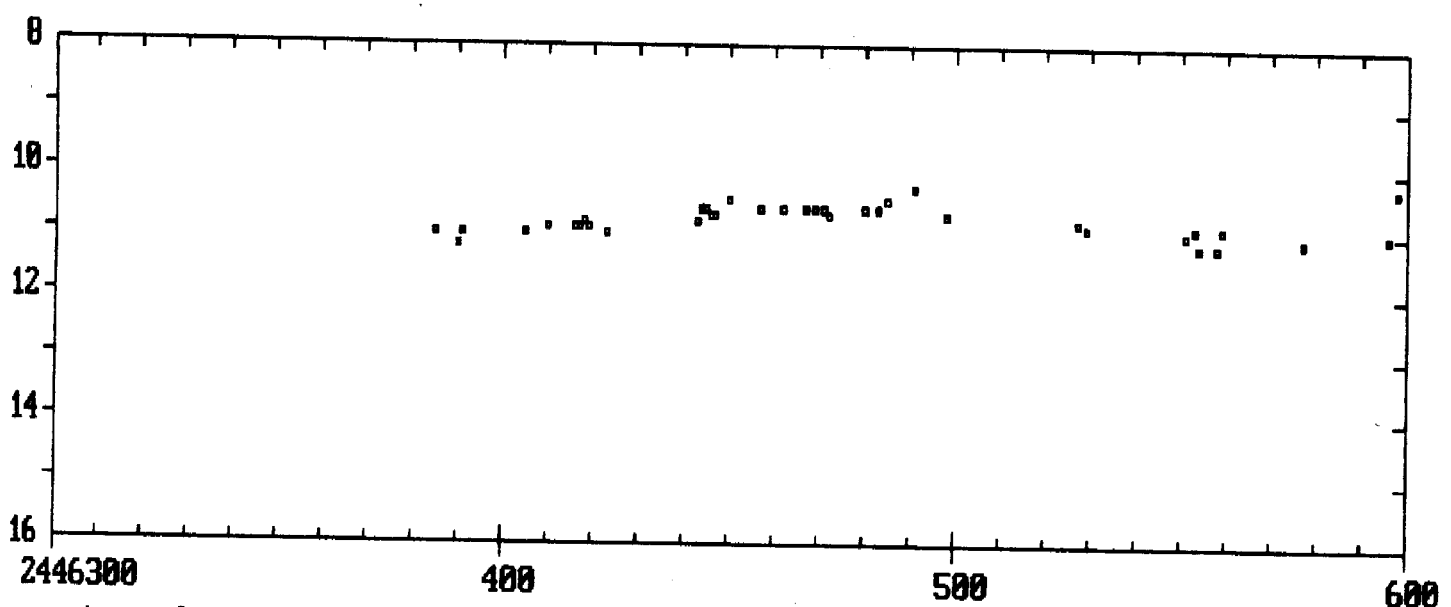

Figure 1, RX Cru. J.D. 2446,385 to 2446,600.

(Individual observations)

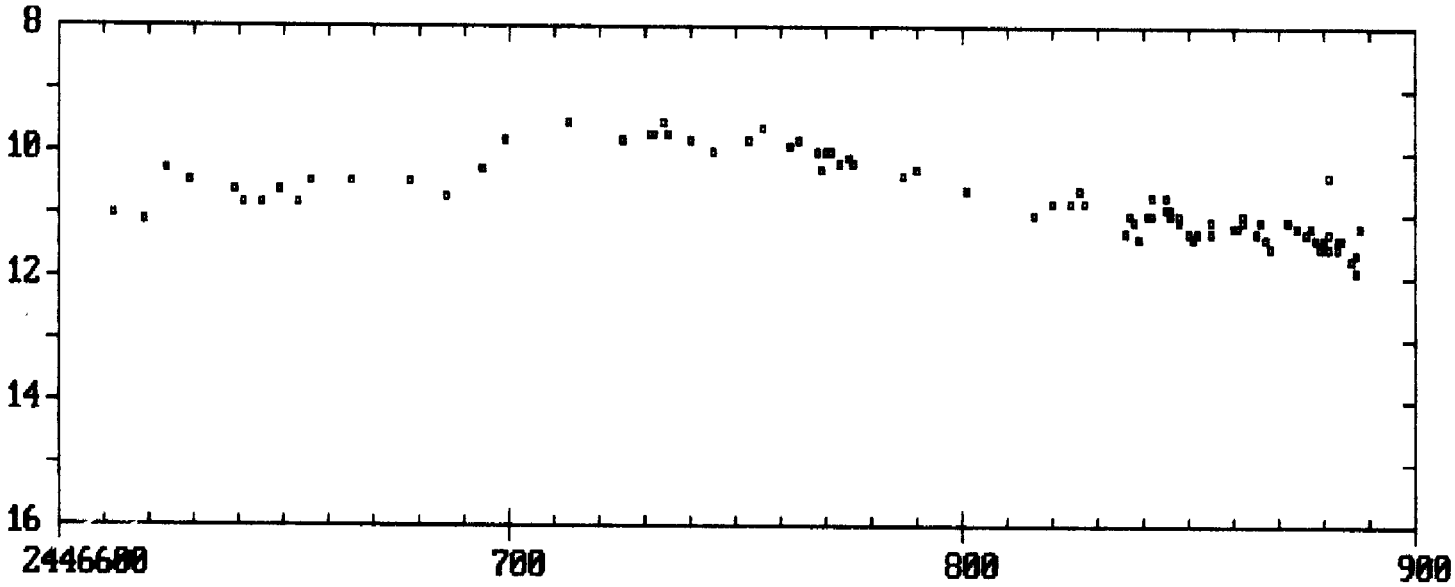

Figure 2. RX Cru. J.D. 2446,600 to 2446,900

(Individual observations)

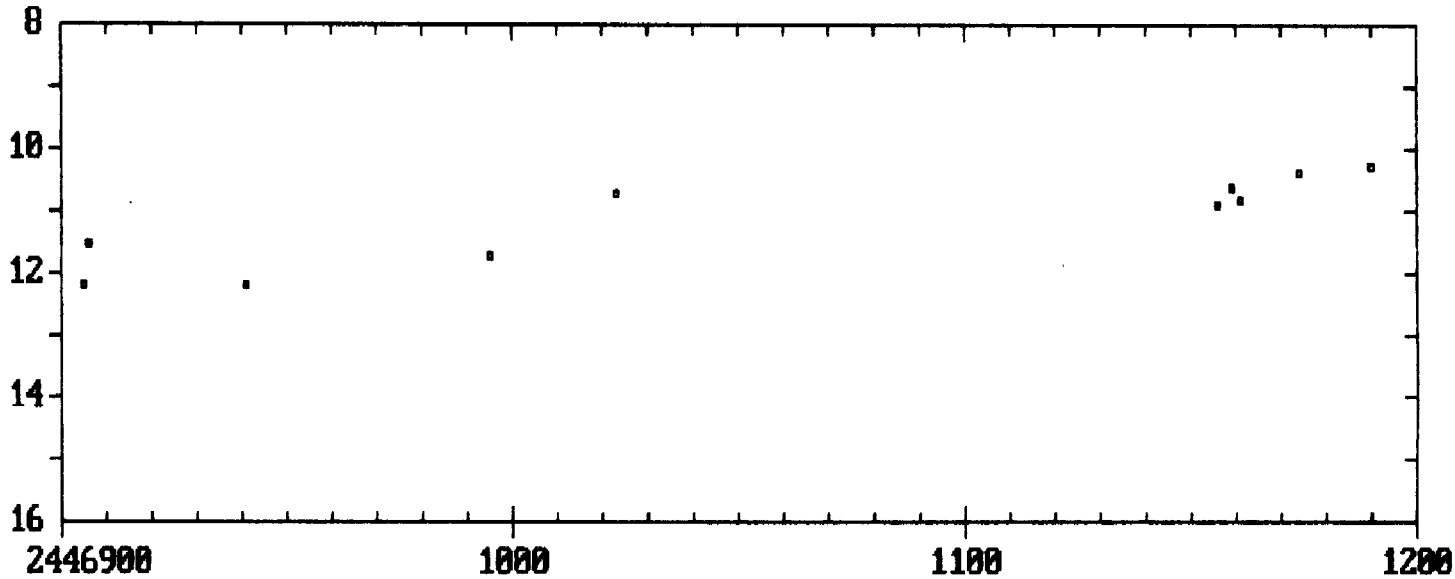

Figure 3. RX Cru. J.D. 2446,900 to 2447,200

(Individual observations)

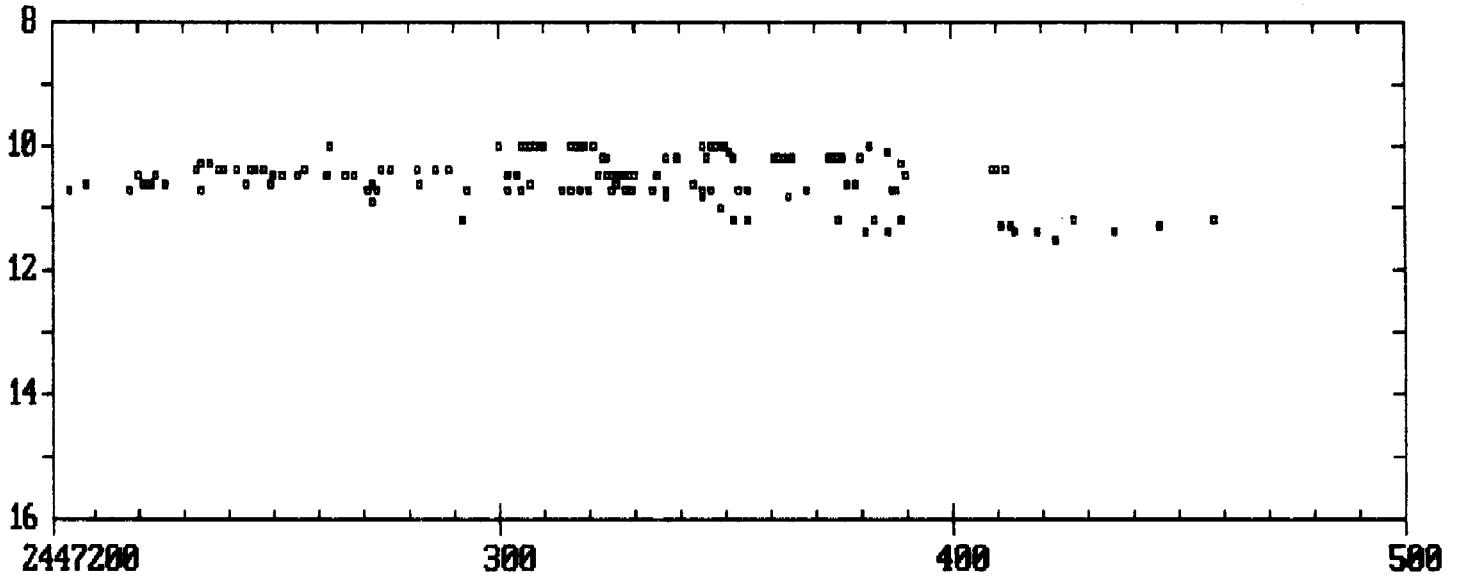

Figure 4. RX Cru. J.D. 2447,200 to 2447,500

(Individual observations)

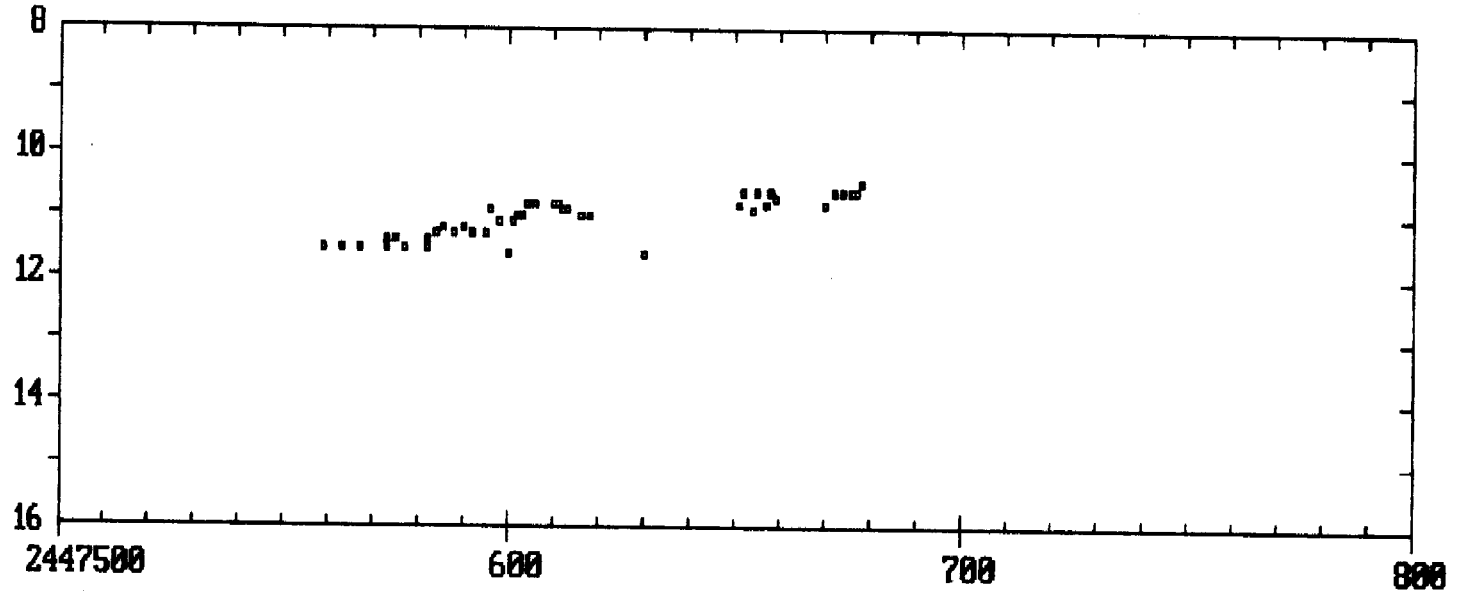

Figure 5. RX Cru. J.D. 2447,500 to 2447.678

(Individual observations)

A LIGHT CURVE FOR TV SCORPII. A SEMI-REGULAR VARIABLE STAR.

by

A.W.Dodson
Variable Star Section, R.A.S.N.Z.

1. INTRODUCTION.

The work presented here is a computer generated plot taken from Variable Star Section ledger entries. The original programmme was written and supplied by Ranald McIntosh and has been restructured by the author to run on an Amstrad CPC 464 or 6128 personal computer. All observations have been made by using chart No. 37. (1).

2. OBSERVATIONS.

Observations cover the interval JD 2435528 (1956 Feb. 24) to JD 2446368 (1985 Oct. 29). Contributions from individual observers are listed in table 2. All observations were made visually. There was generally good coverage throught the year up to 1970 but from thence onwards, although the number of observations from an increasing number of observers multiplied, the star was less well observed over a period of about 50 days either side of the stars conjunction with the Sun (approximately December 17). This was partly due to experienced observers diverting their observations to more important stars.

3. THE LIGHT CURVE.

The light curves, plotted from 10 day means, are shown in figures 1(a) to 1(k). The symbols in figure 2. indicate the number of observations in each mean which range from 1 to 16. Julian dates are shown at the bottom of each scale and the beginning of each calendar year is shown at the top. Magnitudes ranges are shown at the left and right hand sides of the scales. Each graph covers a period of 1,000 days. A line has been drawn through the mean range of the plots giving due consideration to the weighting of observations. This is done to show more clearly the probable light curve.

4. DISCUSSION.

Details of observered minima and maxima are given in Table 1. Columns show the following details:

Column No.	Details
1.	Allocated cycle number.
2.	JD of observed maxima.
3.	Observed mean magnitude at maxima.
4.	Interval in days from observed previous maxima. Where a previous maxima is presumed to have gone unobserved, the interval between observed maxima is shown in parenthesis.
5.	Interval in days from the previous minima to the current maxima.
6.	O-C residuals in accordance with the derived period given below rounded off to whole days.
7.	JD of observed minima.
8.	Observed mean magnitude at minima.
9.	Interval in days from the previous minima. Where the previous minima is presumed to have gone unobserved, the interval between observed minima is shown in parenthesis.
10.	Interval in days from the previous maxima to the current minima.
11.	O-C residuals in accordance with the derived period given below rounded off to whole days.

The following elements have been calculated from the observed minima and maxima.

Mean maximum magnitude:	10.268
Range in magnitude at maximum:	9.6 - 11.2
Mean minimum magnitude:	11.455.
Range in magnitude at minimum:	10.6 - 12.3
Range of intervals between cycles measured at observed maximum:	124 - 295 days.
Mean period of maxima:	211d.137
Range of intervals between cycles measured at observed minimum:	116 - 351 days.
Mean period of minima:	211d.72

Adopted mean period Epoch JD 2435553: $\pm$ 211d.929

The mean period of maxima is based on 52 cycles during the period under discussion of which 47 were observed. The mean period of minima is based on 51 cycles of which 45 were observed. The adopted mean period is the average of the minimum and maximum periods.

Times and magnitude of maxima and minima are in general carefully scaled from the curve drawn through the plotted points.

5. CONCLUSIONS.

TV Scorpii is a Semi-Regular variable star which at times shows well expressed maximum and minimum brightness peaks and dips with regular cycles. At other times, there are large variations from the mean period with sometimes small brightness changes that makes determination of maximum and minimum brightness difficult. GCVS (2) classifies TV Scorpii as a type SRb variable with a period of 200 days. Whilst the classification is probably correct, it seems that the period determination may now need revising.

6. ACKNOWLEDGEMENTS.

I wish to thank all observers for their records. I am also grateful to Dr.Frank Bateson for his guidance and assistance and to Mr.Ranald McIntosh for supplying the initial computer programme used to generate the light curves.

7. REFERENCES.

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(2) General Catalogue of Variable Stars, 4th Edition, Volume 3, Astronomical Council of the USSR Academy of Sciences, 1987.

TABLE 1.

173643 TV SCORPII - OBSERVED MAXIMA & MINIMA.

Cycle No.	Maxima JD	Mag. V	Int. d	m-M d	O-C d	Minima JD	Mag. V	Int. d	M-m d	O-C d
1	2435557	10.2	-	-	-	2435648	11.7	-	91	-
2	5753	10.1	196	105	-16	5875	11.5	227	122	+15
3	5993	10.1	240	118	+28	6108	11.7	233	115	+21
4	6211	10.8	218	103	+6	6319	11.5	211	108	-1
5	6400	10.3	189	81	-23	6515	11.6	196	115	-16
6	2436629	10.3	229	114	+17	6823	11.5	308	194	+96
7	6887	10.9	258	64	+46	6939	11.4	116	52	-96
8	7015	10.3	128	76	-84	2437171	11.6	232	156	+20
9	7262	11.2	247	91	+35	7313	11.4	142	51	-70
10	7437	9.8	175	124	-37	7602	11.6	289	165	+77
11	2437718	10.6	281	116	+69	2437775	11.2	173	57	-39
12	7881	9.8	163	106	-19	8026	11.4	251	145	+39
13	8151	10.7	270	125	+58	8207	11.0	181	56	-31
14	8297	10.3	146	90	-66	8407	11.6	200	110	-12
15	8592	10.5	295	185	+83	8660	11.0	253	68	+41

TABLE 1. (cont.)

173643 TV SCORPII - OBSERVED MAXIMA & MINIMA.

Cycle	Maxima JD	Mag. V	Int. d	m-M d	O-C d	Minima JD	Mag. V	Int. d	M-m d	O-C d
16	2438728	10.2	136	68	-76	2438859	12.2	199	131	-13
17	8967	10.4	239	110	+27	9087	11.2	228	120	+16
18	9172	10.8	205	85	-7	9260	12.3	173	88	-39
19	9381	9.8	209	121	-3	9518	11.6	258	137	+46
20	9572	10.6	191	54		9663	11.6	145	91	-67
21	2439779	9.8	207	116	-5	2439921	11.6	258	139	+46
22	2440002	10.1	223	81	+11	2444099	11.4	181	97	-31
23	0200	10.5	198	101	-14	0322	11.3	223	122	+11
24	0427	10 4	227	105	+15	0520	11.6	198	93	-13
25	0617	10.5	190	97	-22	0697	11.6	177	75	-35
26	2440818	10.6	201	121	-11	2440934	11.5	237	116	+25
27	1020	10.2	202	86	-10	1155	11.0	221	135	+9
28	1224	10.8	204	69	-8	-	-	-	-	-
29	1451	10.1	227	-	+15	1582	11.7	(436)	131	-
30	1662	10.4	211	80	-1	1760	11.2	178	98	-34
31	2441868	10.8	206	108	-6	2441968	11.9	208	100	-4
32	2128	10.5	260	160	+48	2198	11.1	230	70	+18
33	2264	10.2	136	66	-76	2400	11.8	208	136	-4
34	2500	10.5	236	100	+24	2587	11.5	187	87	-25
35	2714	10.3	214	127	+2	2805	11.8	218	91	+6
36	2442896	10.4	182	91	-30	2443021	11.4	216	125	+4
37	-	-	-	-	-	3239	11.3	218	-	+6
38	3350	9.7	(454)	111	-	-	-	-	-	-
39	-	-	-	-	-	-	-	-	-	-
40	3759	9.6	(409)	-	-	3835	11.0	(596)	76	-
41	2443929	9.7	170	94	-42	2444018	11.3	183	89	-29
42	4161	9.6	232	143	+20	-	-	-	-	-
43	-	-	-	-	-	4453	11.5	(435)	-	-
44	-	-	-	-	-	-	-	-	-	-
45	4532	10.4	(371)	-	-	4806	11.9	(353)	274	-
46	-	-	-	-	-	2445190	11.8	351	-	+139
47	5354	9.7	(822)	164	-	5459	10.8	269	105	+57
48	2445500	10.5	146	41	-66	5639	11.2	180	139	-32
49	5744	10.2	244	105	+32	5881	11.1	242	137	+30
50	5975	10.1	231	94	+19	-	-	-	-	-
51	2446202	9.6	227	-	+15	2446284	10.6	(403)	82	-
52	6326	10.4	124	42	-88	-	-	-	-	-

TABLE 2.

TV SCORPII - OBSERVERS TOTALS.

Aj	-	26	Mf	-	24
Bt	-	50	Nk	-	28
Cj	-	42	Ov	-	118
Cl	-	28	Pk	-	35
Cm	-	21	Pw	-	26
Cy	-	33	Rg	-	41
Dd	-	56	SF	-	35
Gh	-	48	Tr	-	29
Hi	-	79	Ty	-	80
Hl	-	22	Ve	-	262
Hn	-	21	Wk	-	20
Jo	-	273	Wu	-	78
Jn	-	182	Wy	-	83
Ld	-	24			

From 46 observers with less than 20 observations each:	217
TOTAL	2,056

FIGURE 2. NUMBER OF OBSERVATIONS PER 10 DAY MEAN.

▯ 1 to 3 observations
+ 4 to 6 observations
× 7 to 9 observations
Δ 10 or more observations

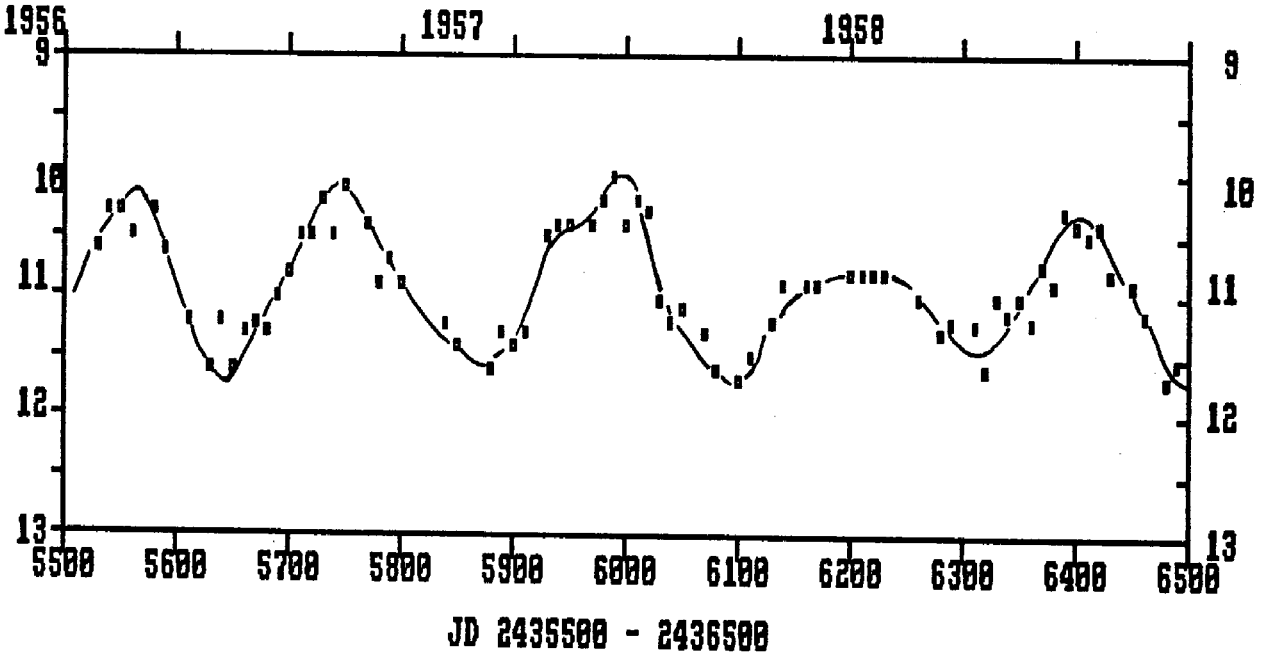


Figure 1a

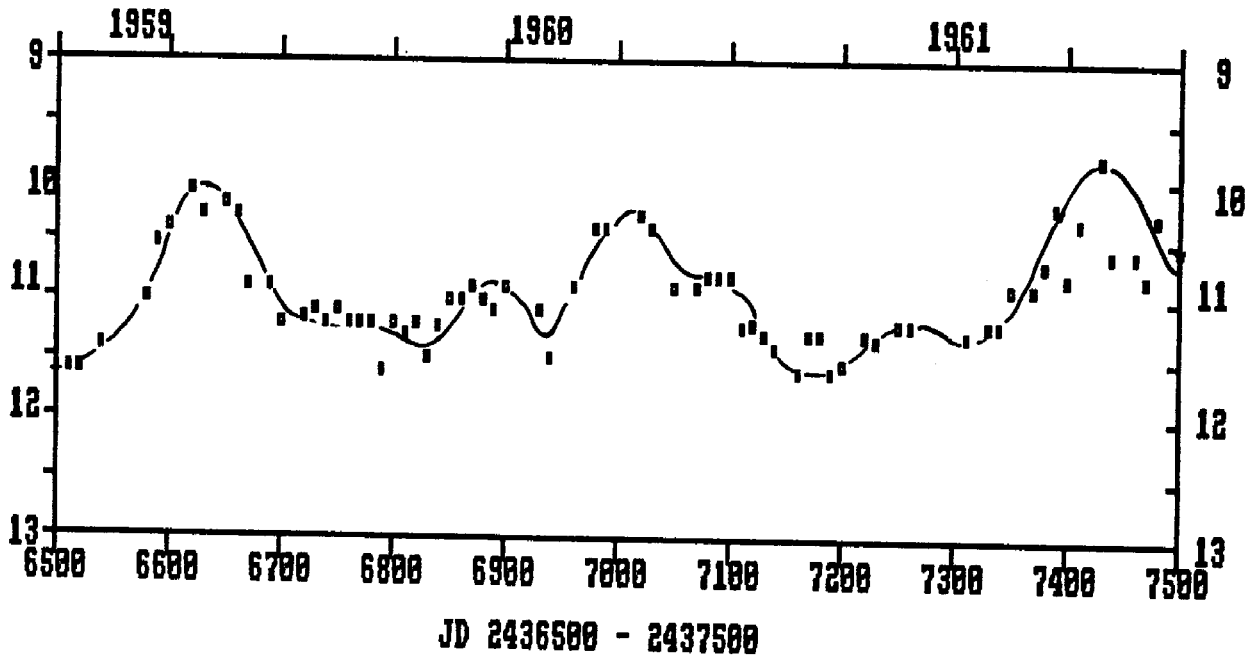


Figure 1b.

173643 TV SCORPII - LIGHT CURVES.

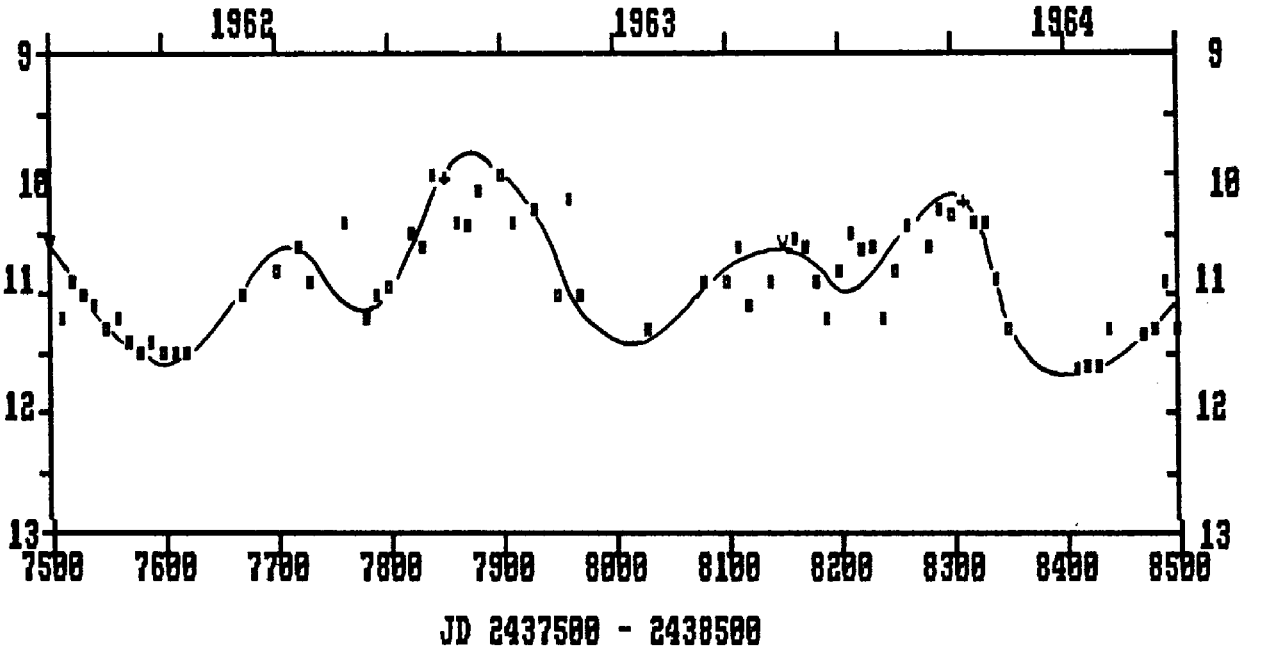


Figure 1c.

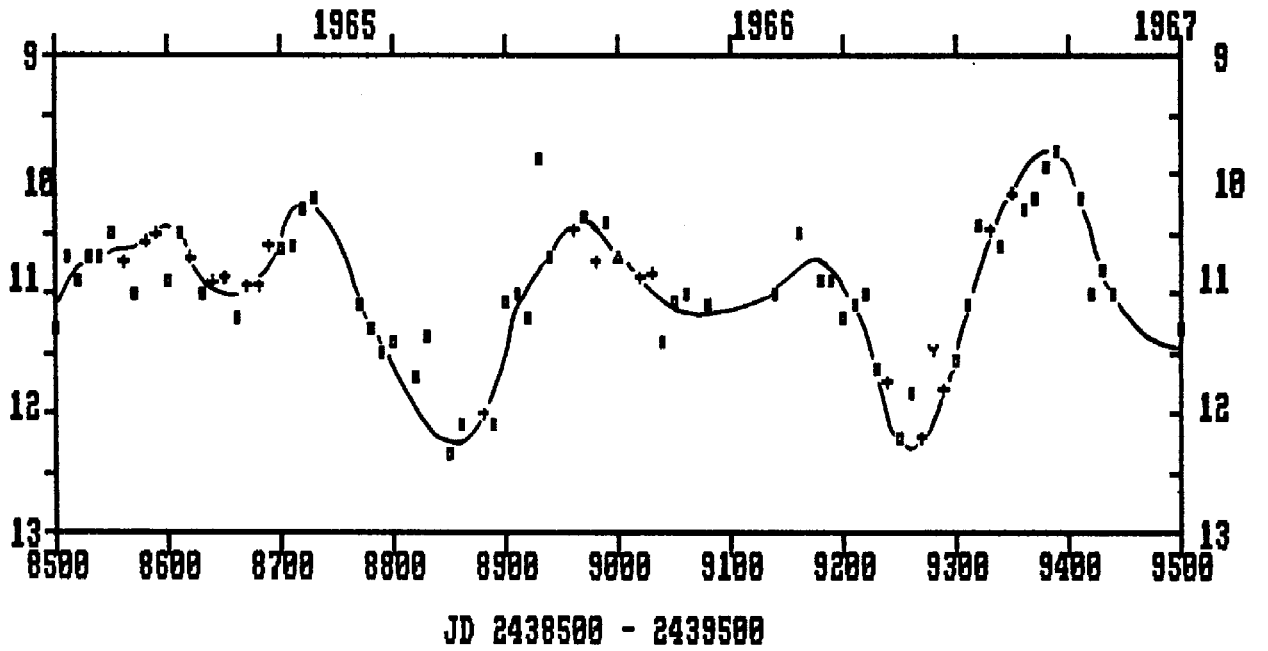
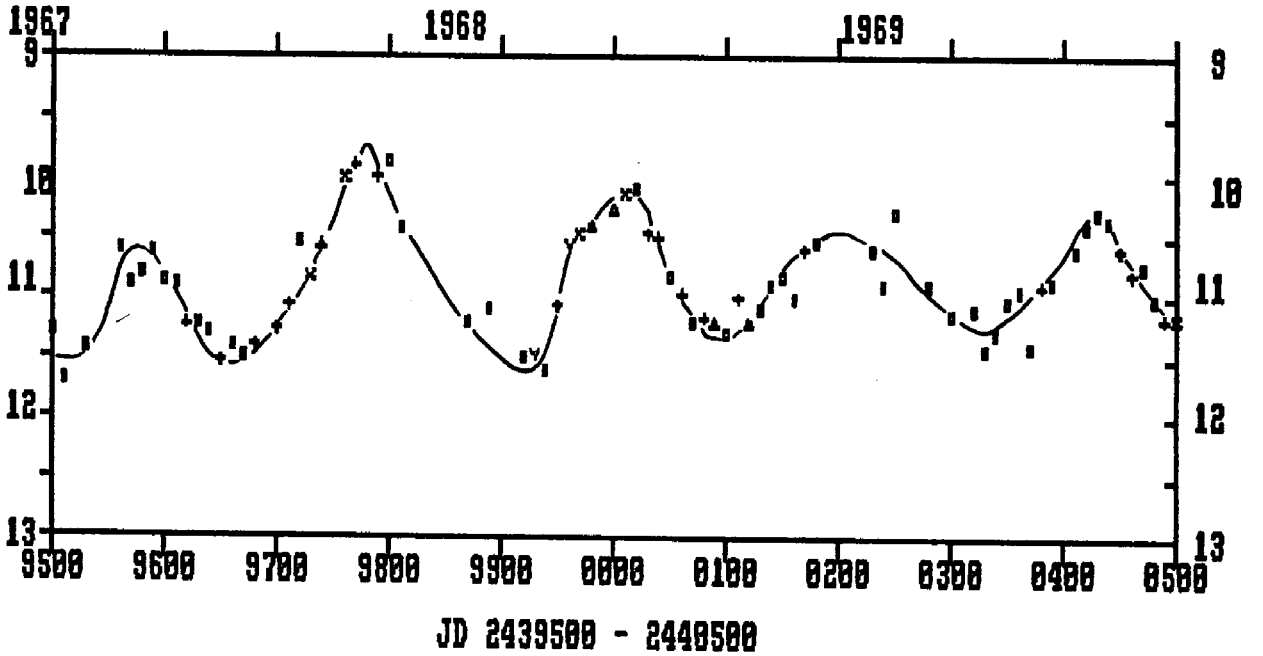


Figure 1d.

173643 TV SCORPII - LIGHT CURVES.



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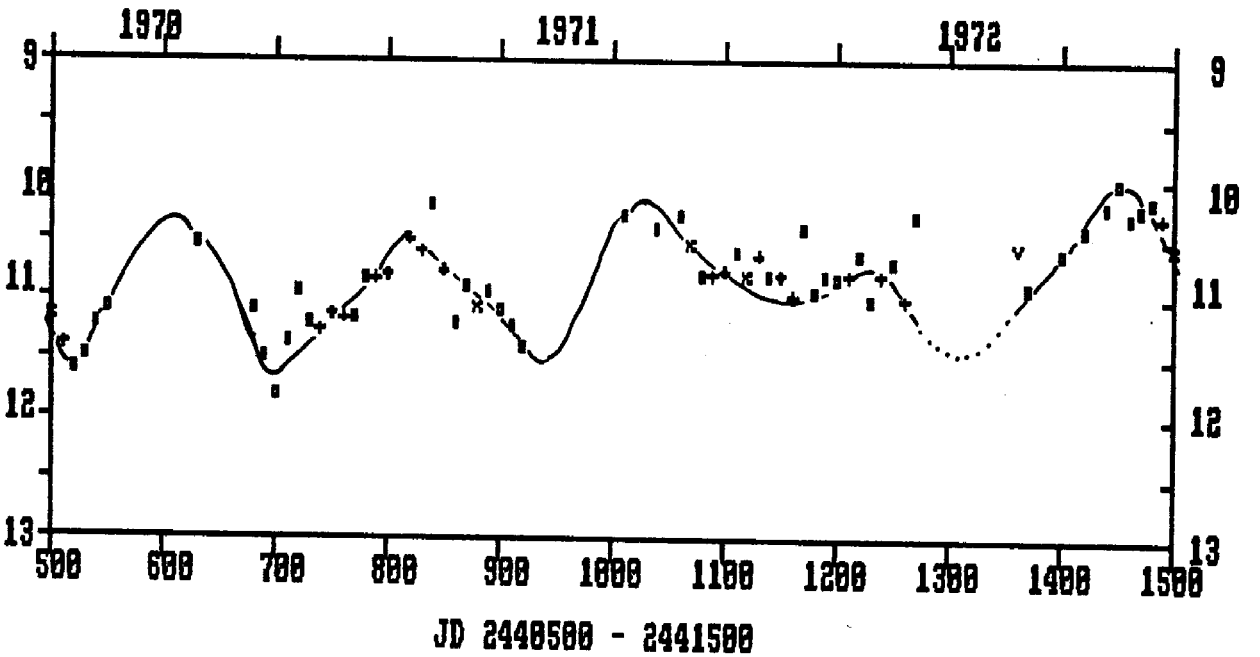

Figure 1f.

173643 TV SCORPII - LIGHT CURVES.

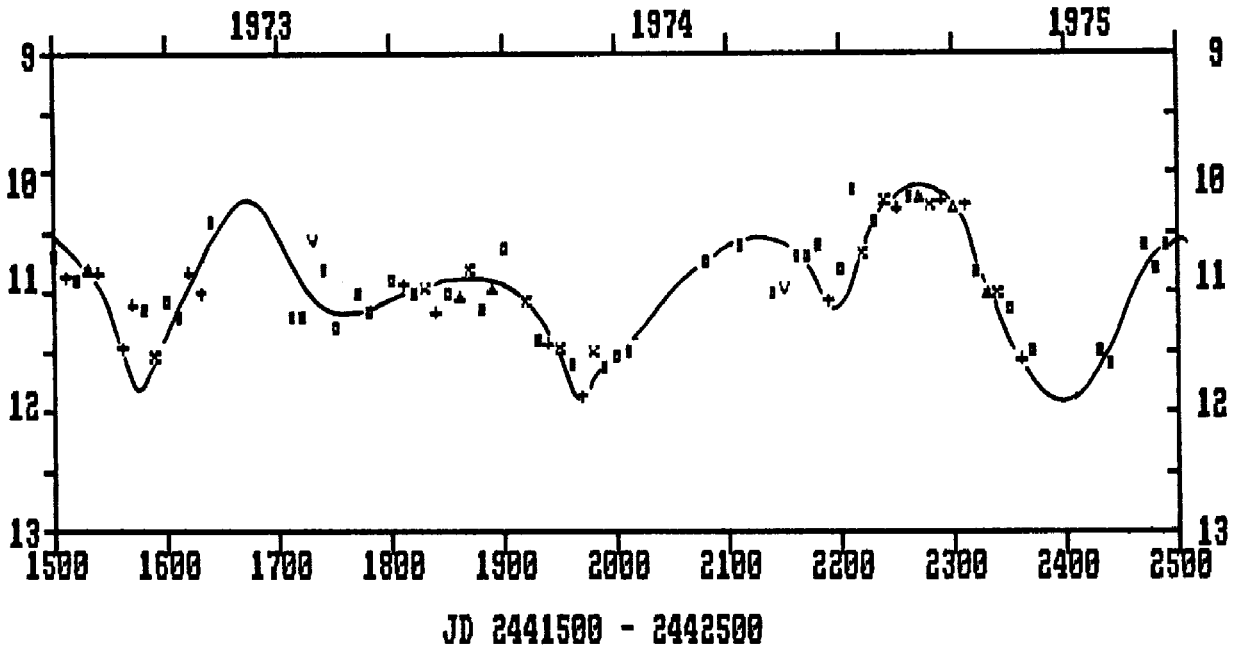

Figure 1g.

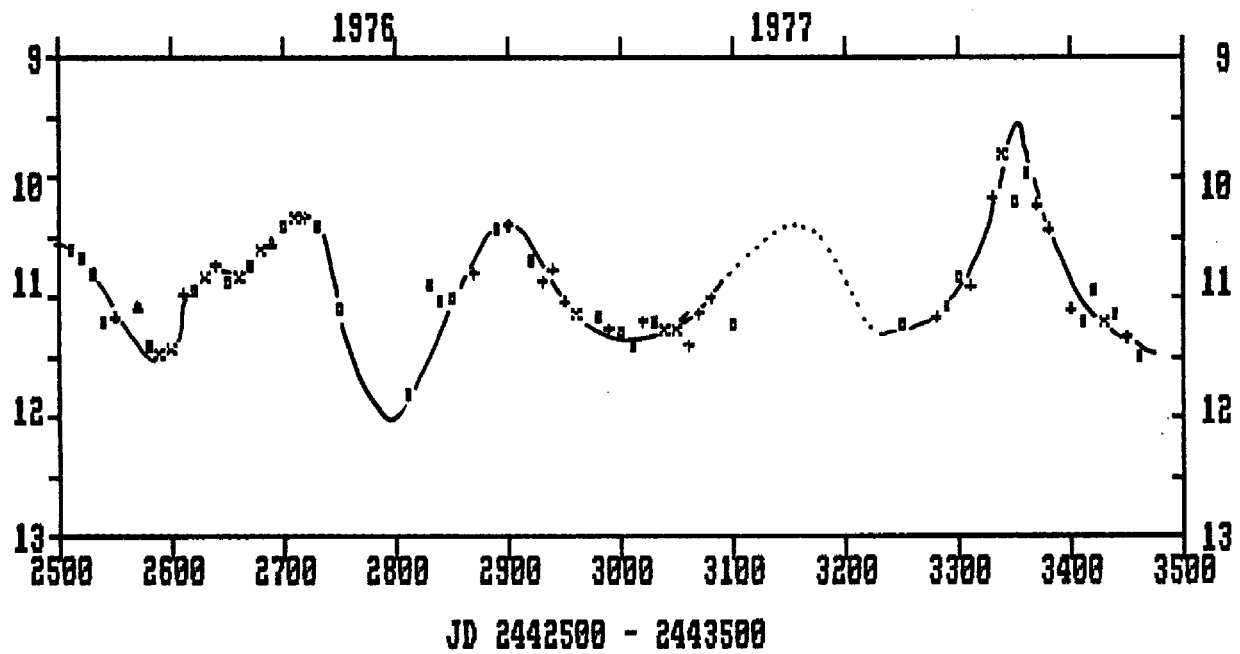

Figure 1h.

173643 TV SCORPII - LIGHT CURVES.

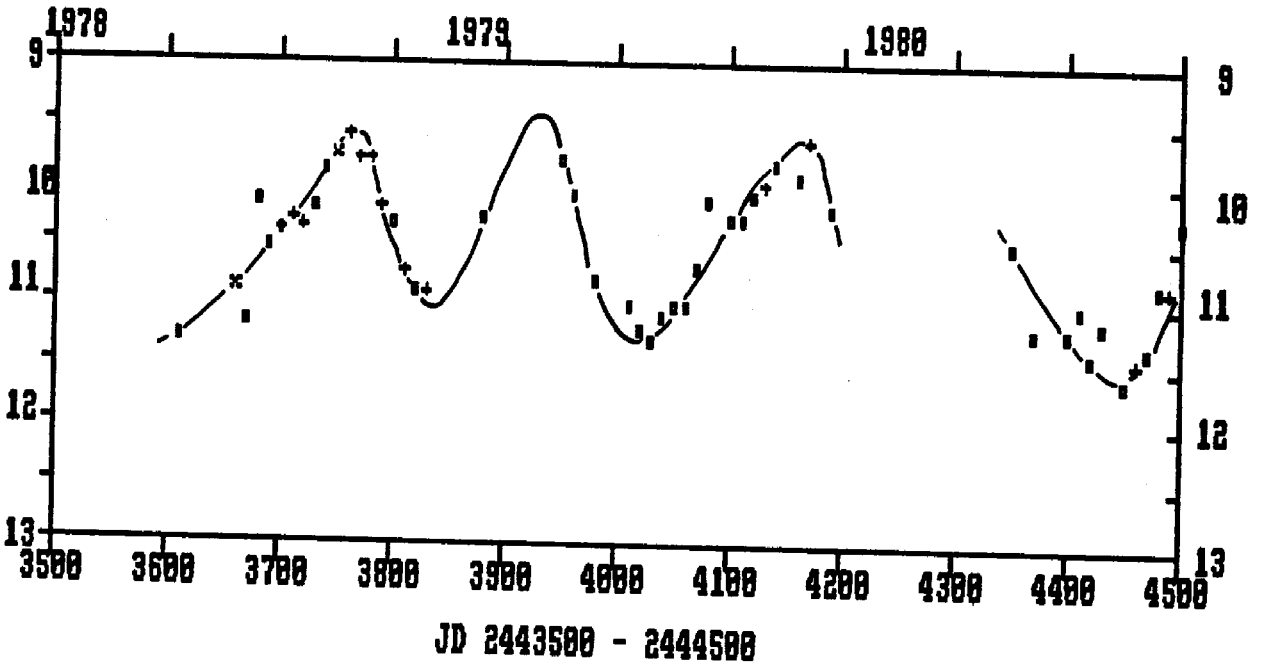

Figure 1i.

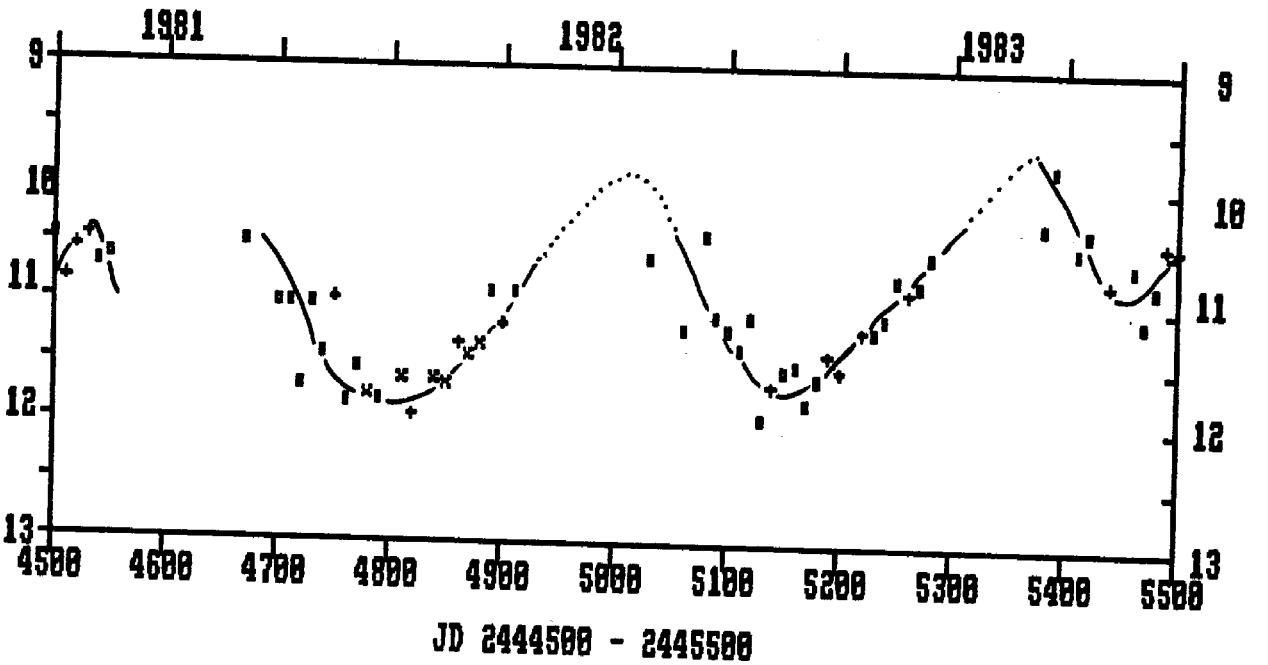

Figure 1j.

173643 TV SCORPII - LIGHT CURVES.

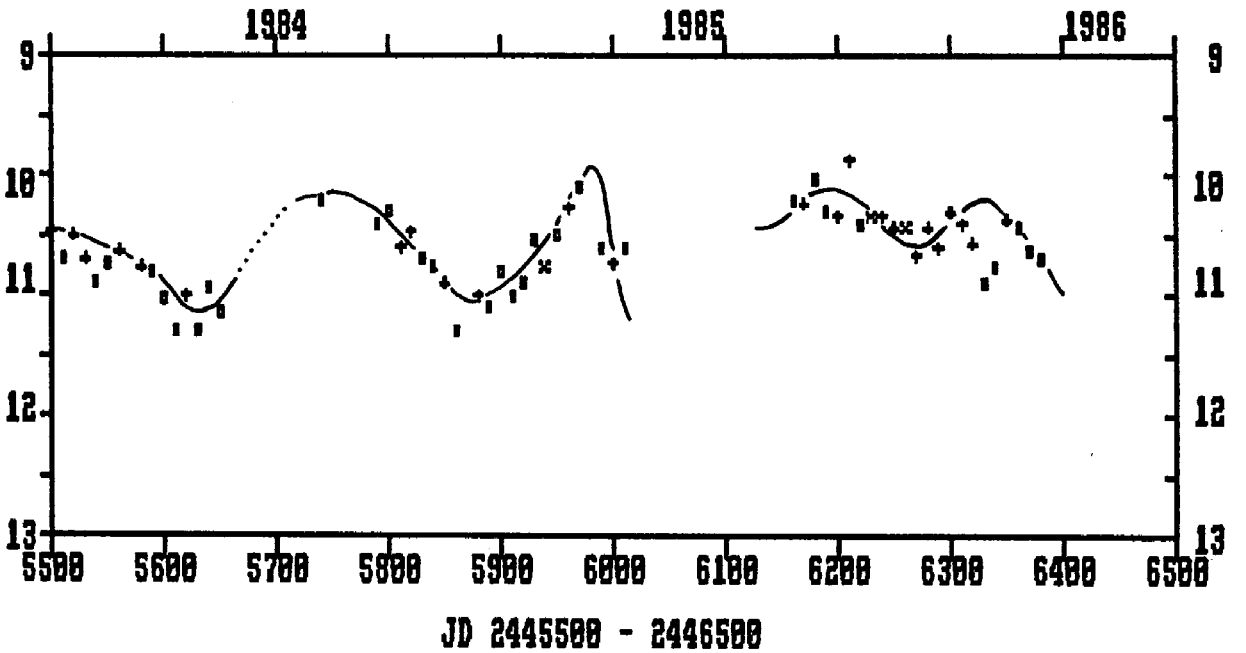

Figure 1k.

173643 TV SCORPII - LIGHT CURVES.

LIGHT CURVE OF THE CATACLYSMIC VARIABLE IX VELORUM

Frank M. Bateson (1) & Ranald McIntosh (2)

(1) Director, VSS,RASNZ
(2) Director, Computing Section,RASNZ

SUMMARY: A light curve from individual visual observations of IX Velorum is reproduced and discussed.

. . . . .

1. INTRODUCTION

Garrison et al (1) announced the discovery of IX Vel as a cataclysmic variable with a magnitude of about 9.8 making it the brightest star of this type in the sky. IX Vel = CPD $-48^{o}1577$=CoD $-48^{o}3636$=LSS 1024. It is classified as nova-like, but Warner (2), on the basis of its spectrum and the absence of any outbursts, places it in the UX UMa sub-class of C.Vs., which are usually considered to be dwarf novae permanently in outburst.

A number of papers have been published on IX Vel, usually under its CPD number. For example see Warner, et al (2); Wargau et al (3) and the references they contain.

The Variable Star Section, RASNZ, has always monitored every southern CV so after its discovery it was placed on the observing programme. Chart 729 (4) was published and this showed the V magnitudes for suitable comparison stars.

2 OBSERVATIONS

Visual observations commenced on J.D. 2445,644 (1983 November 5). The individual observations are plotted in Figures 1 to 7. All observations, except 35, were made by A.F. Jones during the first three years. Thereafter more observers contributed estimates. All observations were made using the V sequence on chart 729.

3. DISCUSSION

An inspection of the light curve shows that, whilst the mean magnitude is around 9.8, there appears to be small amplitude variations occurring at intervals of less than one day.

We tested this by excluding all observations except those made by A.F. Jones. He recorded a range of 9.1 to 10.2. We then selected a number of his observations at magnitudes 10.0 to 10.2 as representing minima to ascertain whether there was any recurrent period. The points of minima were selected at random from the listing of the individual observations.

The periods derived for minima ranged from 4hrs 31m to 4hrs 42m. These results are preliminary because (a) many of the observations were only given to hundredths of a day, and, (b) we made no attempt to convert the dates to HJD.

We then compared these results with the preliminary ephemeris given by Wargau et al (3) and found an excellent agreement considering the lack of more precise timings. These results show the value of the observations made by a careful and experienced visual observer and are a tribute to the high standard of accuracy with which Albert Jones makes all his observations.

4. CONCLUSIONS

IX Vel varies between visual magnitudes 9.1 and 10.2 in a period of approximately 4hrs 36 mins. This gives an approximate orbital period, but is not precise for the reasons we have already pointed out.

We wish to stress to all observers that it is essential to give their estimates of IX Vel to four decimal places and they must see that their timings are strictly accurate.

ACKNOWLEDGEMENTS

We very much appreciate the estimates from all observers. Our special thanks are due to Albert Jones for his excellent series of observations.

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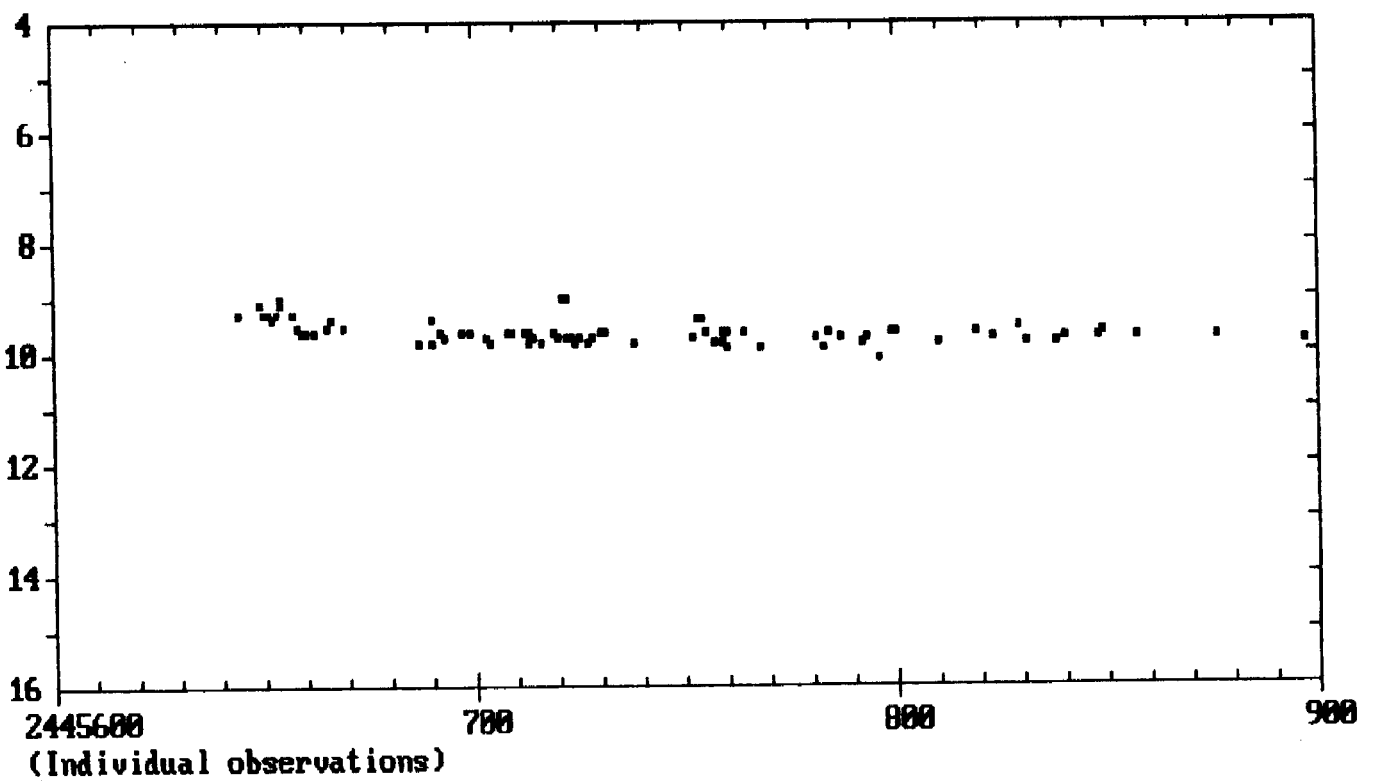

Fig. 1. IX Vel. Light curve. J.D. 2445,644 to 2445,900

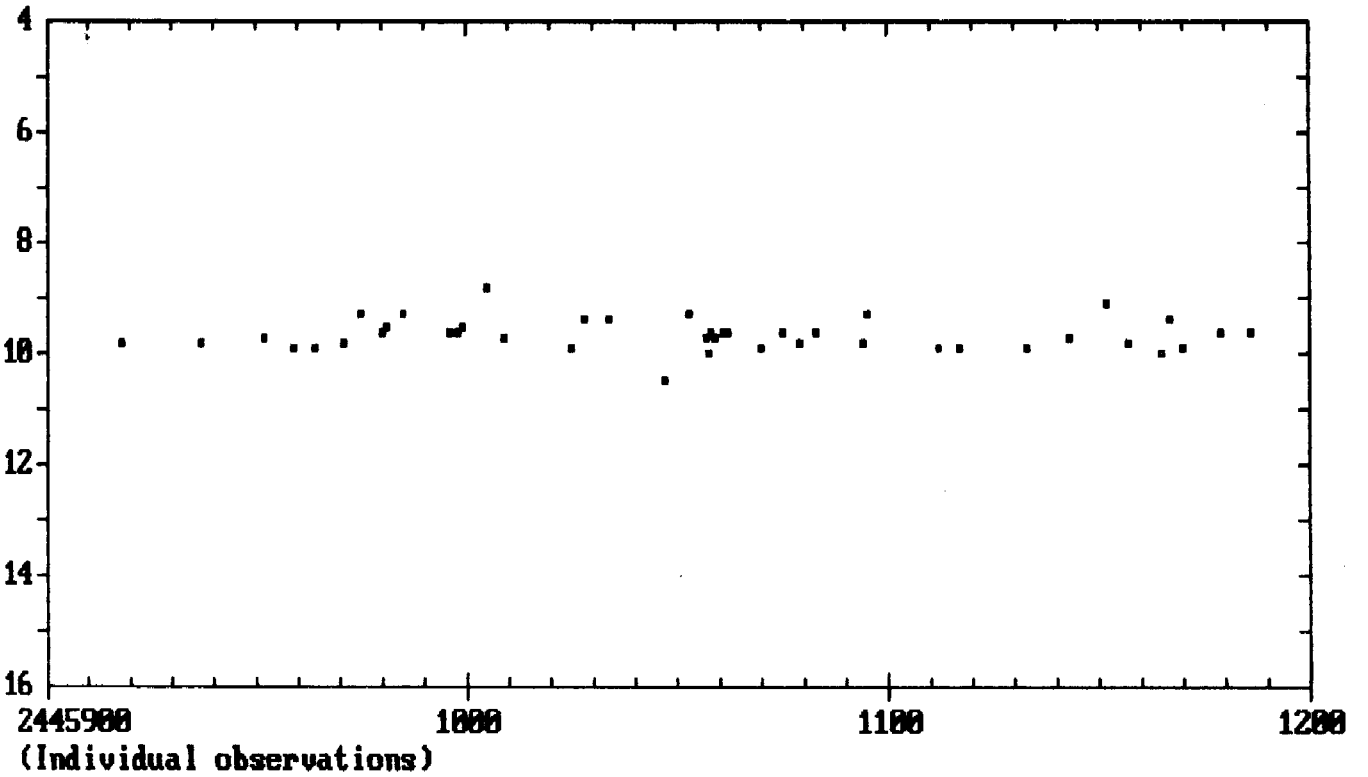

Fig.2. IX Vel. Light curve J.D. 2445,900 to 2446,200.

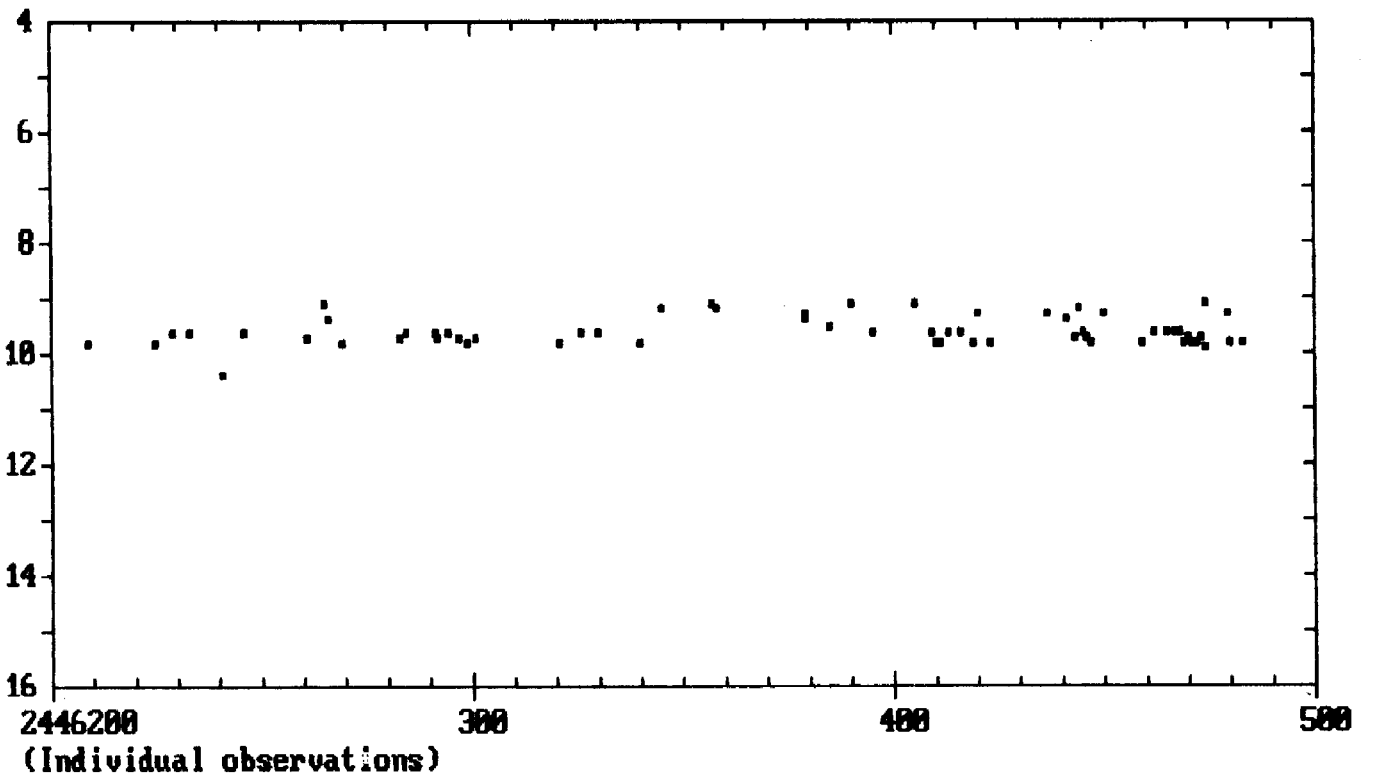

Fig. 3. IX Vel. Light curve. J.D. 2446,200 to 2446,500.

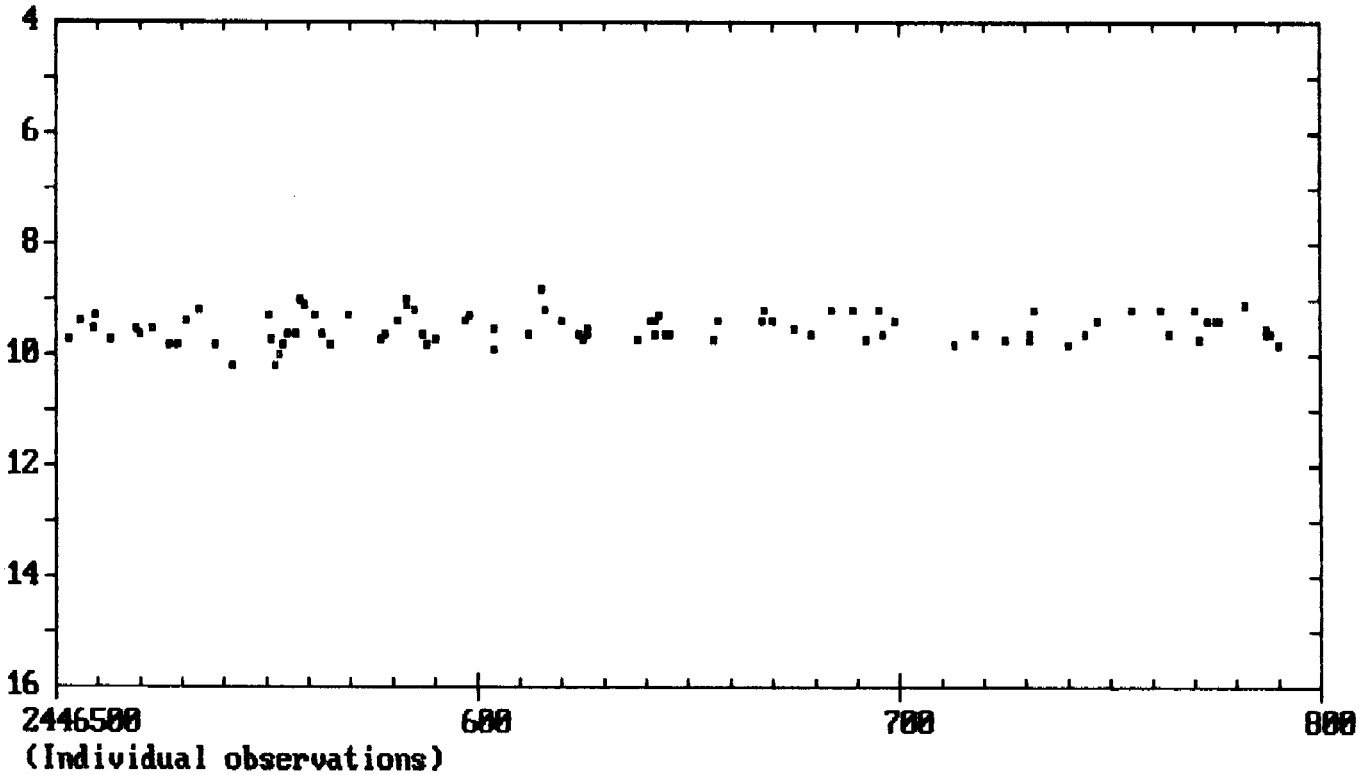

Fig. 4. IX Vel. Light curve. J.D. 2446,500 to 2446,800.

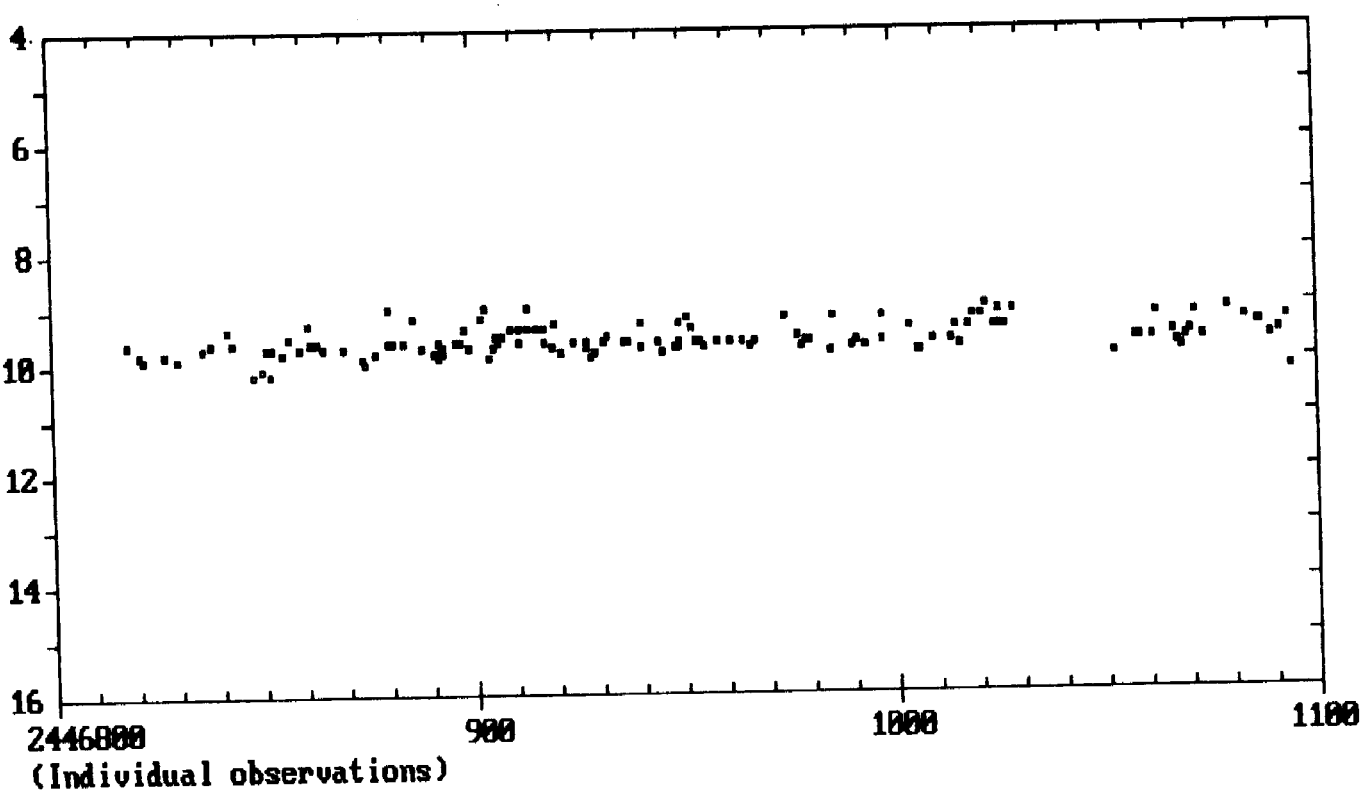

Fig. 5. IX Vel. Light curve. J.D. 2446,800 to 2447,100

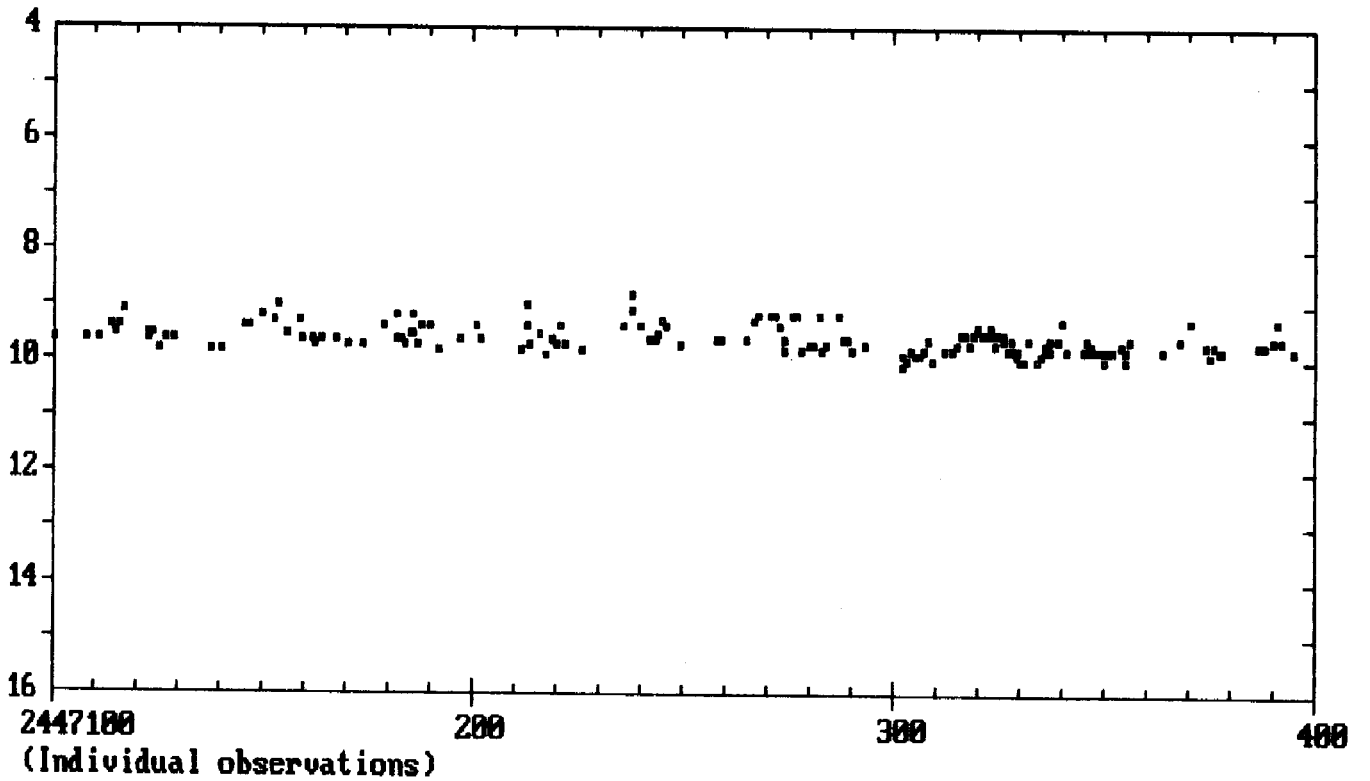

Fig. 6. IX Vel. Light curve J.D. 2447,100 to 2,447,400.

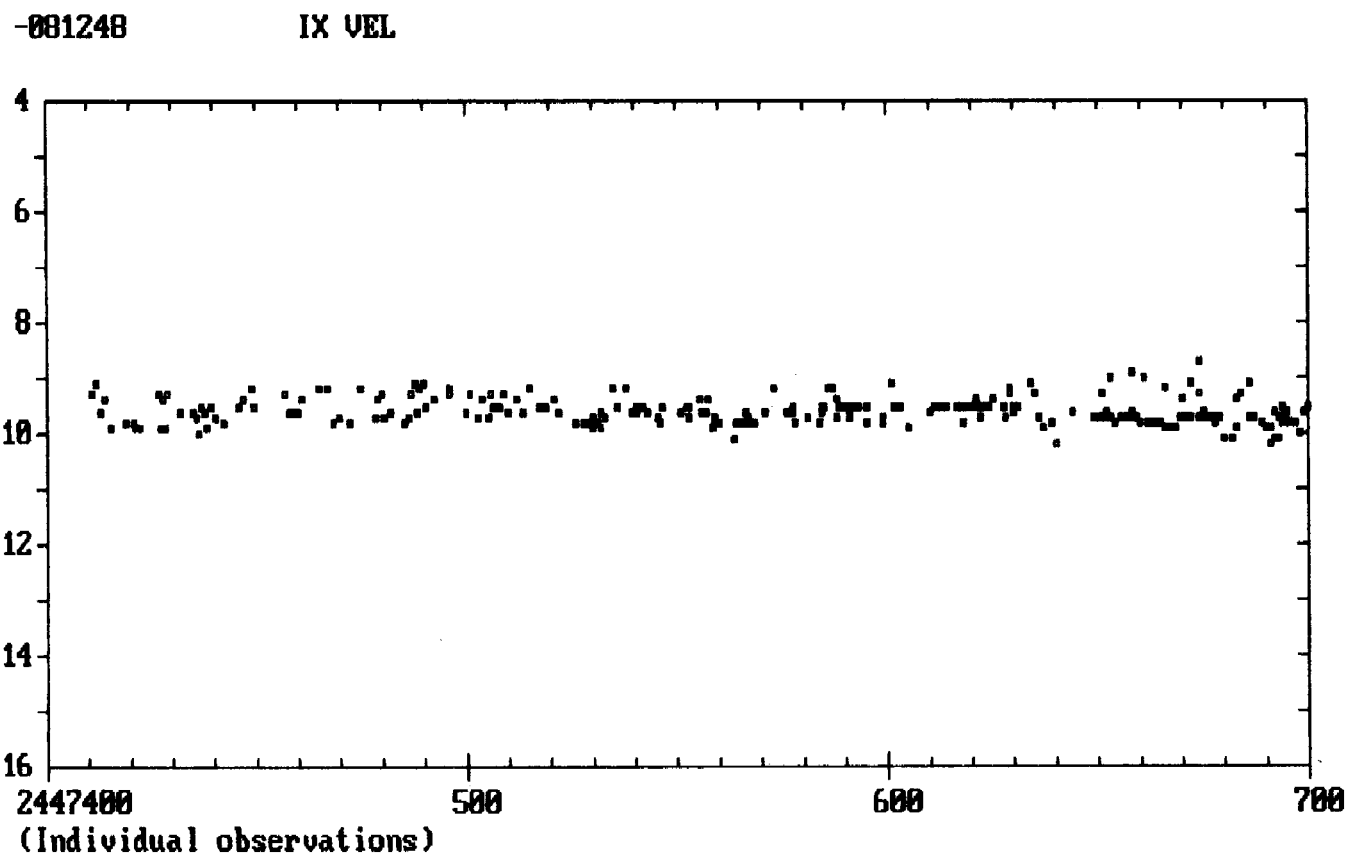

Fig. 7. IX Vel. Light curve J.D. 2447,400 to 2447,700

THE CHANGING PERIOD OF BH CRUCIS

F.M. Bateson (1), R. McIntosh (2) & C.W. Venimore(3)

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SUMMARY: It is shown that the period of BH Crucis has changed.

. . . . .

1. INTRODUCTION

A previous paper compared visual estimates of BH Cru with photoelectric V magnitudes obtained over the same time interval. Bateson (1) in that paper showed that most observers, especially the less experienced tended to estimate the magnitude of BH Cru too faint. Its extreme redness accounts for this. The elements that satisfied the previous observations were (1):

EPOCH MINIMUM 1. 2,440,858 $\pm$ $421^{d}.0$

This period agreed closely with others quoted, for which see references in Paper 1 (1).

BH Cru resembles R Cen in having a double maximum and two minima of unequal depth. There have been numerous papers reporting on its spectrum--for example see Keenan (2) and references therein. The spectra has undergone marked changes (3).

2. OBSERVATIONS

The observations discussed in the present paper cover the interval J.D.2,441,500 to 2446100. All observations were made visually by members of the VSS,RASNZ, using the sequence of V magnitudes shown on Chart 446(4). They are shown on Figures 1 to 5 as ten day means.

The frequency of observations has varied from one year to another with the result that at times there are gaps in the observations. There is also some scatter in the individual estimates, which is usual for such a red star. These facts have made it difficult to precisely determine the dates of maxima and minima. This is especially true for Maximum II and Minimum II.

Table 1 lists our determinations for maxima and minima. Dates we consider uncertain are followed by a question mark. Columns 5 and 10 in the Table gives the period between maxima and minima respectively of the same type. Columns 4 and 9 for maxima the interval, in days, from the preceding minimum, irrespective of type (Colum 4) and the interval from the preceding maximum, irrespective of type.(Column 9).

3. DISCUSSION

Inspection of Table 1 shows that the period lengthed from Maximum II on 2441985. This tendency for the period to increase in length was broken between 2,442,512 and 2442,826, during which intervals between maxima, and/or minima, of the same type appeared to be abnormally short. The period thereafter was certainly much longer than that found in the first paper.

Superimposing the light curves in Figures 1 to 5 on those in the first paper also showed plainly that there had been a period change. This was also apparent by extending the epoch and period in the first paper forward. The O-C residuals for the first three minima in Table 1 were: -11; +33 and -30 days. Thereafter these rapidly increased from +18 to +311 days clearly showing the original period no longer

applied.

We adopted the following elements for the last seven minima in Table 1.

EPOCH MINIMUM I 2444842 ± 464 days.

The O-C values for these seven minima are given in Table 2.

Omitting uncertain values the mean difference, in days, between the various maxima and minima are:

MINIMUM I to MAXIMUM I	156 days
MAXIMUM I to MINIMUM II	57.4 days
MINIMUM II to MAXIMUM II	70.8
MAXIMUM II to MINIMUM I	179.8 days

The limited number of reliable dates make these intervals somewhat uncertain.However, they tend to show that most of the increase in period was between Minimum I and Maximum I.

The mean magnitudes for all values that appear certain are:

MINIMUM I	9.7 (9.5)
MAXIMUM I	7.9 (7.5)
MINIMUM II	8.26(8.13)
MAXIMUM II	7.73(7.2)

The magnitudes in brackets are the values from the first paper. There appears to be a slight tendency for the magnitudes in the present paper to be fainter than those in the previous paper. This probably is because this time it has not been possible to correct them from photoelectric data in the same interval. It was shown in the first paper that visual observers tend to make their estimates too faint and this may account for the differences shown above.

4. CONCLUSIONS

There can be no doubt that the period of BH Crucis has increased in length and that prior to this there were abnormally short periods. We are unable to state whether the change has been associated with spectral changes but we suggest that this is probably so.

We wish to stress to all visual observers that BH Cru requires close monitoring over many decades, because if changes in period are associated with spectral changes it is essential to have a very complete light curve on a continuous basis for very many years to corelate the two parameters with one another. We also stress that in making visual estimates of such a red star it is essential to use quick glances between the variable and comparison stars and avoid staring at the variable.

ACKNOWLEDGEMENTS

We express our appreciation to the observers for their contributions, without which this paper could not have been written.

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TABLE No. 1

BH Crucis---OBSERVED MAXIMA AND MINIMA

MAXIMA					MINIMA				
TYPE	J.D.	MAG_v	INT_d	INT_d	TYPE	J.D.	MAG_v	INT_d	INT_d
					MIN. I	2441689	9.8	164	415
MAX. I	2441826	7.7	137	428	MIN.II	893	8.2	67	436
MAX. II	985	7.6	92	460	MIN. I	2442154	9.9	169	465
MAX. I	2442293	7.7	139	467	MIN.II	386	8.1	93	493
MAX. II	442	7.8	56	457	MIN. I	512	9.6	70	358
MAX. I	688	8.0	176	395	MIN.II	745	8.2	57	359
MAX. II	826	7.7	81	384	MIN. I	981	10.0	155	469
MAX. I	2443171	8.2	190	483	MIN.II	2443242	8.7	71	497
MAX.II	280	8.0	38	454	MIN. I	424	9.6	144	443
MAX. I	611	8.0	187	440	MIN.II	692	8.6	81	450
MAX.II	747	8.0	55	467	MIN. I	900?	9.8	153?	476
MAX. I	2444032	7.5	132?	421	MIN.II	2444101	8.2	69	409
MAX.II	2444169?	7.7?	68?	422?	MIN. I	2444400?	9.7	231?	500?
MAX. I	490?	8.0?	90?	452	MIN.II	610?	8.3	120?	509?
MAX.II	632	7.9	22?	463	MIN. I	842	9.5	210	442
MAX. I	995	7.8	153	505?	MIN.II	2445057	8.1	62	447
MAX II	2445119	7.3	62	487	MIN. I	301	9.5	182	459
MAX. I	453	8.1	152	458	MIN.II	499	8.0	46	442
MAX.II	590	7.4	91	471	MIN. I	800	9.7	210	499
MAX. I	957	8.1	157	504	MIN.II	986	8.2	29	487
MAX.II	2446061	7.9	75	471					

TABLE No. 2

BH CRUCIS---O-C VALUES FOR MINIMUM I--EPOCH Min.I 2444842 +464 days.

No.	CALCULATED	OBSERVED	$O-C_d$
-4	2442986	2442981	- 5
-3	2443450	2443424	-26
-2	2443914	2443900?	-14
-1	2444378	2444400?	+22
+0	2444842	2444842	0
+1	2445306	2445301	- 5
+2	2445770	2445800	+30

NOTE TO TABLE 2.

The observed Min. I at 2442512 had an O-C of -10 days despite its short interval from the preceding Min. I whereas the first two Min. I in Table 1 had O-C values of +95 and +96 days. This may indicate that BH Cru adjusted to its increased period from 2442512.

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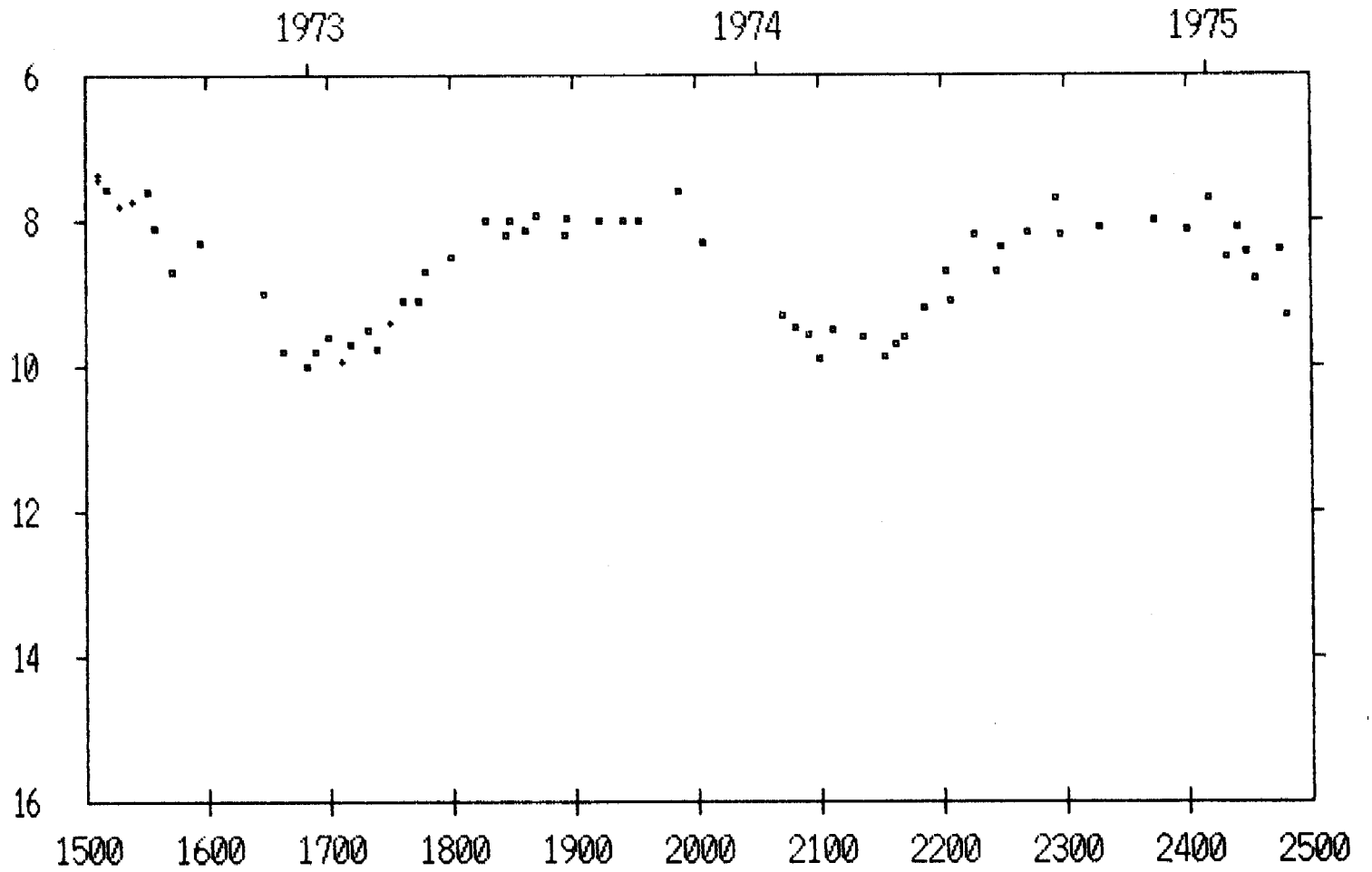

Fig.1. BH Cru. Light curve J.D. 2441500 - 2442500 from ten day means

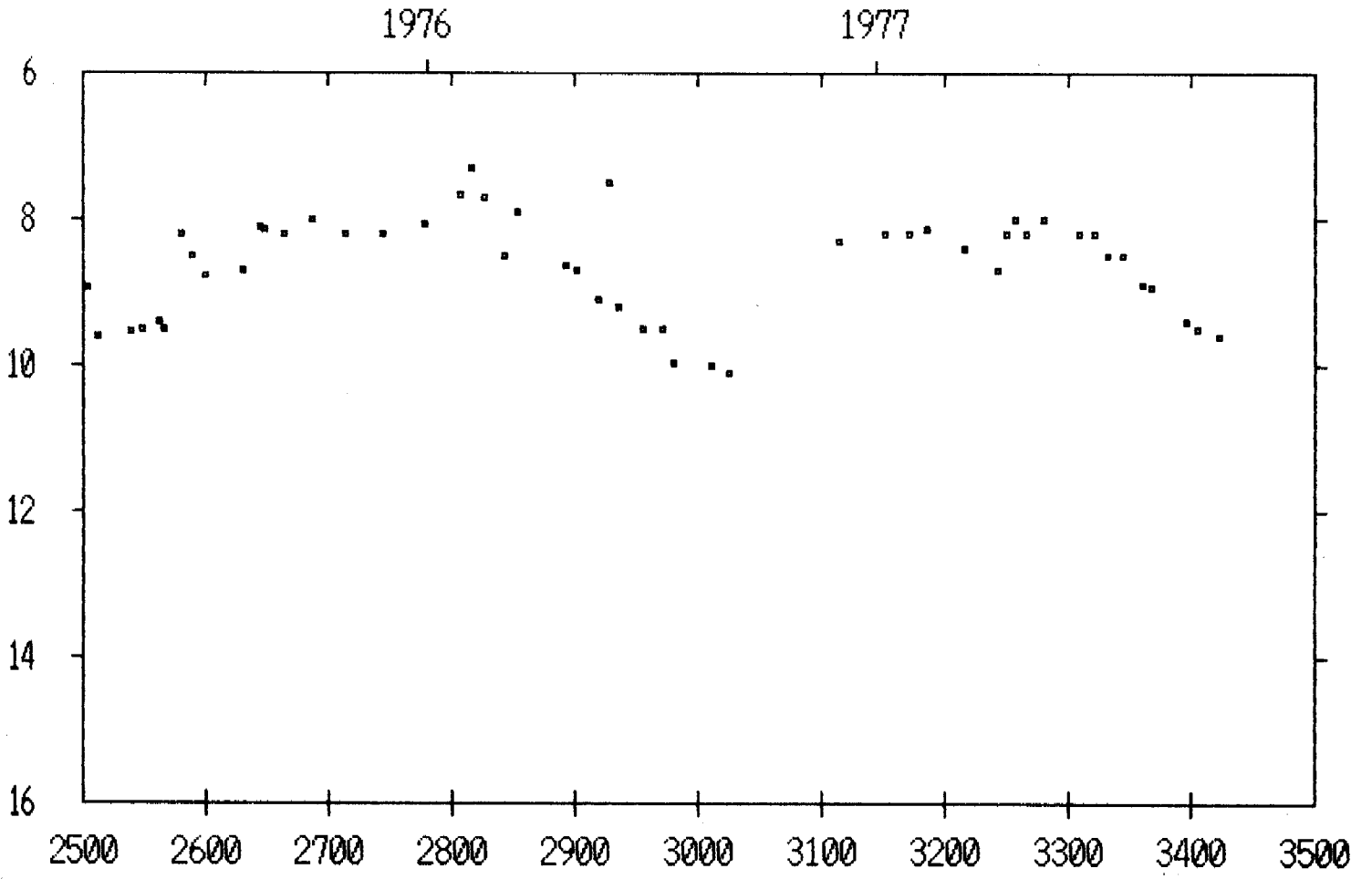

Fig.2. BH Cru. Light curve J.D. 2442500 - 2443500 from ten day means

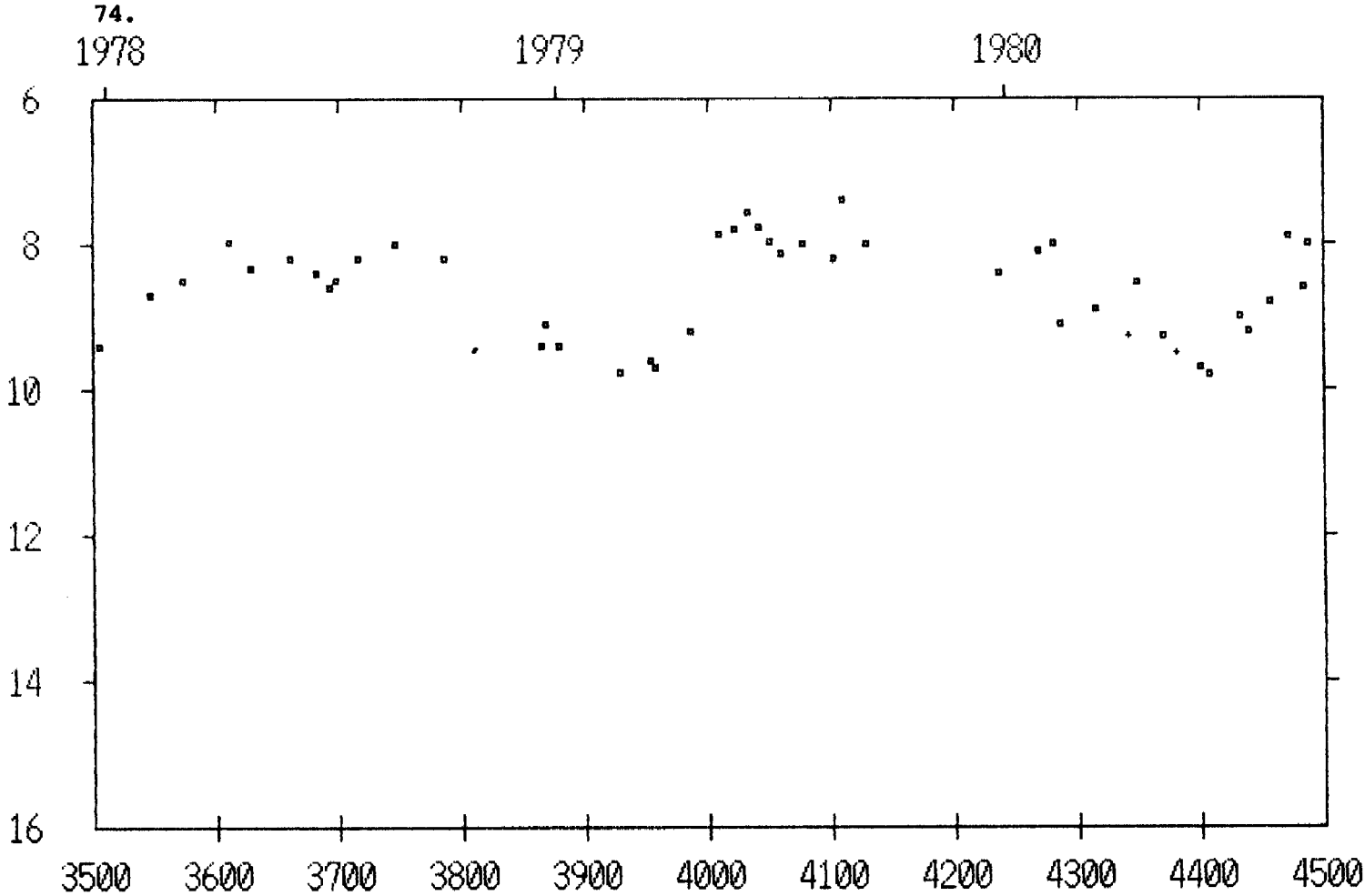

Fig. 3. BH Cru. Light curve J.D. 2443500 - 2444500 from ten day means

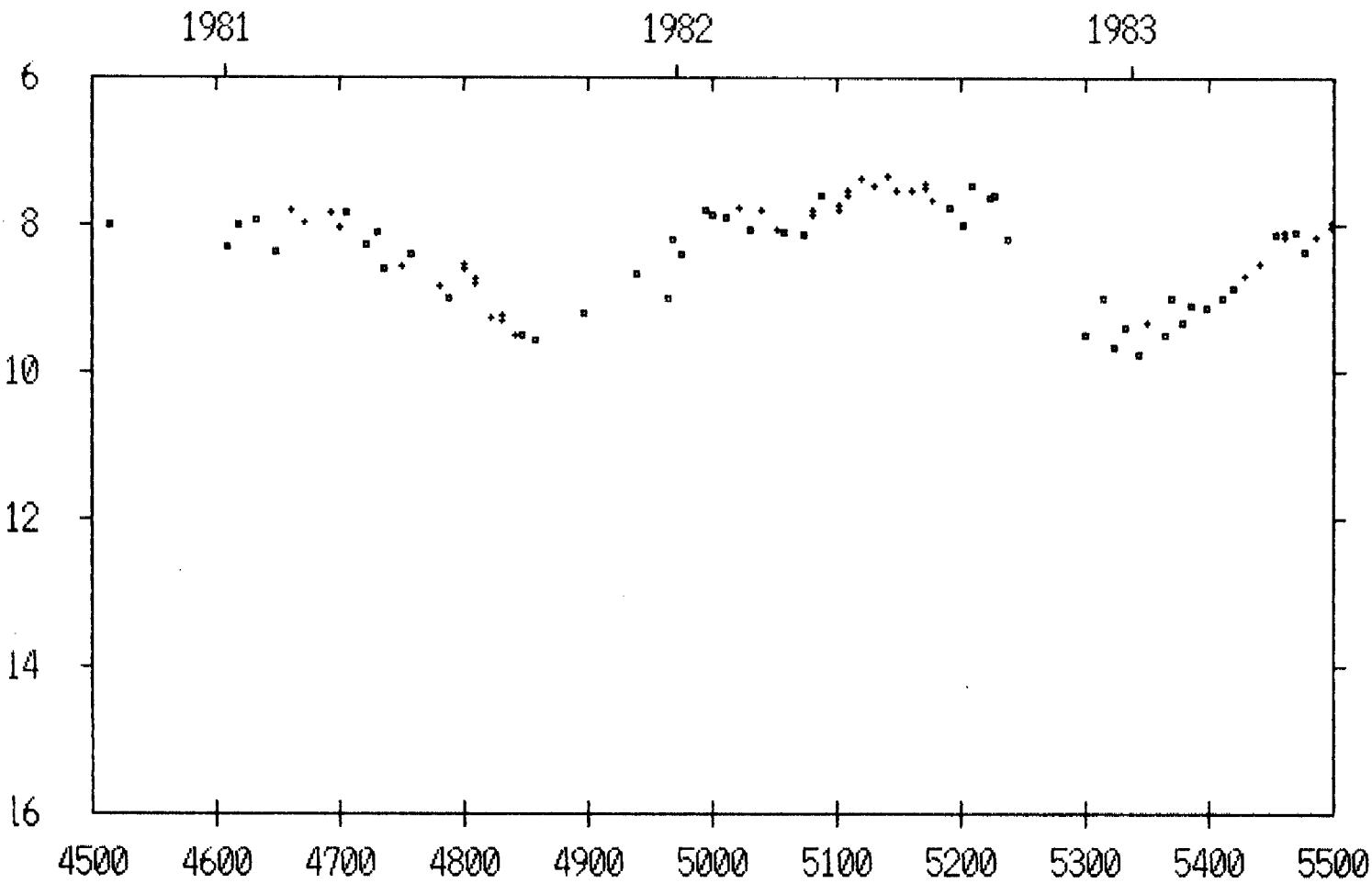

Fig. 4. BH Cru. Light curve J.D. 2444500 - 2445500 from ten day means.

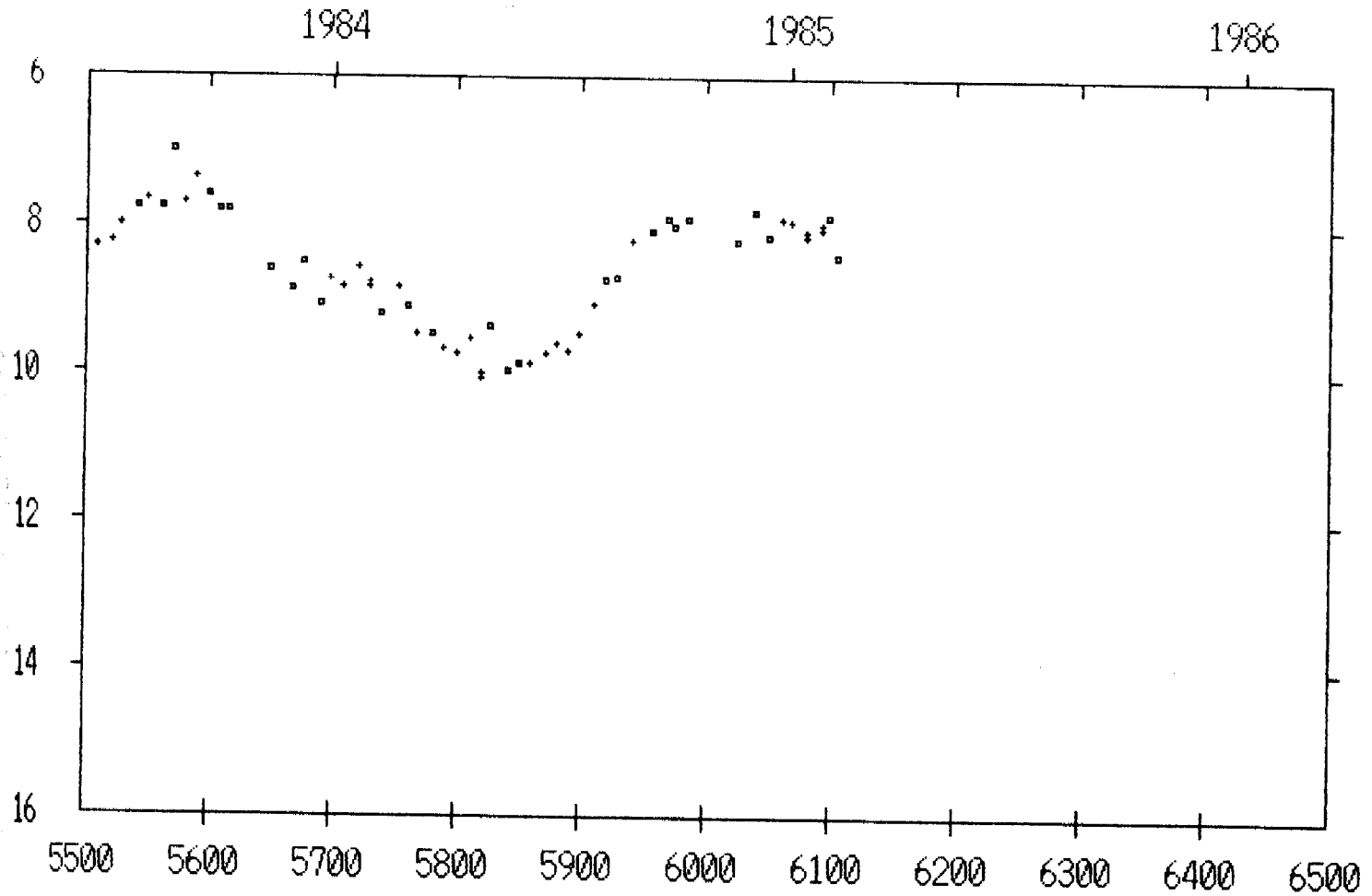

Fig. 5. BH Cru. Light curve J.D. 2445500 - 2446100 from ten day means

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NOTE ON OBSERVING DWARF NOVAE AT OUTBURST

F.M. Bateson & R. McIntosh.

SUMMARY: light curves of Z Cha,on different scales, are used to show observers why frequent, very accurately timed observations are required during their outbursts.

. . . . .

1. INTRODUCTION

A wealth of detail can be obtained from very accurately timed and frequent observations of dwarf novae at outburst. This is illustrated by light curves of Z Cha on different scales during its 1987 Superoutburst in March/April. Z Cha is one of the dwarf novae which show eclipses but our comments apply to all dwarf novae, especially those of the SU UMa sub-class. Estimates are required at intervals of a few minutes as long as possible right throughout an outburst. It is essential that each estimate be very accurately timed so that they can be converted in HJD in papers discussing the results.

This note is purely to direct observers' attention to the foregoing and is not a discussion of the results of this particular superoutburst. Observed parameters can change with time as has been already pointed out in various papers. Visual estimates of continuous monitoring over long time intervals are quite accurate in revealing such changes.

2. LIGHT CURVES OF Z CHA.

Figure 1. This plot covering 300 days merely shows that an outburst was observed. The maximum magnitude and duration of the outburst shows it was a superoutburst.

2, The same scale as Fig.1 but with the details more clearly shown. This plot enables the duration of the superoutburst to be well determined. The rise was obviously very rapidand that eclipses took place and the slow decline.

Figure 3. Covers three days. Enables some idea of the structure of the eclipses to be seen

Figure 4. Same scale as Fig. 3 but has the eclipses which appeared on the right hand edge in Fig.3 is now centred showing that three eclipses were observed instead of what appears in Fig.3 as a confused jumble.

Figure 5. Another three day plot showing that eclipses are centred around the evening hours when most observers were active.

Figure 6. This very much enlarged plot clearly shows the shallow and U shaped eclipses that occur at the start of a superoutburst. The rise and decline of one eclipse was well observed; only the rise of another.

Figure 7. Another enlarged plot clearly showing the typical V-shaped, deep eclipse and one U shaped and shallower eclipse.

Figure 8. Complete details of this deep V-shaped eclipse are shown.

Figure 9. This is one of a number of excellent results obtained by W. Goltz from his own observations in which he has plotted his estimates in HJD against phase.

Figure 10. This again is by W. Goltz and shows his observations for each cycle in HJD and phase. This, with accompanying light curves is the end product of observations that observers submit. Bateson (1) published such data for Z Cha; Taylor & Gilmore (2) for OY Car.

GENERAL COMMENT

We hope that this short note answers the questions that some observers have asked and, at the same time, demonstrates the points we have stressed on the preceding page.

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(2) Taylor, N.W. & Gilmore, A.C. 1983. Publ. Var. Star Sect., Publ.11 p.14

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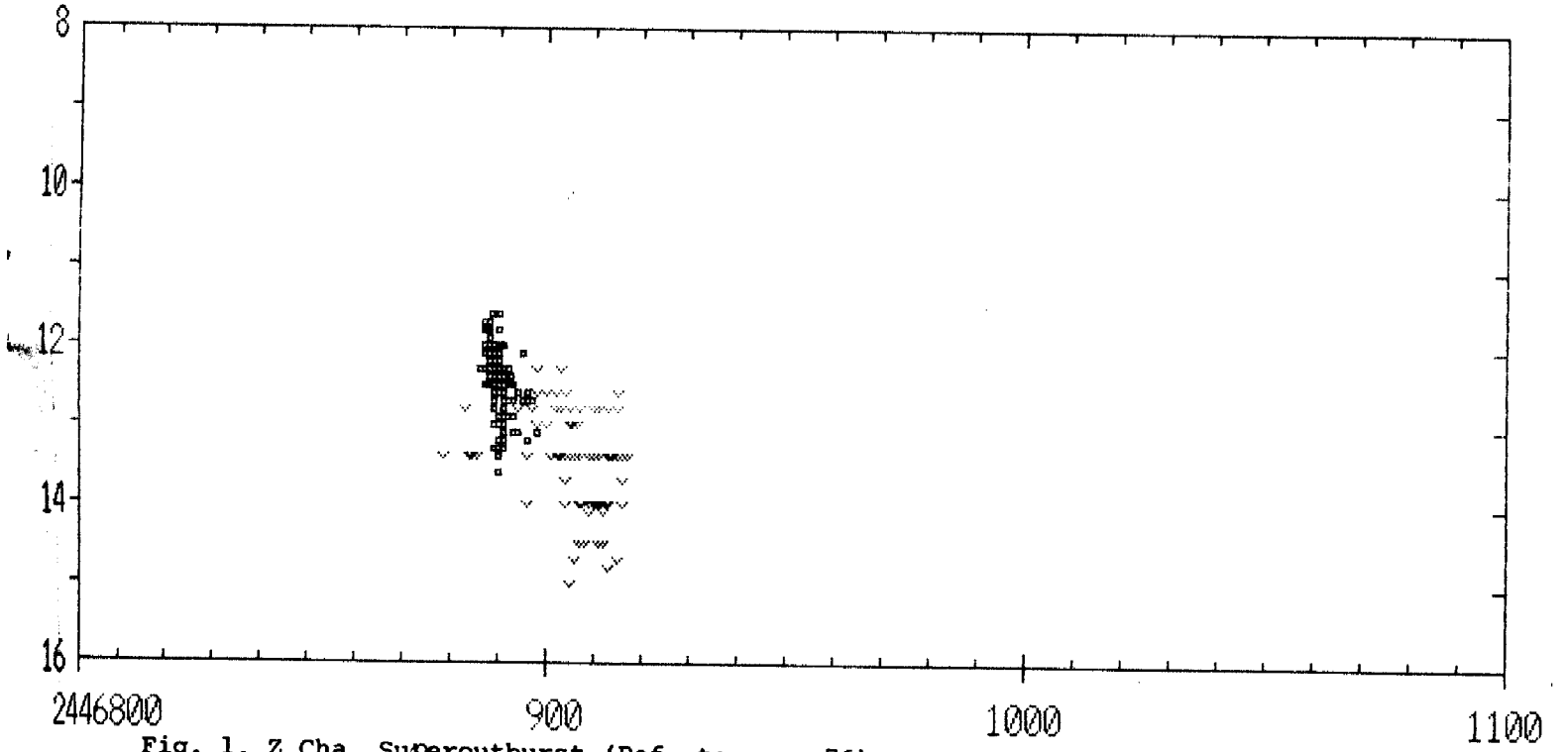

Fig. 1. Z Cha. Superoutburst (Ref. to page 76)

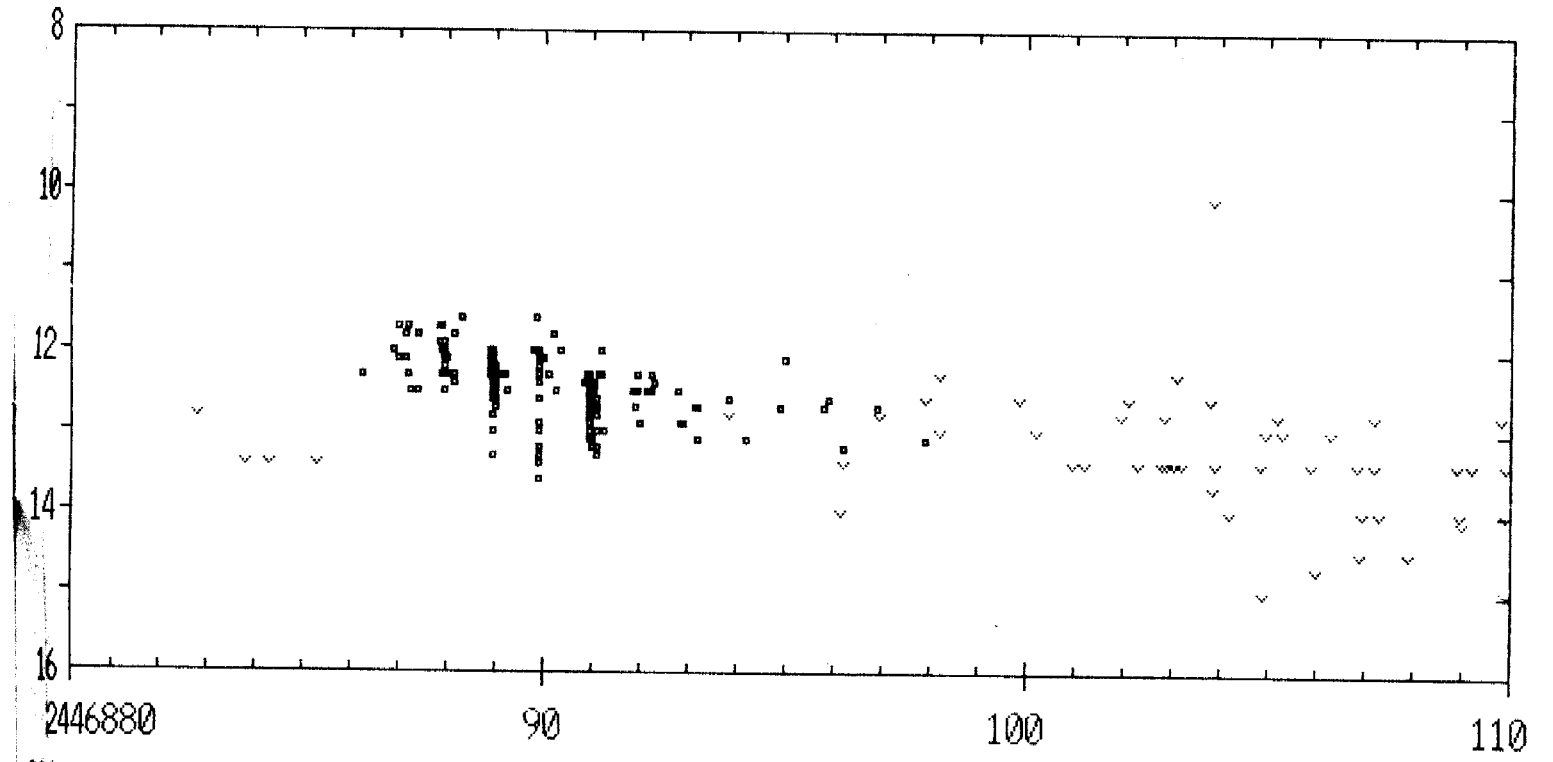

Fig. 2. Z Cha. Superoutburst (Refer to page 76_

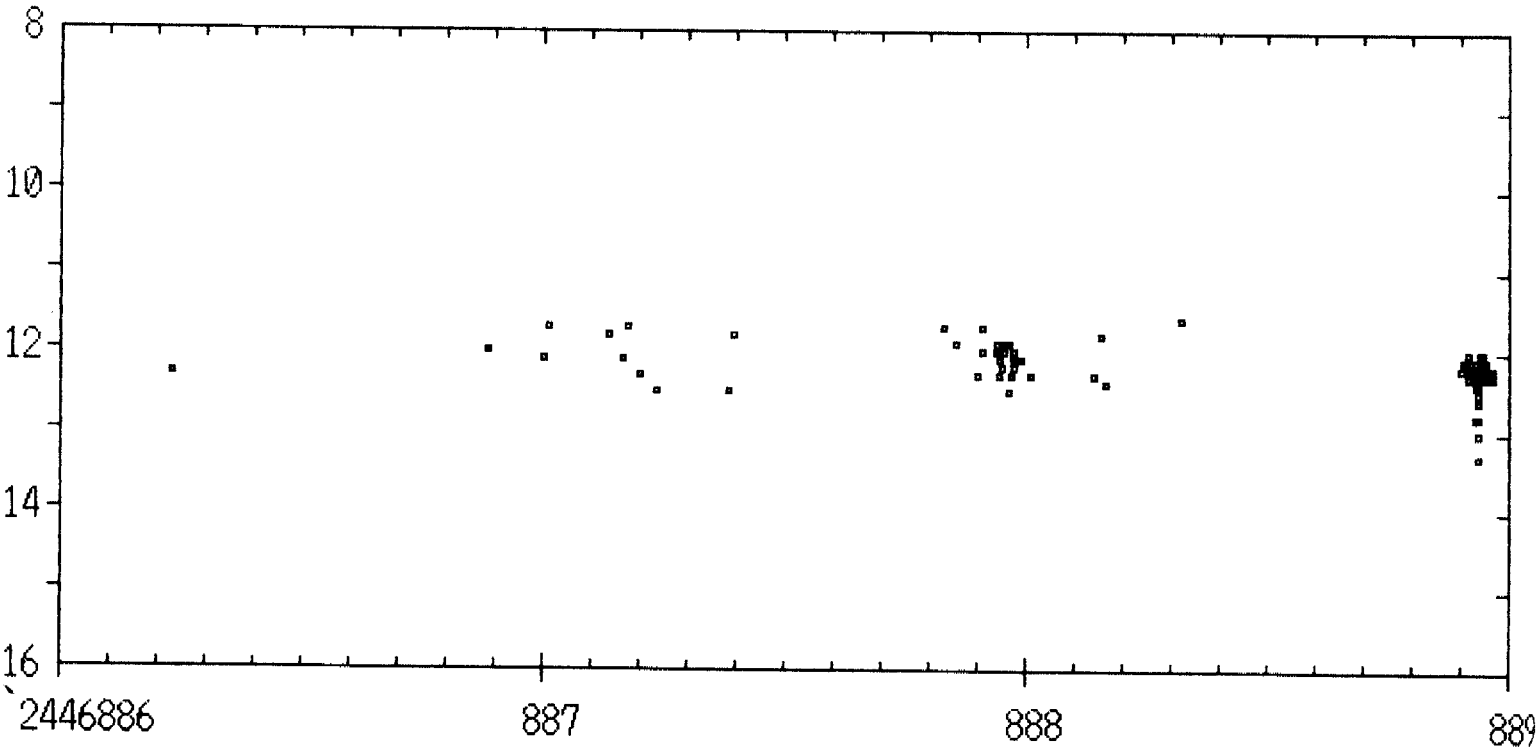

Fig.3. Z Cha. Superoutburst (Refer to page 76)

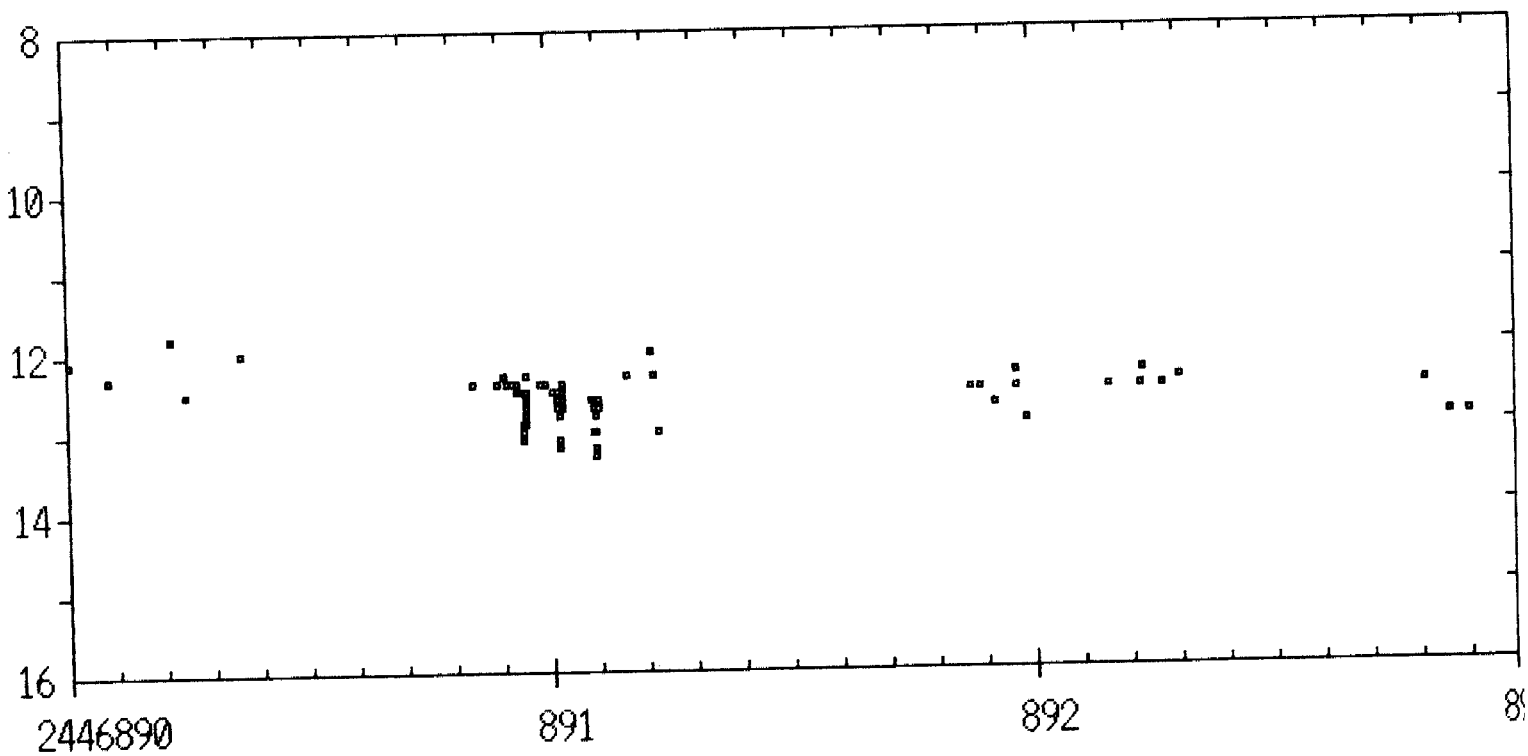

Fig. 4. Z Cha. Superoutburst (Refer to page 76).

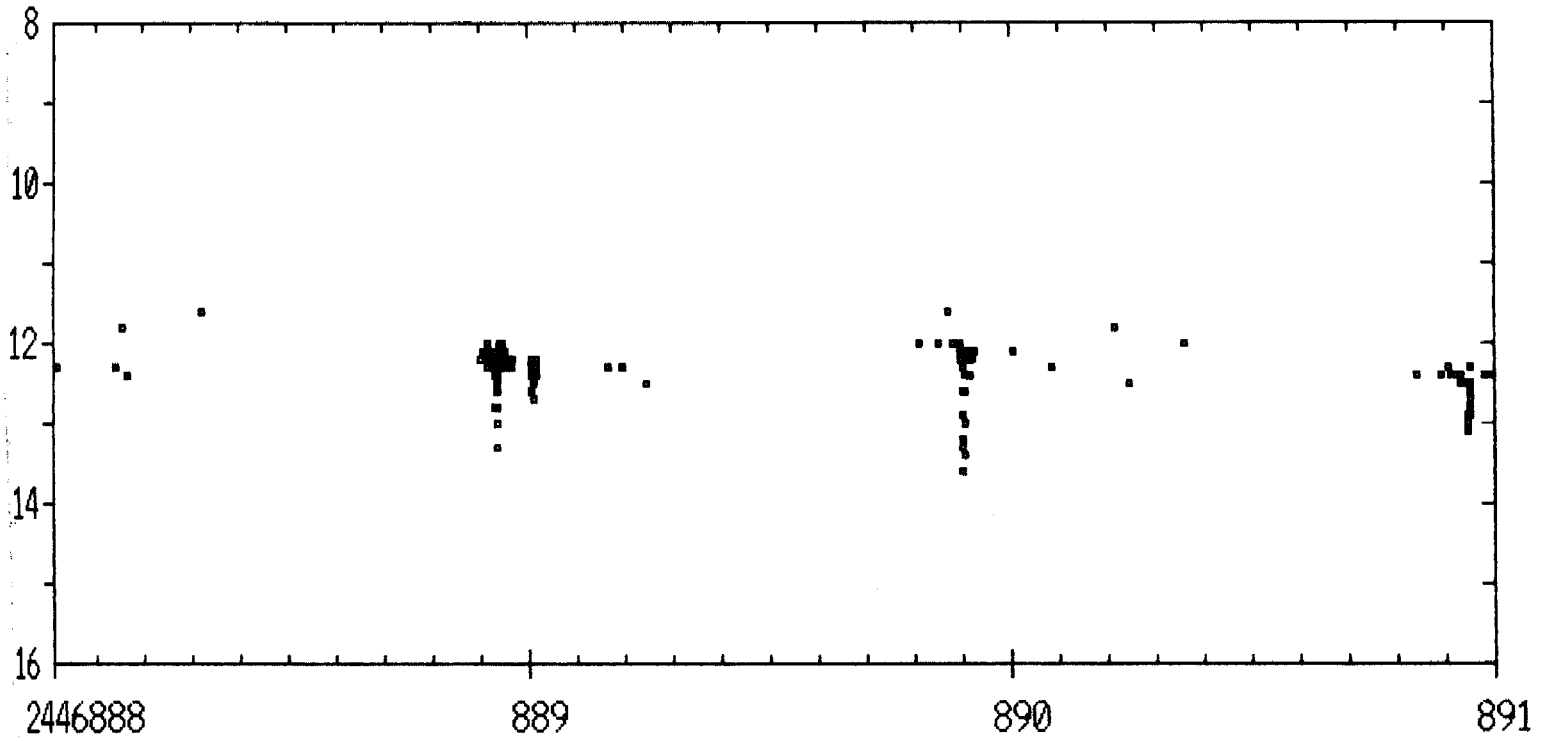

Fig. 5. Z Cha. Superoutburst *Refer to page 76).

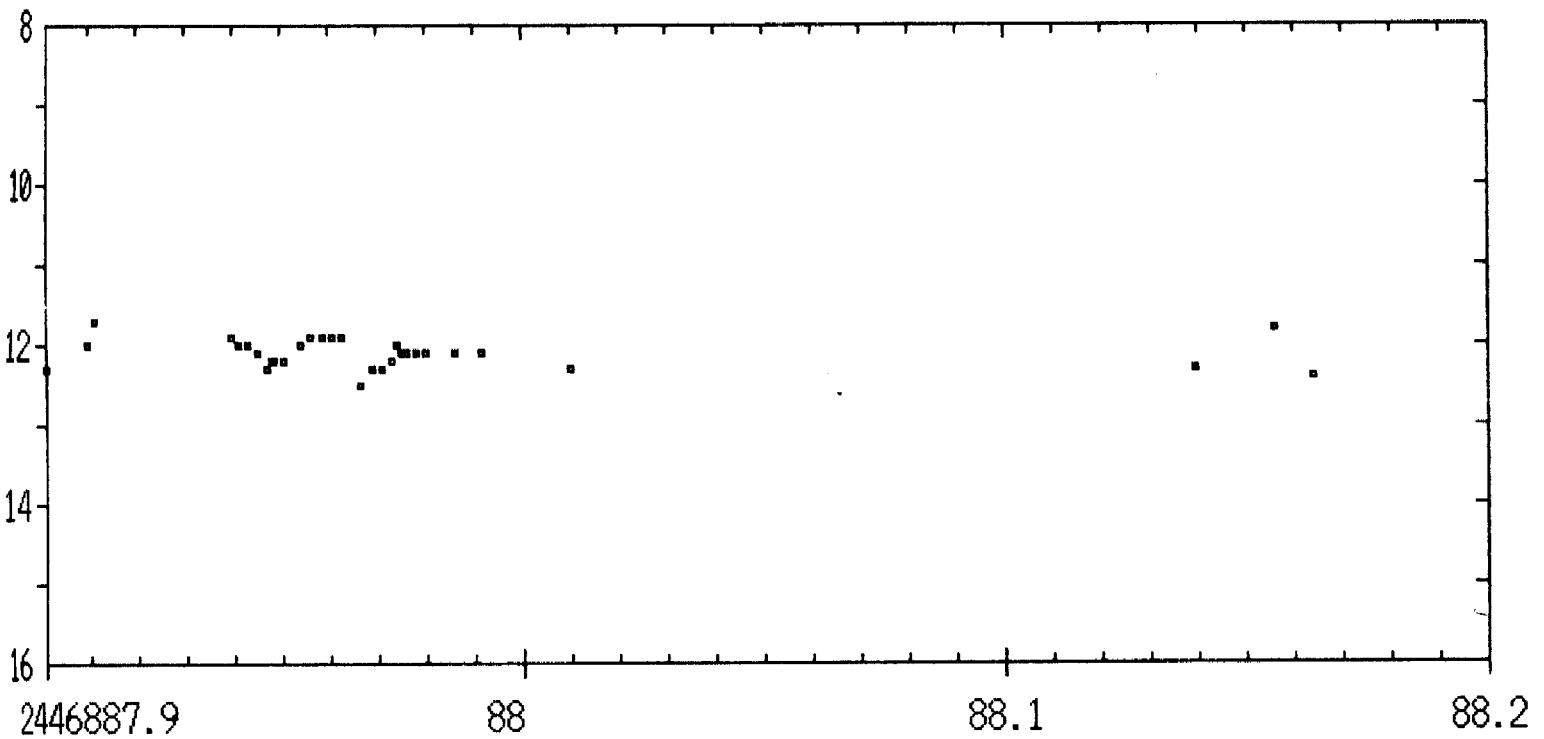

Fig.¢. Z Cha. Superoutburst (Refer to page 76)

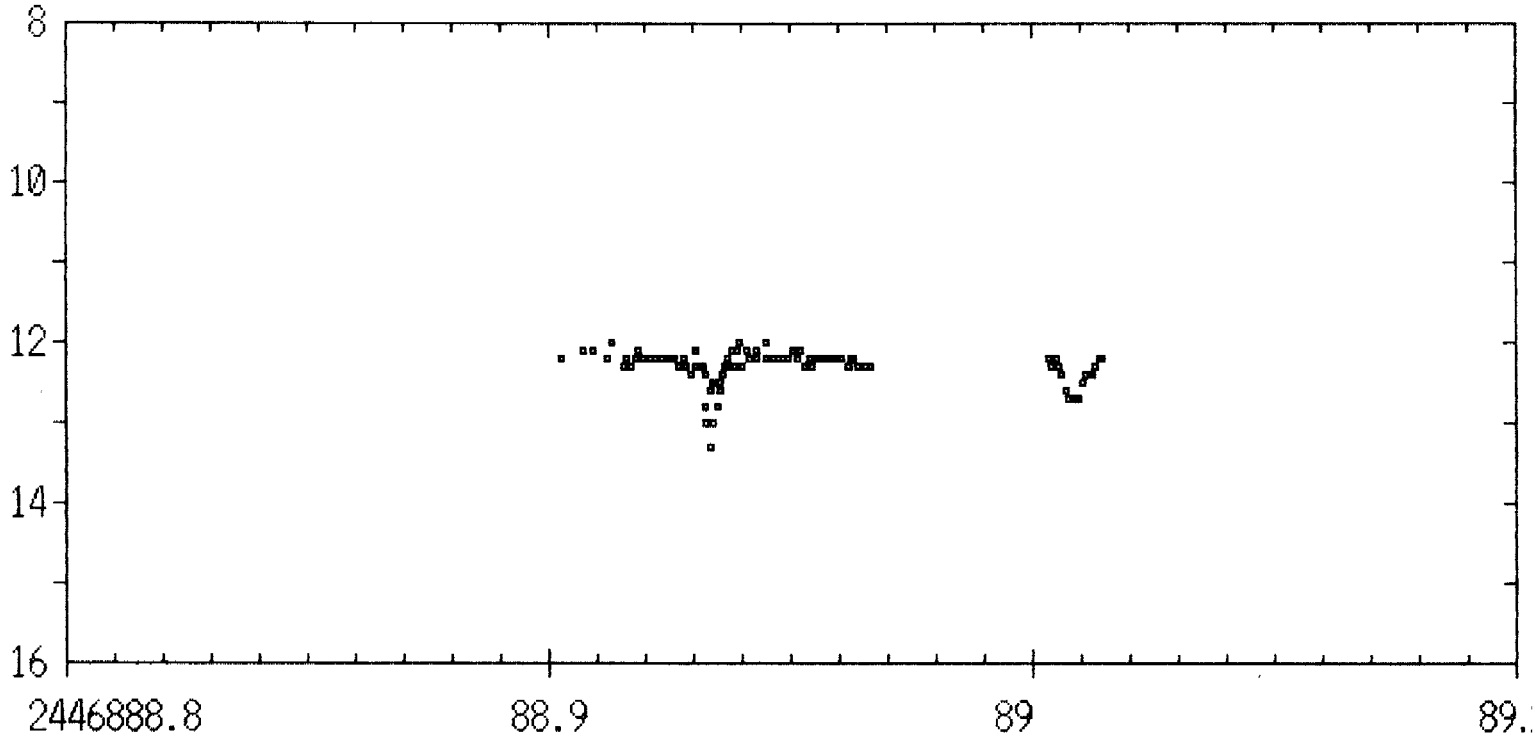

Fig. 7. Z Cha. Superoutburst (Refer to page 76).

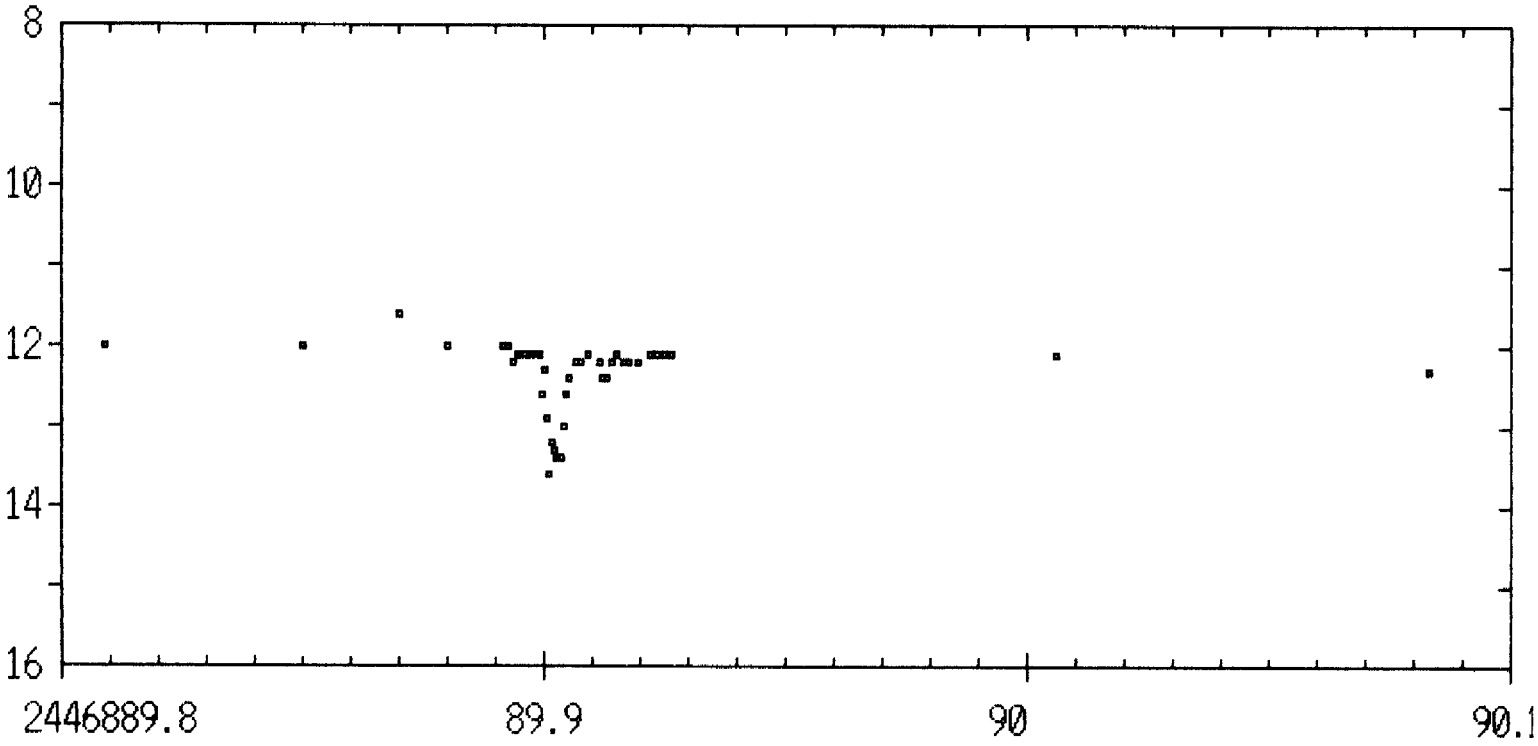

Fig. 8. Z Cha. Superoutburst (Refer to page 76)

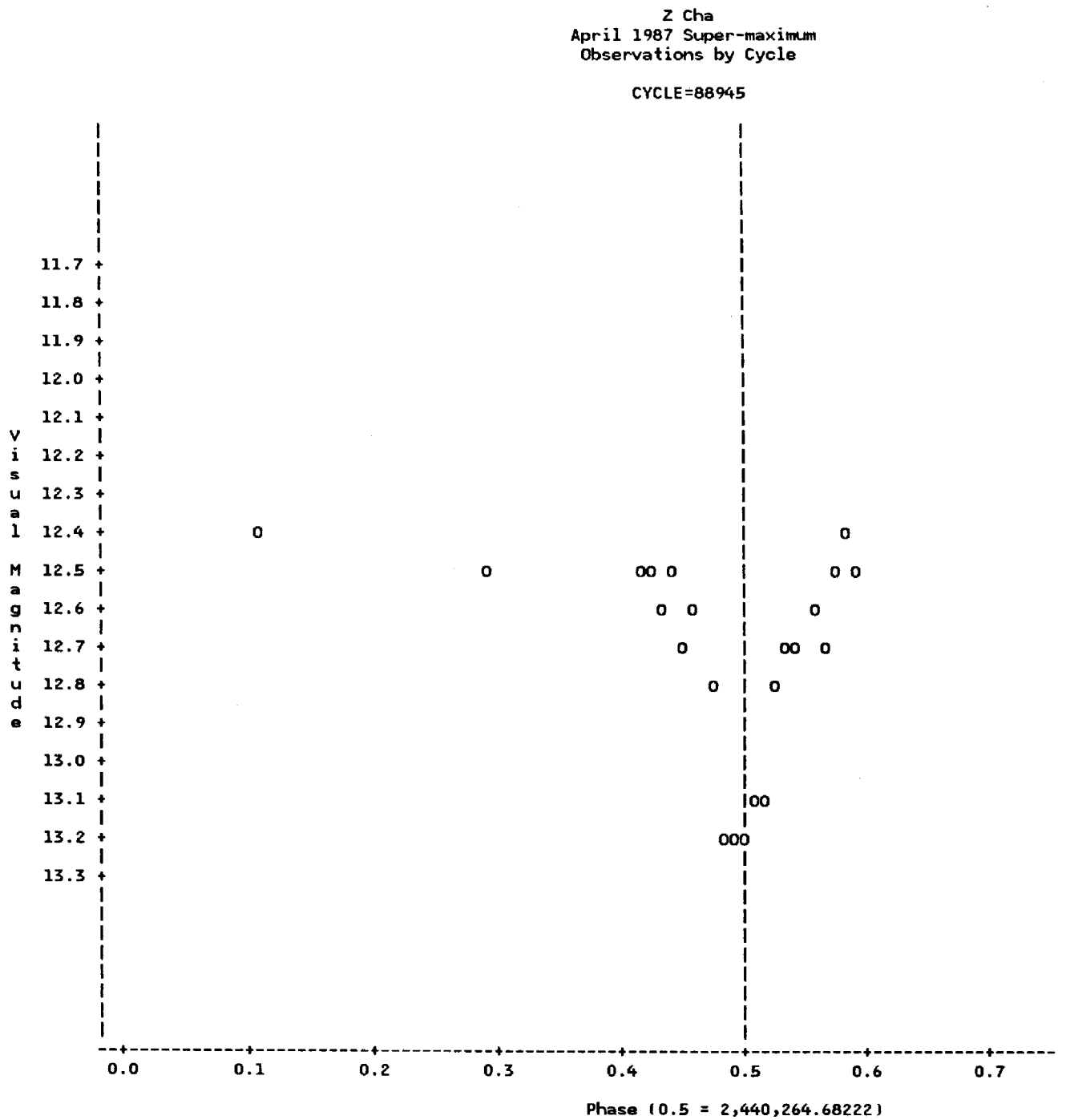

Fig. 9. Observations by W. Goltz of an eclipse in cycle 88945 of Z Cha during Superoutburst 1987 April 1.

10:47 TUESDAY, MAY 19, 198

Z Cha
April 1987 Super-maximum
Data by Eclipse Cycle for Reduced Eclipses

---------- CYCLE=88917 ----------

OBS	HJD	PHASE	MAG
47	6888.9511	0.72164	12.1
48	6888.9525	0.74043	12.1
49	6888.9546	0.76862	12.2
50	6888.9560	0.78741	12.2
51	6888.9573	0.80486	12.2
52	6888.9587	0.82365	12.2
53	6888.9629	0.88003	12.2

---------- CYCLE=88918 ----------

OBS	HJD	PHASE	MAG
54	6889.0039	0.43036	12.2
55	6889.0046	0.43975	12.3
56	6889.0053	0.44915	12.2
57	6889.0060	0.45854	12.3
58	6889.0066	0.46660	12.4
59	6889.0073	0.47599	12.6
60	6889.0080	0.48539	12.7
61	6889.0087	0.49479	12.7
62	6889.0094	0.50418	12.7
63	6889.0101	0.51358	12.7
64	6889.0108	0.52297	12.5
65	6889.0115	0.53237	12.4
66	6889.0122	0.54177	12.4
67	6889.0129	0.55116	12.4
68	6889.0136	0.56056	12.3
69	6889.0143	0.56995	12.2
70	6889.0150	0.57935	12.2

---------- CYCLE=88944 ----------

OBS	HJD	PHASE	MAG
71	6890.9184	0.12934	12.4
72	6890.9288	0.26894	12.4
73	6890.9309	0.29712	12.5
74	6890.9329	0.32397	12.5
75	6890.9350	0.35216	12.5
76	6890.9364	0.37095	12.5
77	6890.9371	0.38034	12.5
78	6890.9378	0.38974	12.5
79	6890.9385	0.39914	12.5
80	6890.9392	0.40853	12.5
81	6890.9399	0.41793	12.5
82	6890.9406	0.42732	12.5
83	6890.9413	0.43672	12.5
84	6890.9420	0.44611	12.5
85	6890.9454	0.49175	13.0
86	6890.9461	0.50115	13.1

Fig. 10.Observations by W. Goltz of Z Cha's eclipses arranged under cycles during superoutburst 1987 April 1.

THE LIGHT CURVE OF THE MIRA VARIABLE, RS CENTAURI

F.M. Bateson, R. McIntosh & C.W. Venimore

SUMMARY: RS Cen has been observed for almost six decades. This paper, the first of two, presents part of the light curve and a list of some observed maxima and minima.

. . . . .

1. INTRODUCTION

Observations of the Mira variable, RS Cen, commenced on 1931 July 16 and have continued ever since. The observations to the end of 1943 were fragmentary, mainly due to most observers being on active service during the war years. From 1944 January 29 (J.D. 2,431,119) this star has been well observed.

2. OBSERVATIONS.

All observations have been made visually using the sequence of comparison stars on chart 175 (1). The observers were members of the Variable Star Section, R.A.S.N.Z. The magnitudes of the comparison stars were Cape SP_V for those brighter than 10.0 and Harvard photovisual for those fainter than 10.0.

Table 1 lists observed dates of maxima and minima, firstly for those intervals in the early observations for which these dates could be determined, and, then for those between J.D. 2,431,118 and 2,437,000. That table will be continued in the second paper.

The O-C values in Table 1 are based on the elements given in the G.C.V.S. (2), which are:

EPOCH MAXIMUM 2,441,966 $\pm$ $164^{d}.37$. M-m (Minimum to maximum $75^{d}.61$.

Doubtful dates and magnitudes in Table 1 are marked with a query.

Part of the light curve appears in Figures 1 to 6 plotted from ten day means.The dates listed in Table 1 have been determined from the individual observations with due weight given to the estimates by the most experienced observers. The light curve will be continued in the Second paper.

3. DISCUSSION

All results will be discussed in the second paper to appear in Publications No.16 after the complete table of observed maxima and minima, as well as the rest of the light curve has been published. This arrangement has been necessary as space is running out for the present issue.

No light curve is published for the years prior to 1944 because of the broken nature of the records and the large gaps that occur in them.

ACKNOWLEDGEMENTS

Our thanks are due to all the observers who have followed RS Cen over so many years.

REFERENCES

(1) Bateson, F.M., Jones, A.F. & Stranson, I. 1968. Charts for Southern Variables, Series 5. Publ. by Astronomical Research Ltd., Tauranga.
(2) Kholopov, P.N.(ed).General Catalogue of Var.Stars. 4thed.Vol.1.Nauka.Moscow.

TABLE No. 1

RS CENTAURI---OBSERVED MAXIMA & MINIMA

	MAXIMA				MINIMA			
EPOCH	J.D. MAX.	MAG_v	INT_d	$O-C_d$	J.D. MIN.	MAG_v	INT_d	$O-C_d$
-90	2427,170	9.0?	...	- 3	2427,281?	13.7	...	+20
-89	335?	8.0	165	- 2	429?	(12.7	148?	+ 3
-88	500	9.2	165	- 1	590?	(12.7	161	± 0
-87	661	8.2	161	- 5	...	....	...	...
-86	841?	8.9	180?	+11	...	....	...	...
-85	990	8.5	149	- 4	...	....	...	...
-84	2428,159	8.0?	169	± 0	2428,251?	(12.0	...	+ 2
-83	323	8.8	164	± 0	...	....	...	...
-66	2431,118	8.8	...	± 0	2431,203?	(12.1	...	- 3
-65	291	9.1	173	+ 9	370?	(12.1	167?	- 1
-64	440	8.2	149	- 6	540?	(12.1	170?	+ 5
-63	610	9.3	170	- 1	700	13.3	160	+ 1
-62	781	9.0	171	+ 6	860	13.5	160	- 4
-61	943	9.7	162	+ 4	2432,027	14.1?	167	- 1
-60	2432,102	8.6	159	- 2	190	14.0	163	- 3
-59	268	9.0	166	± 0	356	13.3	166	- 1
-58	427	7.6	159	- 5	554?	13.1	198?	+33?
-57	595	9.5	168	- 2	700	14.1	146?	+14
-56	760	8.4	165	- 1	859	12.7	159	+ 9
-55	926	7.6	166	± 0	2433,012	14.1	153	- 2
-54	2433,098	9.2	172	+ 8	176	13.7	164	- 3
-53	263	8.9	165	+ 9	344	14.1	168	+ 1
-52	418	8.5	155	- 1	506	14.1	162	- 1
-51	586	9.1	168	+ 3	680	13.4	174	+ 8
-50	745	8.9	159	- 2	835	14.1	155	- 1
-49	911	8.9	166	- 1	2434,005	13.9	170	+ 4
-48	2434,079	8.7	168	+ 3	166	14.1	163	- 1
-47	243	8.8	164	+ 2	328	13.7	162	- 1
-46	406	9.1	163	+ 1	500	14.1	172	+ 6
-45	585	9.1	179	+16	668	13.3	168	+10
-44	737	8.7	152	+ 3	830	13.6	162	+ 8
-43	899	9.2	162	+ 1	994	13.0?	164	+ 7
-42	2435,067	8.4	168	+ 5	2435,166	13.7	172	+15
-41	236	8.9	169	+ 9	326	13.7	160	+10
-40	395	8.2	159	+ 4	484	12.9	158	+ 4
-39	555	8.5	160	- 1	651	13.7	167	+ 7
-38	726	9.3	171	+ 6	804	(13.7	153	- 5
-37	891	8.8	165	+ 7	972	13.5	168	- 1
-36	2436048	9.1	157	- 1	2436 140	14.1	168	+ 3
-55	216	7.8	168	+ 3	305	13.8	165	+ 3
-34	373	8.8	157	- 4	462	13.7	157	- 4
-33	556	9.1	183	+14	646	13.4	184	+16
-32	703	8.7	147	- 3	803	13.3	157	+ 8
-31	880	7.6	177	+ 9	951	13.7	148	- 8

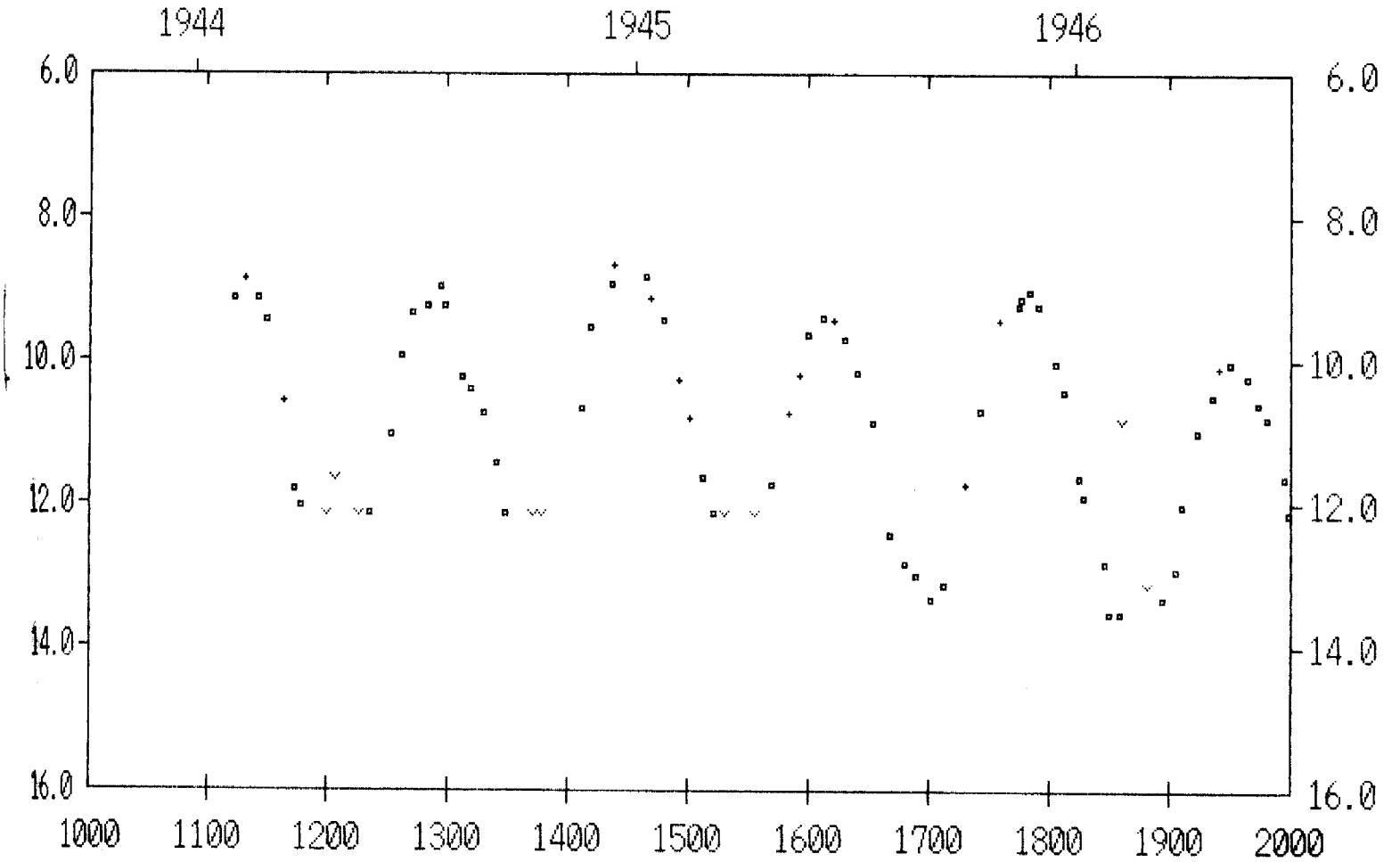

Fig. 1. RS Cen. Light curve. J.D. 2431000 to 2432000 from ten day means.

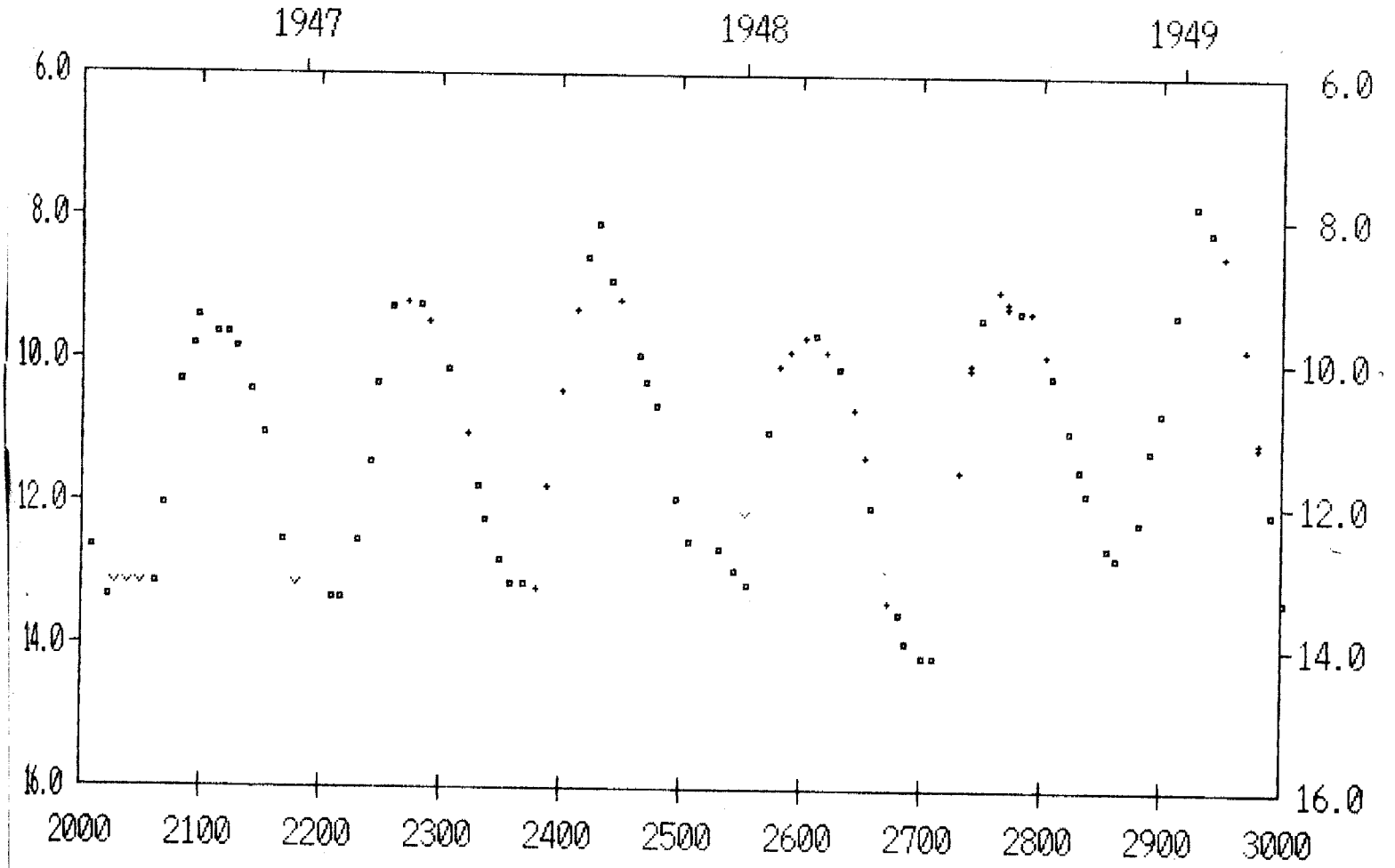

Fig.2. RS Cen. Light curve J.D. 2432000 to 2433000 from ten day means.

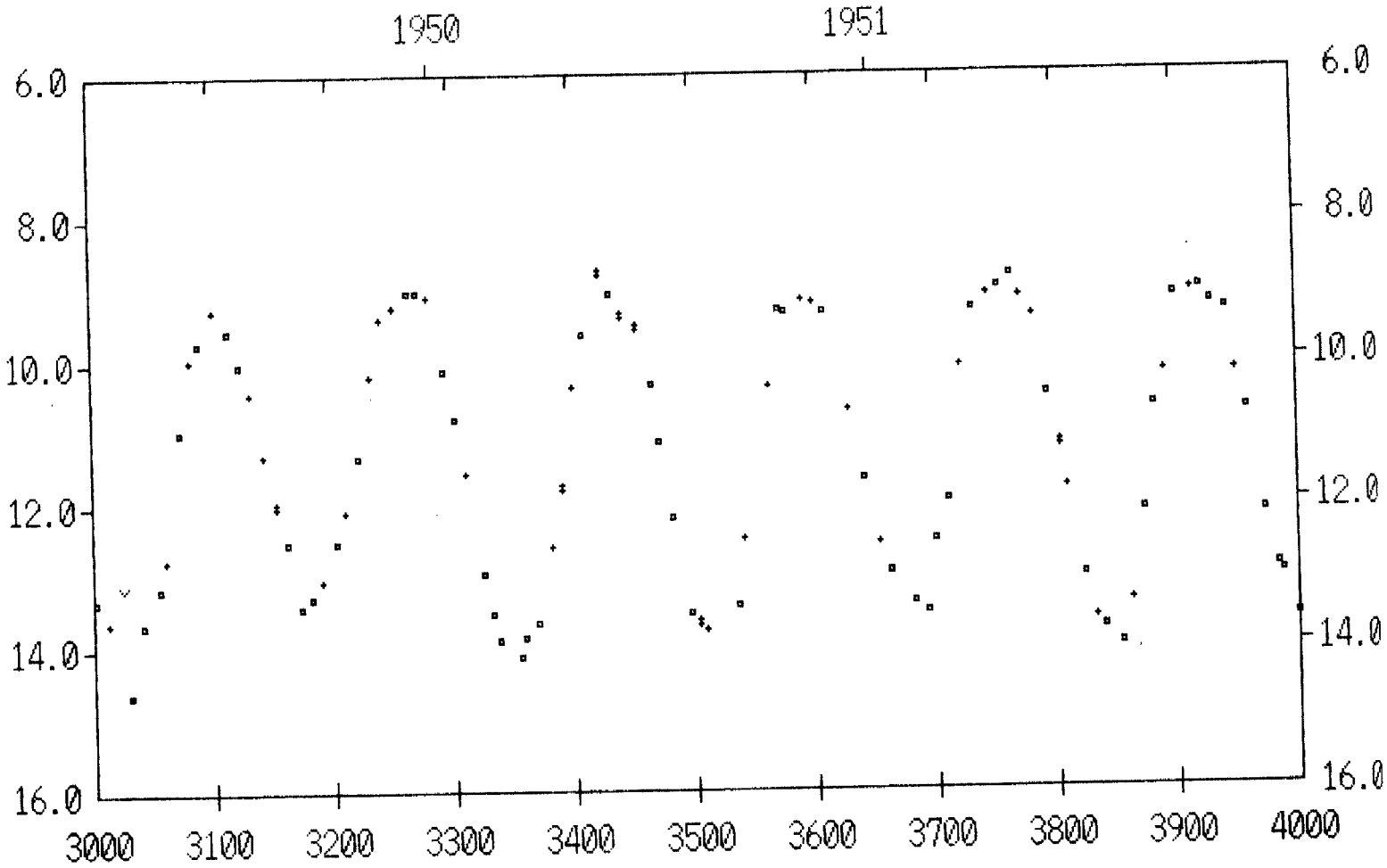

Fig.3. RS Cen Light curve J.D. 2433000 to 2434000 from ten day means.

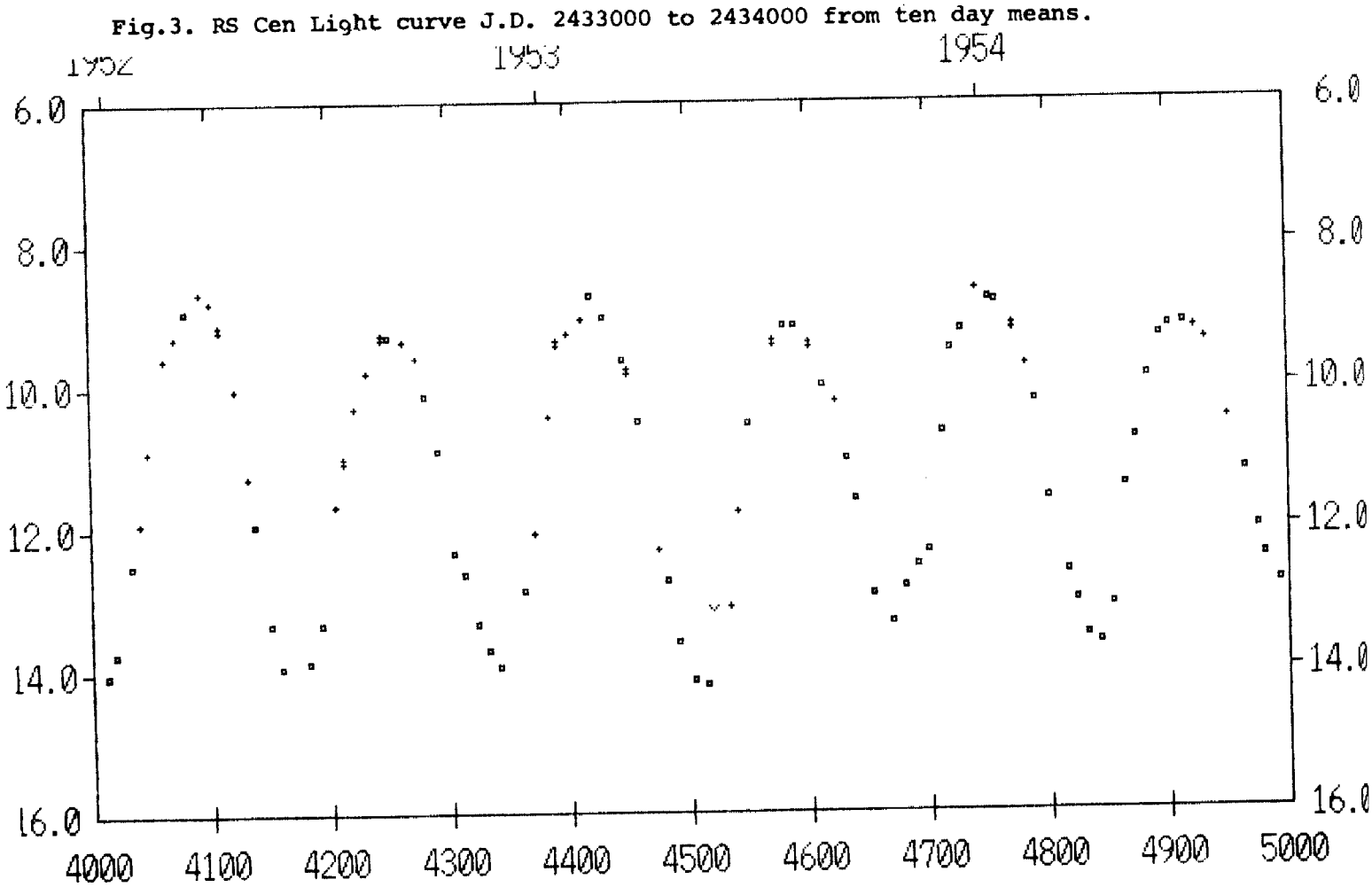

Fig 4. RS Cen Light curve J.D. 2434000 to 2435000 from ten day means.

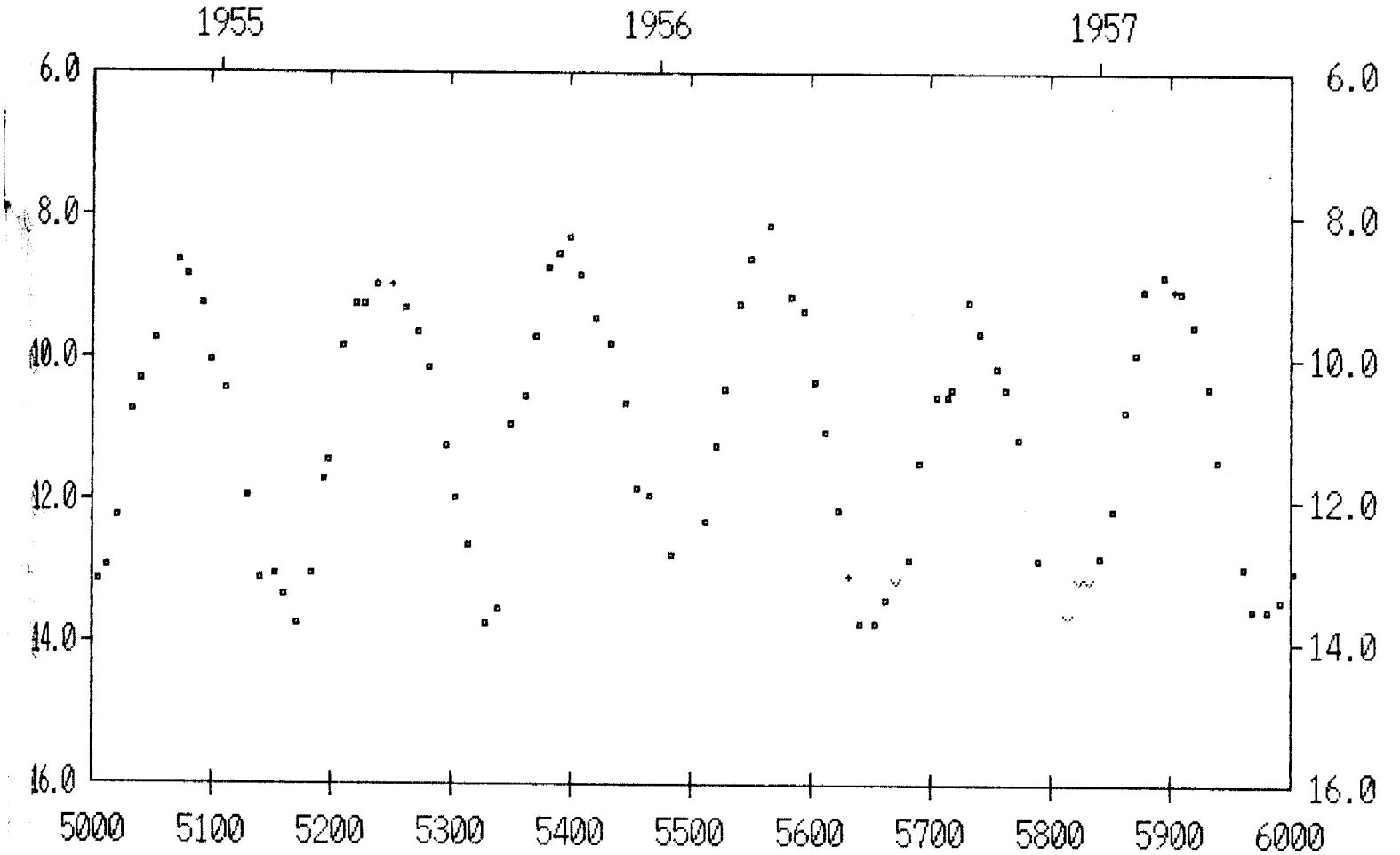

Fig.5. RS Cen Light curve J.D. 2435000 to 2436000 from ten day means.

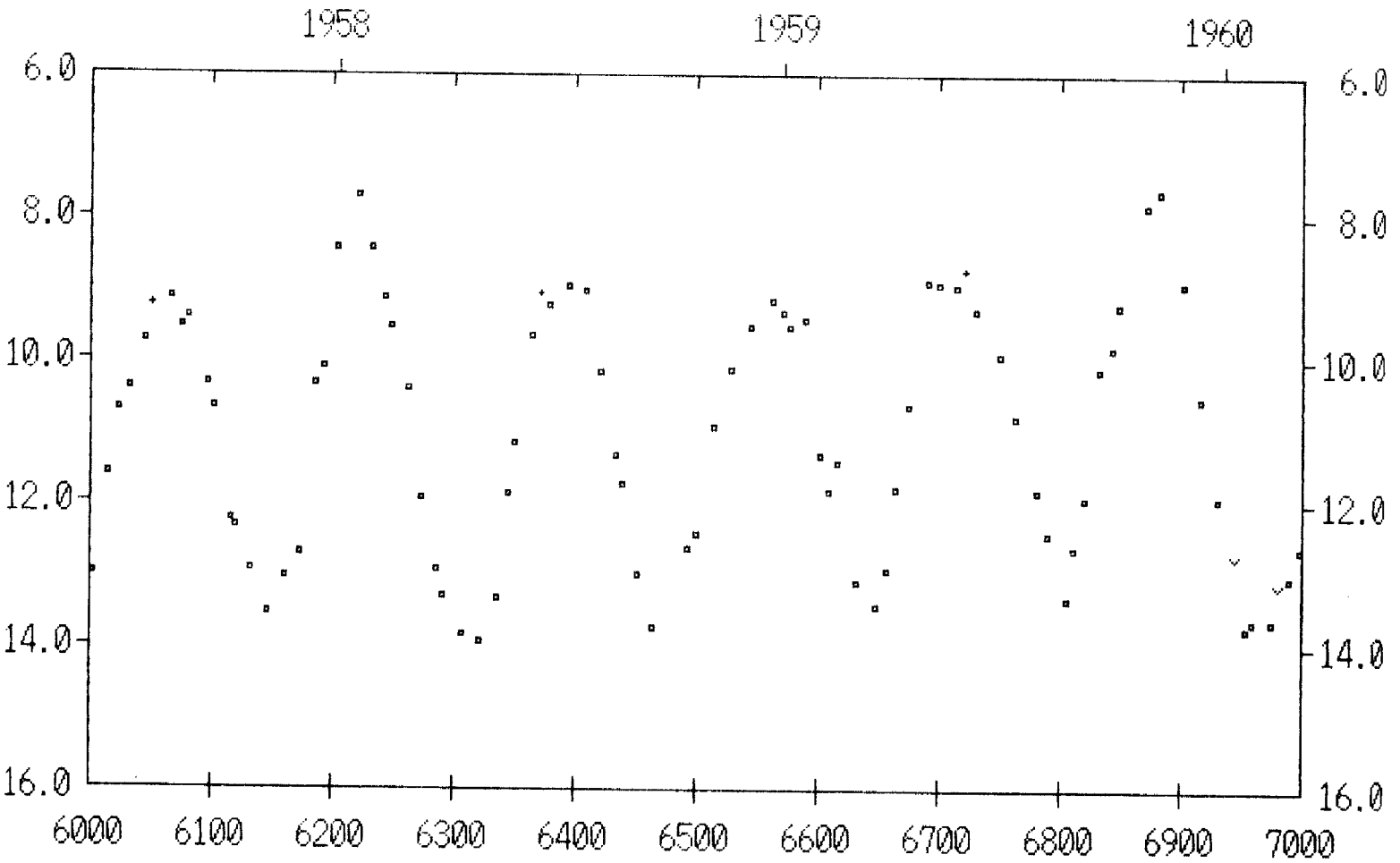

Fig. 6. RS Cen Light curve J.D. 2436000 to 2437000 from ten day means.

THE LATEST NEWS ON THE HIPPARCOS PROGRAMME

Members will have read in Monthly Circular No. M89/7 that the programme on the observation of Miras and S.Rs is to continue despite what you may have read in the press. There is insufficient space in M89/7 to keep members fully informed so I have taken out the material that was to appear on this page and give below a short summary of the position as at 1989 September 8.

Hipparcos was successful launched on August 9, U.T. The original plan was that at the fourth apogee passage the control centre at ESOC would send the command to fire the Apogee Booster Motor (ABM)to take the satellite from a low (about 200 km at perigee) elliptical transfer orbit into a circular geostationary orbit at 36,000 kms above the equator. The command was received and acknowledged by the satellite, but it soon became clear that the ABM did not start. Repeated attempts also using the redundant fire channel were equally unsuccessful.

Investigations into the cause of the failure were immediately undertaken, but a final conclusion has not yet been reached. It is suspected that the prime cause of the failure could be the Safe and Arm Device (SAD) of the ABM. The SAD is a mechanical device used to ensure that the ABM is not accidentally activated during transportation and mating with the satellite on ground. It is manually reset just before launch to arm the ABM. According to one failure scenario consistent with the telemetry readings, the SAD was incorrectly reset, or was otherwise faulty.

The satellite is now on a highly eccentric orbit with a perigee altitude of approximately 200 kms. The main problems with the present orbit are the expected strong degradation of the solar panels due to the radiation environment and the increase of Earth occultations. Current expectations are for a lifetime of about six months, although this will be revised as actual measurements become available, especially for the actual mission configuration, once the solar panels are deployed.

The problems of data acquisition in the perigee region (torques, radiation effect on the detectors) are being studied, along with the expected performance of the RTAD in view of the possible long occultations at perigee. It may be possible to optimise the scanning to reduce the effect of these occultations.

Assuming a mission lifetime of six months, and taking account for expected deadtime, positional accuracies of 0.02-0.05 arcsec for most of the 120,000 stars should be achievable. For such a short mission duration parallaxes and proper motions will not be derivable. For Tycho, we still hope that positions of many of the stars should be measurable to some 0.1 arcsec.

It will take at least two months for ESOC to change the operational procedures needed to control the satellite in its new orbit.

Meanwhile, the programme on Variable Stars continues and all observers are requested to continue to monitor these stars in accordance with the instructions given in a Special Circular, dated 1989 August 17.

Frank M. Bateson

BOOK REVIEWS

A VISUAL ATLAS OF THE SMALL MAGELLANIC CLOUD by Mati Morel. 1989. Publ by Mati Morel, Rankin Park, N,S,W, 19pp plus 2 Master charts showing the entire S.M.C. and 10 large scale charts. Price $A. 17.00

This is a companion Visual Atlas to that of the L.M.C. produced by the same author. The two master charts cover the entire S.M.C. from R.A. 01h 15m to 1h 45m and Declinations -70° to -76°. Ten large scale charts show some interesting areas in greater detail and resolution.

The accompanying booklet contains a wealth of useful information, including a catalogue of clusters and nebulae as well as a list of named and HV variables. It is amazing how much data has been packed into a limited number of very clearly printed pages.

The charts are very clear with the stars shown as black dots on a white background. Clusters and nebulae are clearly marked. These charts are, as we have come to expect from the author, a model of clarity and accuracy. V magnitudes are given for stars when such information is available. The charts are for Epoch 1950 and there is a handy precession table in an appendix.

No serious observer can afford to be without this Atlas. It provides a most useful tool in observing variable stars, clusters and nebulae. It will also, like its companion Atlas of the L.M.C. provide both visual and photographic searchers for novae with a precise method of checking any discovery and plotting the position.

The author is to be congratulated on producing once again a basic aid to observers in a clear and concise format with a very high standard of accuracy.It can be thoroughly recommended to all observers. No observatory should be without a copy.

COMING OF AGE IN THE MILKY WAY by Timothy Ferris. Publ. by The Bodley Head,London. 1988. Hard cover. 495pp. N.Z. Retail price $50.95.

This volume contains 388 pages divided into three sections--Space; Time and Creation--and a rather rambling introduction. Each section is divided into various chapters. The remainder of the book consists of several appendices. These include a 21 page glossary; a 15 page history of the Universe on a time scale dating from its origin; 13 pages of notes and an extensive bibliography, which runs to 43 pages. There is also an Index.

The title is misleading inasmuch as the objective of the author is to trace human concepts of the Universe through the history of western civilisation and the theories of the scientists in their search for an understanding of the universe. The book has obviously involved considerable research as shown by the appendices. The author also aims his work at a popular level.

The book is very well printed and illustrated mainly by simple black and white diagrams that are well placed in the text and apt. Proof reading has been done with care and there are no serious misprints. The text is well written although at times the sentences become overlong in striving for effect.

Interwoven with the tracing of the changing views of the Universe are fascinating accounts of the scientists who shaped those views. Many of these stories are well known, whilst others are entirely new at least to the reviewer. Typical of this is the account of the trouble which Kepler had in extracting from Tycho Brahe the latter's observations of the positions of Mars. This provides a most interesting account of the characters of these two astronomers.

The author has drawn his material from all sciences to weave an account of the gradual awakening, age by age, to the modern ideas of the universe. The parallel between the reluctance of Copernicus to publish his theory and of Darwin to so long delay

publication of his "The Orgin of the Species" were due to the same fear. They both realised that the wrath of the church would fall upon them. Darwin also, being essentially a simple, kind hearted man, also knew that scientists would ridicule his theory. It is interesting to learn that John Herschel was one of those who attacked Darwin's ideas.

There are many delightful accounts of the characters of scientists from the earliest times down to the most recent. Yet, we are reminded that some of the early Greeks advanced theories that are refreshingly modern. A typical example occurs in a discussion of extra-terrestrial life. We are reminded that it was the aromist, Merrodorus, who wrote in the fourth century B.C., "To consider the Earth the only populated world in infinite space is as absurb as to assert in an entire field sown with millet only one grain will grow."

The only fault I have to find with this book is that it attempts to cram too much information into too small space. However that is a minor blemish. I can thoroughly recommend "Coming of Age in the Milky Way" to any reader seeking to obtain a clear account of how scientific ideas have evolved over the ages. Along the way the reader will also gain a vivid insight into the lifes and times of the scientists who have built the edifice of modern ideas.

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AN UPDATED REPORT ON THE NOVA SEARCH PROGRAMME.

At the time these Publications went to press all observers who asked to take part in this programme have been allocated search areas. They have been supplied with the charts for their areas. All areas have been given to two observers to enable more frequent searching to be done.

Photographic observers have been requested to concentrate in the two Magellanic Clouds using the excellent atlases produced by Mati Morel. Selected,experienced observers have been sent Morel's chart of the Galactic Centre as they have the ability to cover a wider region. This distribution should provide adequate and systematic coverage of all areas, allowing for those times when any one observer may be clouded out or engaged in other observations.

I have now requested Arthur Page to produce finding charts for other areas. This will enable these to be distributed when the present areas have passed from convenient viewing positions. These charts will be distributed on the same basis of two people to each area.

the monograph of instructions written by Arthur Page has also been distributed to all potential observers. These provide adequate details on the programme and how to plot the position of any suspected discovery and to have this verified before transmitting the information to a recognised centre or professional observatory.

Happy hunting to all observers!!

Frank M. Bateson

REPORT OF THE VARIABLE STAR SECTION, ROYAL ASTRONOMICAL SOCIETY OF NEW ZEALAND

FOR THE YEAR ENDED 1988 DECEMBER 31.

It is my pleasure to report to members that the past year has been a very satisfactory one, despite the frustrations in attempting to maintain all services with only one part time assistant.

The list of observers and the estimates they supplied appears on page 96. There is no doubt that the continued interest in SN 1987A has sparked the interest of more observers in visual observation of Variable Stars. The totals of observations are, as usual, for the year to 31 August 1988 so that the figures can be strictly compared to the previous years. There was again a very substantial increase in the number of observations. This was only partly due to the volume of estimates of SN 1987A. This interest resulted in a spin-off in observations of other stars.

The remainder of this report deals with matters arising during the calendar year to 1988 December 31.

I have made every endeavour to keep all members fully informed on the activities of the Section and on special programmes through the Newsletter "CHANGING TRENDS", which appeared quarterly. The aim of this publication is also to keep members in touch with one another. These issues are informal and there is always space for contributions from members. In particular I urge new members to write short notes on their instruments, problems and interest.

The Monthly Circulars have appeared each month, supplemented by the occasional special Circular when there has been some urgent request for observations. Mati Morel has continued to produce the preliminary charts for Novae and other unusual objects in advance of charts being published in a permanent form.

There has been excellent cooperation from observers on the various special programmes. This has enabled the system of alert notices to be transmitted to professionals requiring these prompt advices. I also have to thank Alan Gilmore, Mount John University Observatory, for sending the notices of unusual events to Dr. Brian Marsden for the IAU Circulars.

One issue, No. 14, of the Publications was distributed during the year.Others should have appeared but a combination of circumstances has prevented this. There has been no lack of material for these publications due to the assistance of Don Brunt, Tony Dodson and Colin Venimore in producing lists of ten day means for a number of stars or papers on particular stars. Pam Kilmartin and Dave Kilkenny have kindly supplied sequence magnitudes for several fields. Ranald McIntosh has promptly produced the computer light curves as required. All this wonderful assistance has resulted in sufficient material on hand for the next two issues of the Publications.

The bottleneck I am sorry to say rests with me. During the year a considerable amount of my time was taken up with the completion of "PARADISE BECKONS" and the subsequent proof reading. Additional all other services, including the very extensive correspondence had to be maintained. It must also be confessed that advancing years and sight problems have slowed me up!

Last year I reported that the computer programme was now operating and that all observations after 1 April, 1987 were recorded on the computer. The Section is under an enormous debt to Ranald McIntosh for the very efficient manner in which he has processed all the data. We are most fortunate in having the valuable cooperation of Ranald with his vast knowledge of computing.

Observations, often dating back for several decades, have also been transferred from the written ledgers to the computer. This occurs as papers on those stars are written and computer printed light curves obtained. There are still many thousands of these old observations to be transferred for storage in the computer. Naturally, the rate at which this can be done depends on two factors. Firstly, I must avoid burdening Ranald with too much work. Secondly, there is a limit to the rate at which ten day means can be prepared.

Light curves, on various scales which depend on the nature of the star concerned, have been supplied to many professionals at their request.

Monthly computer print-outs were supplied to W .Lawson (Canterbury) for a number of RCB variables; A.A.V.S.O. (Miras for assisting their predictions); B.A.A. (U.K.) as part of the cooperative programmes maintained with them and for which, we received their observations of stars of particular interest to us. Light curves of dwarf novae outbursts, some RCB variables and a number of unusual stars were supplied to a large number of professionals who requested this data.

There is no need in this report to comment on the many highlights in the year's observations as members have been kept fully informed of these in both the Monthly Circulars and in "CHANGING TRENDS."

I have continued to keep Albert Jones, the Deputy Director, fully informed on all aspects of the Section, especially on administrative matters and objectives. This is essential so that, when I grow too old, Albert will know exactly everything pertaining to the smooth running of the Section. The continuous exchange of information between us has been made so easy by our deep bond of long standing friendship.

I reported previously that the filing system at Headquarters was being completely overhauled. This has been completed. I have commenced to extract archival material;some has already been sent to the Alexander Turnbull Library as part of a bequest to them and more will go forward as time permits. This includes both personal and old VSS correspondence. This keeps the files from being cluttered up with "dead" correspondence.

Our current objectives, apart from maintaining observational programmes can be summarised as:

(a) V magnitudes for comparison stars in fields in which no reliable magnitudes currently exist.

(b) The publication of a list of sequence magnitudes for those fields in which such magnitudes were determined and published after the charts were issued. This will provide a reference list especially for the more recent observers who have no access to the original publication containing these magnitudes.

(c) The transfer for storage in the computer of all observations prior to 1987 April 1.

(d) The publication of an up to date index of all charts published by Astronomical Research Ltd.

(e) A more regular issue of the PUBLICATIONS.

(f) Obtaining funds to enable at least one assistant to be employed on a regular basis.

Progress on (a) has been slow but is gradually being accomplished and is likely to be accelerated in 1989 due to the HIPPARCOS programme. My very sincere thanks are due to Pam Kilmartin and Alan Gilmore (Mt. John Observatory) and to Dave Kilkenny (S.A.A.O.) for their assistance in obtaining sequences.

It appears probable that (b) will also be completed in 1989, whereas (c) will be a long and protracted progress. As the records for any individual variable are stored in the computer it is then possible to despatch the old ledger sheets for storage in the centre for such archival records as recommended by the IAU.

Hopefully some member who holds a complete set of charts will volunteer to produce the index mentioned under (d),

The remaining two objectives are bound up together. The sheer volume of the work at Headquarters makes it essential that funds be found to support the services of at least one assistant. I am most grateful to those who have so kindly given donations during the year which has enabled Mrs. Maureen Phizacklea to be employed on a part time basis. She has gradually been trained to take over at least some of the routine matters.

The more regular issue of PUBLICATIONS also calls for the submission of completed papers from members. This would avoid my having to prepare the various tables that are necessary for papers of the standard required.

The foregoing details will enable members to understand the problems that plague Headquarters and the steps that are being taken to overcome them. Some of the ideas I have for the Publications can only be carried out after I have visited Singapore and Hong Kong to see publishers there.

A very pleasing feature of the records this year has been the increase in members submitting their monthly reports as computer print outs. Any member seeking advice on a computer system for recording observations can always obtain guidance and advive from Ranald McIntosh.

Observers can see the volume of observations obtained during the year from the list on page 96. This imposes a large workload on Ranald McIntosh and myself. That work makes it essential that all observers submit their observations in the format that has been detailed in several issues of "CHANGING TRENDS." That enables us to give full justice to each and every observation you observers make. Members wishing to submit their monthly lists on diskettes should consult with Ranald first so that these are compatible with his computer.

This year I attended the Conference at the A.N.U. on SN 1987A and the subsequent Workshop at Mt. Stromlo Observatory on the same topic. I am indebted to the Organising Committee and the A.A.T. for support for these meetings. This also gave me the opportunity of agai n talking to the Sutherland Astronomical Society and thus maintaining contact with our members in Sydney. My thanks are extended to Linda and Peter Williams for the arra ngements made for that visit.

My sincere appreciation is extended to all members for their observations be their contribution large or small. The Section would not exist without the observations. The friendly cooperation with all observers makes the task of running the Section such a pleasure. Special thanks are due to the two senior members, Albert Jones and Danie Overbeek, not only for their outstanding contributions but also for their understanding and support. Rudi Stabenow, who is a comparatively recent member, made an outstanding contribution especially comcentrating on the unusual stars.

I also have to thank all those, both from overseas and within N.Z., who very kindly gave donations to assist the finances of the Section. I refrain from listing their names and amounts at the request of the two largest donors who prefer to remain anonymous

Cooperation with our kindred organisations has continued on a very happy basis. Janet Mattei, Director A.A.V.S.O., and myself have continued to work closely together for the mutual benefit of both organisations. Doug Saw receives each month our print outs for stars that the B.A.A. will process the joint data.

He supplies us with the B.A.A!s observations of stars south of the celestial equator for which we accept responsibility for processing the combined results. We will also be receiving from John Isles, Director of the V.S.S., B.A.A. his observations of a number of southern variables.

My thanks are due to Jan Hers for his supplyimg the records of the members of the Variable Star Section, A.S.S.A. Exchanges with the Variable Star Observers League of Japan has been to our mutual advantage. Mutual programmes with Japanese and Chinese astronomers, both professionals and amateurs, have continued on a very satisfactory basis.

We have continued to exchange publications with the A.F.O.E.V. and other European organisations.

There is always the tempetation in these Annual Reports to mention all those who have assisted in some way by name but that merely turns a report into a list embracing all members. However, mention must be made of Albert Jones apart from his splendid and extremely accurate observations- his interest extends far beyond observing to all aspects of the Section's work. He is, for example, always ready to supply field sketches as other stars are added to the working list or to hunt up basis data for such stars. I am sure that it is only our long friendship that enables him to withstand the continuous bombardment of letters he receives from me! It is fortunate that he is a very patient man.

Mati Morel has continued to supply first class charts with his usual care and efficiency. He also distributes the preliminary charts for Novae to selected observers enabling prompt observations to be made.

Members will be pleased to know that Gordon Smith maintains his interest in the affairs of the Section and never fails to visit us when he journeys north.

To all members I say a very sincere "Thank You" for your support, friendship and understanding of the problems that beset me. I do so much appreciate your patience when there are delays in answering your letters.

Our thanks are extended to the subscribers to our various publications for their interest and support. We hope that all those who requested data during the year have been satisfied with the results obtained for them. The many favourable comments on our alert notices are tributes to the cooperation of all observers.

Finally I wish to extend my personal thanks to Maureen Phizacklea for so quickly mastering what must have appeared to be a weird an bewildering world with a strange language all its own. She has proved adept in learning strange terms but in also restoring order into chaos!

1989 March 31

Frank M. Bateson
DIRECTOR

OBSERVATIONS RECEIVED FOR YEAR ENDED 1988 AUGUST 31.

ALBRECHT, W.M.B.	6707	LEE, P.	16
BALL, S.J.	3	LESLIE, (Mrs) A.	130
BASTANSKI, M.A.	36	LUMLEY, E.	358
BEGBIE, M.	110	MAZISNI, J.C.	6
BEMBRICK, C.	56	McCRAE, A.R.	220
BENNIE, I.D.	111	MARIONI, J.C.	33
BRUNT, D.	330	MENZIES, B.	997
BRYANT, K.	32	MEYERS, P.	150
COOK. J.C.	5	MONTANELLI,A.	40
COOPER, T.	2156	MOREL, M.	60
CRAGG, T.A.	2836	MORRISBY, A.C.F.	952
CAMPOS,J.A.	324	NELSON, P.	832
DE BONO, I.	8	NOVAK, Z.	13
DODSON, A.W.	165	O'KANE, J.	110
DREDGE, A	161	OVERBEEK, M.D.	12056
EVANS, R.W.	227	PAZZI, L.	23
FAHEY, (Miss) B.	4	PARK, J.	36
FLETT,R.W.	27	PEARCE. A.	1598
FRASER, B.	165	ROMERO, H.D.	19
FREE, R.	3	SCHILLER, D.	25
GARCIA, A.	30	SMIT, (Dr).J.A.	1954
GEYSER, M.J.	77	STABENOW, R.	5745
GOLTZ, W.	1496	STEPHANOPOULOS, G.	766
GRAND, H.C.	8	TAYLOR, (Dr) N.W.	1374
HARRIES-HARRIS, E.	945	THOMSON, R.J.	47
HENSHAW, C.	381	TRAYNOR, F.N.	9
HERDMAN, G.	509	TREGASKIS, B.	874
HERS, J.	521	TURK, C.	149
HULL, O.R.	1120	VARELA, P.	23
INGRASSTA, P.A.	86	VENIMORE, (Rev) C.	432
IVES, F.	601	WAKEFIELD, N.B.	36
JONES, A.F.	13543	WARD,D	100
JOOSTE, J.L.	74	WILLIAMS, D.	985
KILMARTIN, P.	1	WILLIAMS, P.	2912
KURTZ, C.	581	WILLIAMSON, L.	346
		WINNETT, R.D.	79

TOTAL OBSERVATIONS = 66,954

There was an increase of 10,571 observations compared to the previous year. The above totals do not include observations from the B.A.A. (U.K.) received as part of the exchange programme between the B.A.A. and V.S.S. As in previous years, no attempt has been made to show those observers who also communicate their records to the A.A.V.S.O. because there is such close co-operation between the two organisations.

Twelve observers made more than one thousand observations and these accounted, as last year, for nearly 80% of the total. The two most profilic observers (A.F. Jones & M.D. Overbeek) between them accounted for just under 33% of the total records.

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