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GEOS CIRCULAR ON RED VARIABLE STARS

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PHOTOELECTRIC B AND V BAND PHOTOMETRY OF COMPARISON STARS FOR EIGHT MIRA-TYPE VARIABLE STAR FIELDS

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ABSTRACT. PHOTOELECTRIC B AND V BAND PHOTOMETRY OF COMPARISON STARS FOR EIGHT MIRA-TYPE VARIABLE STAR FIELDS.

The comparison star sequences of 8 Mira-type stars have been observed in two colours, B and V in the Geneva photometric system at the Jungfraujoch Observatory. The stars involved were R Cas, V Cas, T Cep, R Aql, W Peg, T Her, Z Cyg and W Lyr.

RESUME. MESURES PHOTOELECTRIQUES B ET V DE SEQUENCES D'ETOILES DE TYPE MIRA.

Les séquences de comparaison de 8 étoiles du type MIRA ont été mesurées en 2 couleurs B et V du système de Genève à l'Observatoire du Jungfraujoch. Il s'agit de R Cas, V Cas, T Cep, R Aql, W Peg, T Her, Z Cyg et W Lyr.

RIASSUNTO. FOTOMETRIA IN 2 COLORI B e V DI SEQUENZE DI CONFRONTO DI VARIABILI MIRA.

Le stelle di confronto di 8 variabili tipo Mira (R Cas, V Cas, T Cep, R Aql, W Peg, T Her, Z Cyg e W Lyr) sono state misurate nei 2 colori B e V del sistema fotometrico di Ginevra all'Osservatorio dello Jungfraujoch.

RESUMEN. FOTOMETRIA EN 2 COLORES B y V de SECUENCIAS DE ESTRELLAS DE TIPO MIRA.

Las secuencias de comparación de 8 estrellas de tipo Mira han sido observadas en 2 colores B y V del sistema fotométrico de Ginebra en el Observatorio de Jungfraujoch. Se trata de las estrellas R Cas, V Cas, T Cep, R Aql, W Peg, T Her, Z Cyg y W Lyr.

PHOTOELECTRIC B AND V BAND PHOTOMETRY OF COMPARISON STARS FOR EIGHT MIRA-TYPE VARIABLE STARS FIELDS

I - PREPARATION OF THE HIPPARCOS PROGRAMME

The HIPPARCOS Space Astrometry satellite is due to be launched in 1988. Its programme includes the determination of the positions of more than 1000 variable stars, most of them often brighter than magnitude 11. Selecting these stars requires, from now on, observations in order to help sorting out those stars whose brightness will fall within the range of the satellite's instrumentation. There will be a demand for large numbers of amateur visual observations to implement this selection.

The charts currently used by amateurs for their estimates are usually rather old and not free from errors, sometimes larger than half a magnitude. Our work, which was suggested to us by Mr Grenon (Geneva observatory), aimed at calibrating several sequences in the fields of interesting variable stars liable to be retained for observation by the satellite.

II - ASTRONOMY COURSE AT THE JUNGFRAUJOCH

For the second time, the Palais de la Découverte (Paris) organized an astronomy run at the Jungfraujoch Observatory, for young students already well advanced in the field of astronomy. The observation of the sequences described above made up roughly half of the work done during the course.

Bernard Pernier (Geneva Observatory) began the observations and solved the technical problems which arose during the first nights. Most of the observations were made later by Isabelle BOSC (ISO), (Ecole Nationale de Physique de Marseille), with Hélène BOITHIAS (HBH), (Ecole Nationale de l'Aviation Civile), Florence GERBAULT (FOG), (Université de Paris XI) and Michel DUMONT (DMT), (Palais de la Découverte).

III - INSTRUMENTATION

We used the 76-cm Cassegrainian telescope at the focus of which a photometer of the Geneva Observatory, equipped with 7 standard filters in the Geneva photometric system, was attached. The first nights were devoted to the calibration of the instrumentation, by observing a great number of standard stars in 7 colours. Later, the observations of our sequences were made in two colours only, B and V.

IV - CORRELATION WITH STANDARDS AND REDUCTION

The measures were correlated by observing standard stars of the Geneva catalogue. The exoatmospheric reduction is in conformity with the procedure described in GEOS CIRCULAR RR7 and includes the evaluation of 6 parameters. It was constantly supposed that the absorption coefficients were stable throughout the night. In such conditions, the probable error is lower than 0.03 magnitude. The kij parameters calculated during the correlating with standards and used for the reduction are defined by formulae :

$$V_o = V + k_{11} + F_z [k_{12} + k_{13} (B - V)]$$

$$(B - V)_o = (B - V) + k_{21} + F_z [k_{22} + k_{23} (B - V)]$$

where V_o and $(B - V)_o$ are the magnitude and colour index observed at air mass F_z.

The charts and the magnitudes they mention were supplied by the Geneva Observatory.

V - OBSERVATIONS

- Night 1983 August 8/9

Observers : ISO, FOG
Weather conditions : fair at the beginning of night, then gradual oncoming of cirrus clouds impeding observations.

It was possible to observe the sequence of Z Cyg (fig. 1) before the arrival of a veil of cirrus clouds. The correlation is made with 3 standard stars.

STAR	F_z	I_B	I_v	M_v	$(B - V)_G$	Chart magnitude
1	1,005	1216,38	3107,03	7,211	0,870	7,3
2	1,003	285,24	801,75	8,684	0,989	8,5
3	1,002	275,52	321,76	9,665	- 0,092	9,6
4	1,003	116,03	198,45	10,194	0,377	10,2
5	1,002	110,30	86,13	11,092	- 0,587	11,1

Table 1 : Sequence of Z Cyg

The last column gives the chart magnitude while the M_v column gives the results of our measures. $(B - V)_G$ is the (B - V) index in the Geneva photometric system.

Night 1983 August 13/14

Observers : ISO, FOG, HBH
Weather conditions : fair. Training the telescope in a northerly direction impossible owing to wind blowing frost into the dome.

The sequences of T Her and W Peg were observed and correlated with 5 standard stars (Tables 2 and 3).

STAR	F_z	I_B	I_V	M_V	$(B-V)_G$	chart magnitude
1	1,184	3 841,27	2 483,69	7,445	- 0,870	7,3
2	1,336	1 647,08	1 591,77	7,893	- 0,393	7,8
3	1,302	470,52	508,12	9,133	- 0,246	8,9
4	1,377	298,18	306,65	9,672	- 0,320	9,4
5	1,214	152,55	137,07	10,575	- 0,464	10,4
6	1,268	13,73	32,13	12,109	0,736	11,3
7	1,433	29,79	28,63	12,241	- 0,417	12,4
8	1,236	22,38	21,10	12,602	- 0,407	13,0
9	1,512	9,84	12,70	13,100	- 0,046	13,3

Table 2 : séquence of T Her

STAR	F_z	I_B	I_V	M_V	$(B-V)_G$	chart magnitude
1	1,069	6 321,33	5 444,49	6,600	- 0,491	6,6
2	1,067	2 376,90	1 432,90	8,060	- 0,930	8,2
3	1,100	849,10	620,05	8,959	- 0,701	9,0
4	1,066	197,76	194,40	10,215	- 0,328	9,6
5	1,066	86,44	179,49	10,280	0,593	10,4
6	1,078	109,56	102,16	10,913	- 0,395	10,9
7	1,093	56,58	54,06	11,601	- 0,367	11,8
8	1,084	29,33	26,54	12,377	- 0, 433	12,4

Table 3 : séquence of W Peg

- Night 1983 August 14/15

Observers : ISO, FOG, HBH
Weather conditions : fair

The sequences of R Aql, T Cep, V Cas and R Cas were observed and correlated with 6 standard stars (Tables 4 to 7).

STAR	F_z	I_B	I_v	M_v	$(B - V)_G$	Chart magnitude
1	1,303	2056,33	6666,05	6,298	1,168	6,1
2	1,313	1070,18	2116,66	7,542	0,545	7,2
3	1,275	991,32	661,82	8,817	-0,824	8,3
4	1,276	431,62	433,14	9,276	-0,311	8,9
5	1,278	680,60	299,48	9,679	-1,348	9,5
6	1,286	69,60	98,25	10,883	0,118	10,9
7	1,296	46,46	53,26	11,546	-0,144	11,6

Table 4 - Sequence of R Aql

STAR	F_z	I_B	I_v	M_v	$(B - V)_G$	Chart magnitude
1	1,082	6256,11	4075,84	6,891	- 0,837	6,7
2	1,081	1686,29	1337,37	8,101	- 0,595	8,1
3	1,077	572,45	577,66	9,013	- 0,299	8,8
4	1,077	283,40	302,09	9,717	- 0,232	9,6
5	1,079	168,52	140,63	10,547	- 0,532	10,5
6	1,077	45,77	54,78	11,570	- 0,090	11,6

Table 5 - Sequence of T cep

STAR	F_z	I_B	I_v	M_v	$(B - V)_G$	Chart magnitude
1	1,056	11030,89	6409,84	6,407	- 0,974	6,3
2	1,052	1329,32	2898,71	7,266	0,644	7,4
3	1,045	711,10	765,08	8,716	- 0,220	8,6
4	1,041	134,09	371,64	9,499	0,936	9,6
5	1,037	153,71	164,48	10,387	- 0,226	10,3
6	1,032	116,30	87,65	11,072	- 0,654	10,9
7	1,029	21,15	52,31	11,631	0,796	11,5
8	1,027	17,58	41,63	11,879	0,743	12,4

Table 6 : Sequence of V Cas

STAR	F_z	I_B	I_v	M_v	$(B - V)_G$	Chart magnitude
1	1,016	1204,89	1960,80	7,700	0,285	
2	1,005	830,33	679,19	8,856	- 0,553	
3	1,003	507,47	427,05	9,360	- 0,518	8,4
4	1,003	115,91	247,76	9,949	0,616	9,9
5	1,003	98,83	91,15	11,037	- 0,407	11,0
6	1,012	8,89	12,53	13,188	0,110	12,1
7	1,006	5,69	5,97	13,994	- 0,249	13,5

Table 7 : Sequence of R Cas

- Night 1983 September 22/23

Observers : DMT, Bernard Pernier

Observation of the W Lyr sequence, correlated with 5 standard stars (Table 8).

STAR	F_z	I_B	I_V	M_V	$(B - V)_G$	Chart magnitude
W Lyr	1,33	4,81	11,67	12,866	0,813	-
1	1,61	409,63	955,59	8,069	0,765	7,8
2	1,56	406,37	329,44	9,216	- 0,602	8,8
3	1,48	114,84	99,76	10,518	- 0,501	9,9
4	1,53	21,60	55,14	11,171	0,881	10,8
5	1,44	30,58	41,04	11,490	0,060	11,3
6	1,33	6,27	14,81	12,608	0,780	12,3
7	1,40	13,69	11,83	12,838	- 0,496	12,5

Table 8 : Sequence of W Lyr.

VI - DISCUSSION OF THE RESULTS

The comparison between the magnitudes read on the charts and the photoelectric magnitudes suggests some comments :

- there exist large errors on the charts currently used by variable star observers : these errors may reach up to ONE magnitude ! Figure 9 gives their statistical distribution. The (chart magnitude-photoelectric magnitude) difference (abscissae) is plotted against the frequency (ordinates). One can note a slight systematic bias : the stars are often given as brighter on the charts (37 times out of 55).

- there is no relation between this bias and the (B - V) index of the star.

- the mean systematic error (chart magnitude-photoelectric magnitude) is -.15. The number of comparison stars observed is however not large enough to conclude that :

$$v - M_V = - 0,15$$

where v is the visual magnitude.

This trend needs to be confirmed. The standard deviation σ = 0,239 is in fact too high for this systematic error of 0.15 magnitude to be well established.

Michel DUMONT

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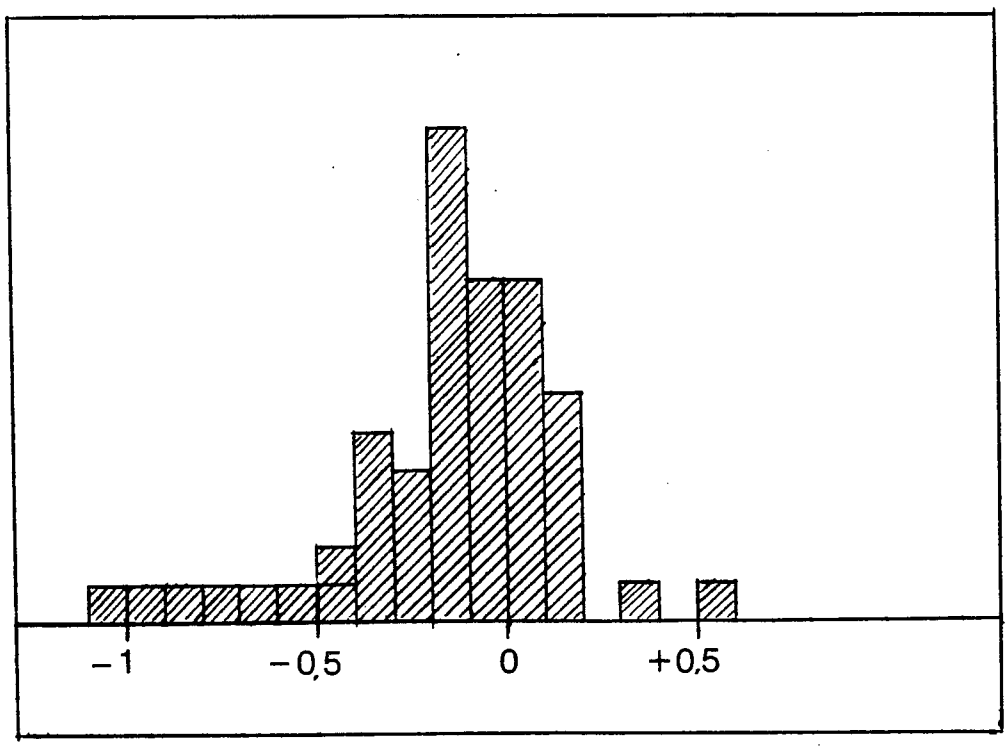


Figure 9 : frequency of errors (ordinates) against importance (abscissae)

HIPPARCOS INPUT CATALOGUE

New Ground Based Photometry

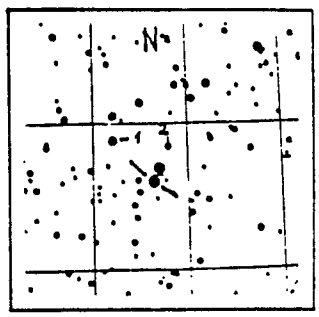
IRREGULAR VARIABLES
PHOTOELECTRIC B,V STANDARD SEQUENCE

VARIABLE : Z Cyg m_v 8.7 - 13.3
Spectral type :

α 1900 : $19^h 58\ 37$ α 1985 : $20^h\ 01\ 01$

δ 1900 : $+49°\ 45.9$ δ 1985 : $50°\ 00\ 05$

DM Number :



STANDARD STARS

N° 1	m_v =	7.3
2		8.5
3		9.6
4		10.2
5		11.1
6		11.9
7		12.4
8		~13.0
9		—

Chart Scale : 1.79 mm / '

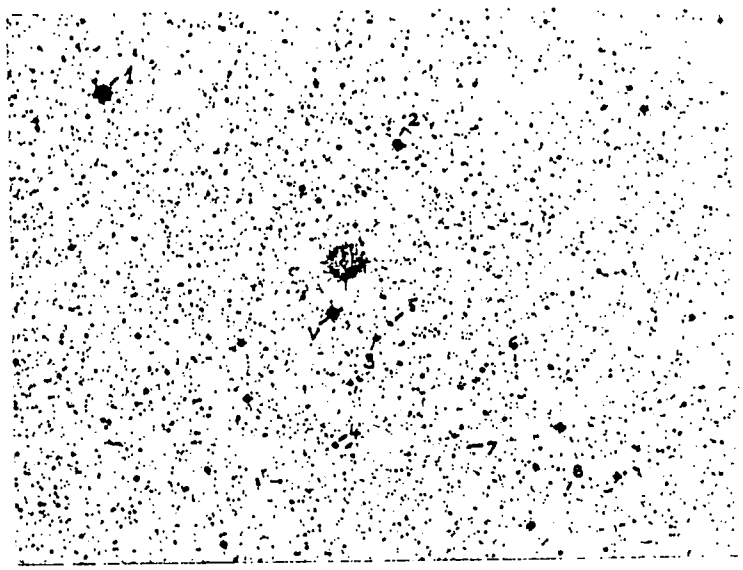


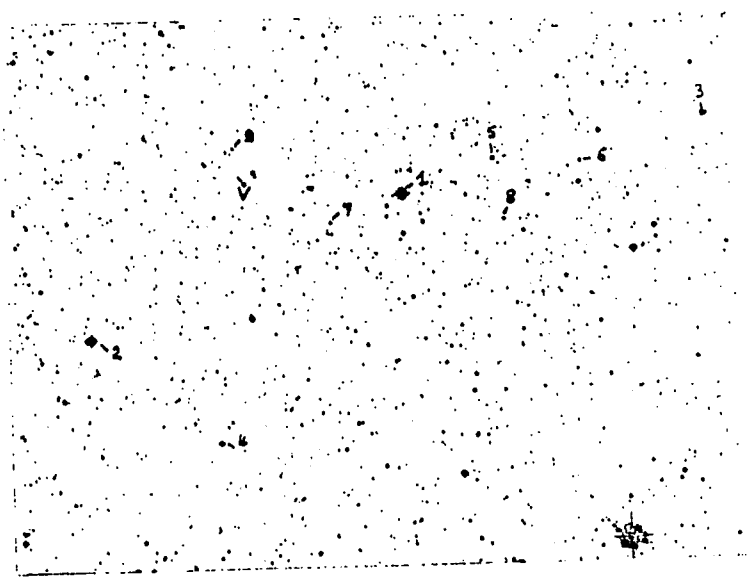
FIG. 1

VARIABLE : T Her m_v 6.8 - 13.9 : FIG. 2

STANDARD STARS

N° 1	m_v =	7.3
2		7.8
3		8.9
4		9.4
5		10.4
6		~11.3
7		12.4
8		~13.0
9		13.3

Chart Scale : 1.79 mm / '



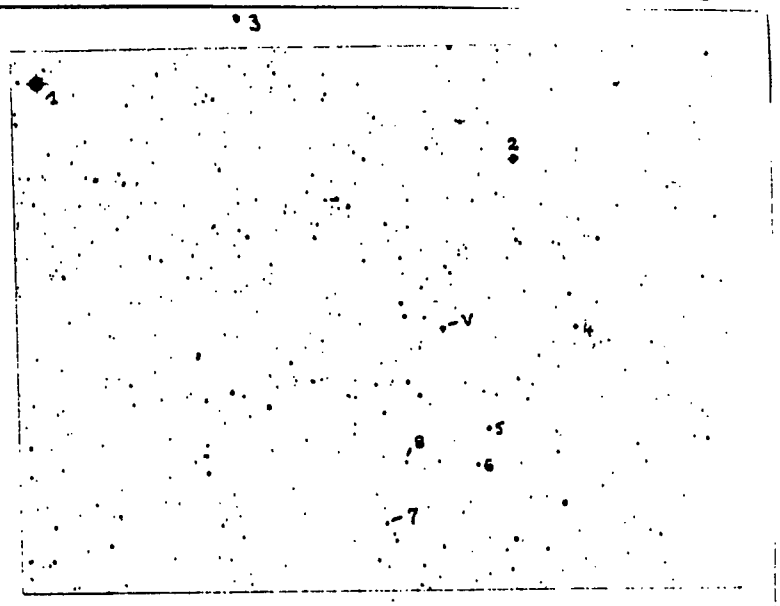
VARIABLE : W Peg m_v : 8.2 - 12.7

FIG. 3

STANDARD STARS

Nº 1	m_v =	6.6
2		8.2
3		9.0
4		9.6
5		10.4
6		10.9
7		11.8
8		12.4
9		-

Chart Scale : 1.79 mm/'



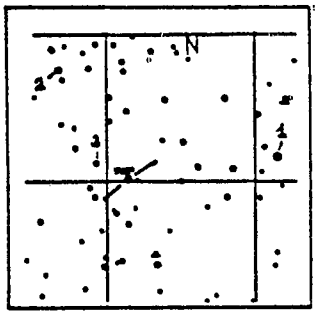
VARIABLE : R Aql m_v 6.1 - 11.5

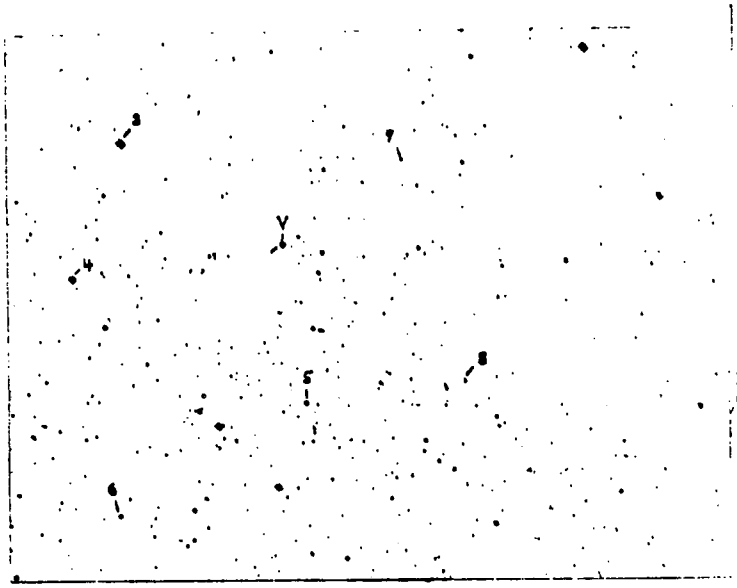
STANDARD STARS

FIG. 4

Nº 1	m_v ≅	6.1 :
2		7.2
3		8.3
4		8.9
5		9.5
6		10.9
7		11.6
8		12.3

2°





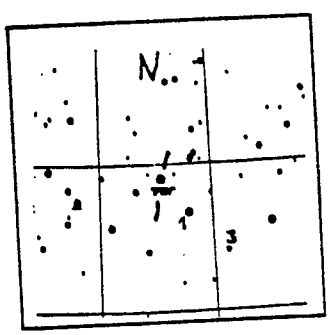
VARIABLE : T Cep m_v 6.0 - 10.3

STANDARD STARS

FIG. 5

Nº 1	m_v =	6.7
2		8.1
3		8.8
4		9.6
5		10.5
6		11.6

2°



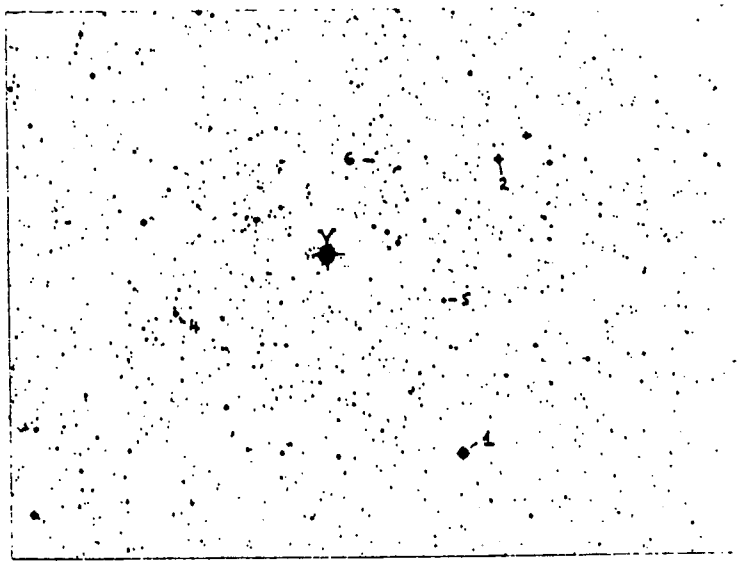


Chart Scale : 1.79 mm/'

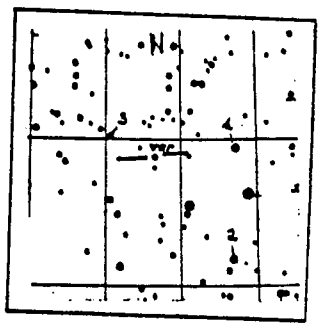
VARIABLE : V Cas m_v 7.9 - 12.2

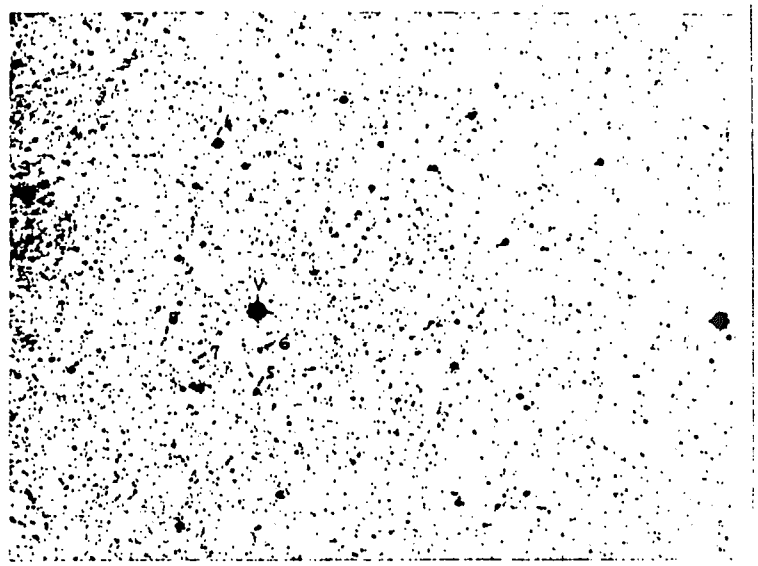
STANDARD STARS

FIG. 6

N° 1	m_v =	6.3
2		7.4
3		8.6
4		9.6
5		10.3
6		10.9
7		11.5
8		12.4

2°





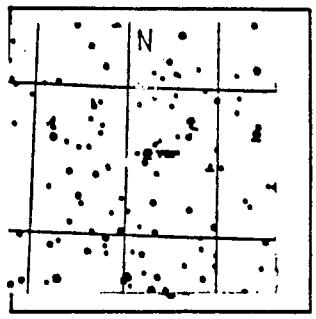
VARIABLE : R Cas m_v 7.0 - 12.6

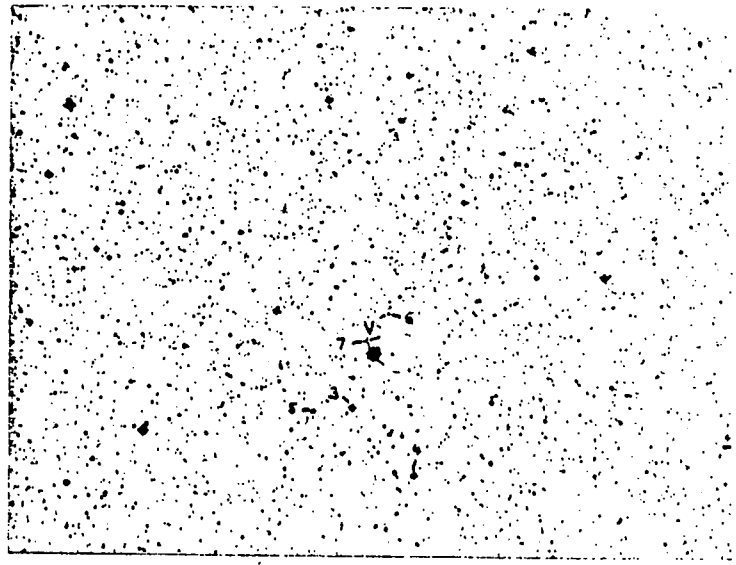
STANDARD STARS

FIG. 7

N° 1	m_v =	---
2		---
3		8.4
4		9.9
5		11.0
6		~ 12.1
7		~ 13.5

2°





VARIABLE : W Lyr m_v 7.9 - 12.2

FIG. 8

STANDARD STARS

N° 1	m_v =	7.8
2		8.8
3		9.9
4		10.8
5		11.3
6		12.3
7		~12.5

1°

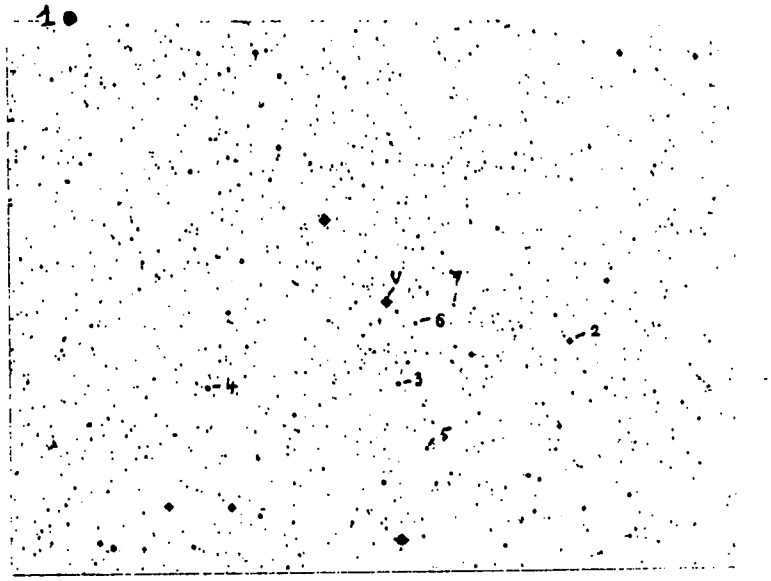


Chart Scale : 1.79 mm/'