BOLETÍN DE LOS OBSERVATORIOS DE TONANTZINTLA Y TACUBAYA, VOL. 5, N°32, 1969.

ON THE PHOTOELECTRIC PHOTOMETRY OF SOME ORION FLARE STARS

Guillermo Haro

SUMARIO

Siendo conscientes de que nuestras magnitudes y colores fotográficos de las estrellas Ráfaga son muy imprecisos —dado que nuestro interés original no requería necesariamente una fina fotometría— examinamos ahora la fotometría fotoeléctrica realizada por Mendoza y Walker en once de nuestras estrellas Ráfaga en la vecindad de la Nebulosa de Orión. En este examen preliminar encontramos, especialmente en la fotometría de Mendoza, ciertas anomalías que bien pueden ser interpretadas como resultado de inconsistencias internas en su sistema, incluyendo considerables posibles errores, o bien que las estrellas Ráfaga por él observadas se comportan como objetos fantásticamente peculiares e interesantes.

1. *Introduction*

Being very conscious of the rather unprecise magnitudes and colors estimated by us for the flare stars found in several stellar aggregates and especially in the Orion Nebula region (Haro 1968; Haro and Chavira 1969) we have limited ourselves to present, in general, only rough photometric data. However, some preliminary conclusions based on our material seem to be quite reliable; for example, we have concluded that there exist some T Tauri and flare stars that because of their apparent visual magnitude and the extreme "blue-ness" in our collection of three-image plates *(UBV)* lie almost certainly on or below the main-sequence.

In the last years we provided, in advance of publication, identification charts of flare stars in the Orion region to Dr. A. D. Andrews of the Armagh Observatory, who has been doing photographic photometry of these stars. Andrews' preliminary results (1968) confirm the existence of flare stars in Orion which "apear" to lie below the main-sequence.

Photoelectric photometry on several Orion flare stars has also been done in the last years and although the observed number of these objects is very limited, perhaps it would be of interest to consider and comment on these results in the hope that it will stimulate workers in the field to do photoelectric photometry of flare stars in the Orion region.

2. *Mendoza's Photoelectric Photometry of Orion Flare Stars*

At our suggestion, several of the flare stars in Orion were included in the more extensive multicolor photometric observations of Mendoza (1968) in his study of T Tauri stars and related objects. His photometric data in the *UBVRIJKL* bands for seven flare stars are reproduced in Table 1. Using his V and K magnitudes and different colors we have derived, in the right hand part of this table, the corresponding magnitudes from U to L.

In Mendoza's work there are two important statements, which are extended to the flare stars observed. First, the infrared excesses observed in these stars persist even after correction is applied for interstellar extinction; second, in all bands there are irregular light variations. Although it would be desirable to make a more sound and thorough analysis of these important photometric results, at this time we are advancing some comments on the subject.

At first glance and taking Mendoza's results at their face value, it is unavoidable to conclude that either he detected a really amazing number of a very peculiar kind of flare-ups in the majority of the flare stars observed when passing from one filter to the other, or that these stars behave as a surprisingly strange kind of "normal" irregular nebular variables — or both. A simple inspection of the colors and magnitudes in Table 1 supports this first impression. In many instances it is difficult to correlate or to understand what happens in a given color in relation to the others, even if we take into account that the photometry was done using different diaphragms as this could introduce —due to the presence of the nebula— strange effects or reasonably great differences. Probably the only way to explain these apparent anomalies— if we leave out very large errors —is to contemplate the possibility that superposed on the "normal" irregular light variation there exist extremely rapid and erratic changes which could occur in these stars, as has been said earlier, during the short interval when passing from one color to the others. The latter seems to be unlikely due, among other reasons, to the kind of techniques used by the observer which consist —according to Mendoza's personal explanation— in starting the observations following the order of the *UBVRI* filters and then immediately going back in the opposite sense *IRVB* and *U*, and taking as final value the average of the "back and forth" results for each of the published magnitudes and colors.

TABLE 1

Mendoza's Photoelectric Photometry of Flare Stars

Flare Star No.	*Colors*						*Magnitudes*								*J.D.*
	U–B	*B–V*	*V–R*	*R–I*	*J–K*	*K–L*	*U*	*B*	*V*	*R*	*I*	*J*	*K*	*L*	*2430000+*
25–P1353*	−0.88	0.83	0.96	0.91	....	....	14.13	15.01	14.18	13.22	12.31	.....	....	....	9032.956
25–P1353*	−0.56	0.48	1.15	0.54	....	....	14.08	14.64	14.16	13.01	12.47	.....	....	....	9034.001
25–P1353†	−0.34	1.04	0.96	0.82	....	....	15.05	15.39	14.35	13.39	12.57	.....	....	....	9034.913
25–P1353‡	+0.95	1.21	1.45	0.54	....	....	16.61	15.66	14.45	13.00	12.46	.....	....	....	9063.901
25–P1353‡	.....	1.20	1.17	0.95	....	....	.....	15.69	14.49	13.32	12.37	.....	....	....	9063.950
146–P1553*	−0.18	1.09	1.02	0.84	....	....	13.58	13.76	12.67	11.65	10.81	.....	....	....	9032.907
146–P1553†	+0.62	1.15	1.12	0.91	....	....	14.71	14.09	12.94	11.82	10.91	.....	....	....	9033.975
146–P1553†	+0.32	1.23	1.13	0.85	....	....	14.41	14.09	12.86	11.73	10.88	.....	....	....	9034.967
146–P1553*	+0.60	1.14	1.14	0.84	....	....	14.49	13.89	12.75	11.61	10.77	.....	....	....	9035.983
146–P1553†	+0.68	1.11	1.15	0.82	....	....	14.63	13.95	12.84	11.69	10.87	.....	....	....	9036.976
146–P1553	.....	....	....	....	1.76	0.07	.....	.....	.....	.....	.....	10.56	8.80	8.73	9054.941
146–P1553	.....	....	....	....	1.93	0.53	.....	.....	.....	.....	.....	10.78	8.85	8.32	9055.936
146–P1553‡	+0.80	1.20	1.11	0.91	....	....	14.88	14.08	12.88	11.77	10.86	.....	....	....	9065.870
146–P1553‡	+0.69	1.21	1.11	0.93	....	....	14.79	14.10	12.89	11.78	10.85	.....	....	....	9065.913
146–P1553‡	−0.12	1.17	1.19	0.88	....	....	14.13	14.25	13.08	11.89	11.01	.....	....	....	9065.965
146–P1553	.....	....	....	....	1.15	1.01	.....	.....	.....	.....	.....	9.85	8.70	7.69	9068.919
58–P2078*	−1.07	0.64	1.21	0.86	....	....	13.23	14.30	13.66	12.45	11.59	.....	....	....	9032.935
58–P2078*	−0.86	0.52	0.95	1.09	....	....	13.32	14.18	13.66	12.71	11.62	.....	....	....	9033.939
58–P2078†	−1.08	1.15	1.21	1.06	....	....	13.88	14.96	13.81	12.60	11.54	.....	....	....	9035.925
58–P2078‡	+0.63	1.52	1.45	0.76	....	....	15.95	15.32	13.80	12.35	11.59	.....	....	....	9063.950
58–P2078‡	+1.04	1.23	1.24	0.99	....	....	16.06	15.02	13.79	12.55	11.56	.....	....	....	9063.994
63–P2172*	+0.73	1.26	1.51	0.84	....	....	15.93	15.20	13.94	12.43	11.59	.....	....	....	9056.979
63–P2172†	+0.74	1.35	1.28	1.06	....	....	16.02	15.28	13.93	12.65	11.59	.....	....	....	9061.854
63–P2172†	+0.31	1.48	1.31	0.98	....	....	15.72	15.41	13.93	12.62	11.64	.....	....	....	9061.902
63–P2172†	+1.05	1.22	1.36	0.97	....	....	16.20	15.15	13.93	12.57	11.60	.....	....	....	9061.953
63–P2172†	+0.75	1.41	1.23	1.20	....	....	16.05	15.30	13.89	12.66	11.46	.....	....	....	9061.999

TABLE 1 (Continued)

Flare Star No.	*Colors*						*Magnitudes*								
	U–B	*B–V*	*V–R*	*R–I*	*J–K*	*K–L*	*U*	*B*	*V*	*R*	*I*	*J*	*K*	*L*	*J.D. 2430000+*
77–P2305*	+0.79	1.34	1.19	0.83	....	....	15.65	14.86	13.52	12.33	11.50	.....	....	....	9057.855
77–P2305†	+0.92	1.30	1.07	0.96	....	....	15.72	14.80	13.50	12.43	11.47	.....	....	....	9057.915
77–P2305†	+1.47	1.27	1.22	0.83	....	....	16.27	14.80	13.53	12.31	11.48	.....	....	....	9060.870
77–P2305†	+1.74	1.33	1.32	0.81	....	....	16.61	14.87	13.54	12.22	11.41	.....	....	....	9060.959
77–P2305‡	+1.16	1.36	1.20	0.84	....	....	16.07	14.91	13.55	12.35	11.51	.....	....	....	9064.837
77–P2305‡	+1.00	1.33	1.17	0.89	....	....	15.89	14.89	13.56	12.39	11.50	.....	....	....	9064.880
77–P2305	.....	....	....	....	0.22	0.88	.....	.....	.....	.....	.....	9.87	9.65	8.77	9066.895
86–P2347*	+0.09	0.96	1.19	0.49	....	....	14.98	14.89	13.93	12.74	12.25	.....	....	....	9057.978
86–P2347*	−0.01	1.02	1.03	0.79	....	....	14.87	14.88	13.86	12.83	12.04	.....	....	....	9060.915
86–P2347*	+0.05	0.96	1.26	....	....	....	14.93	14.88	13.92	12.66	.....	.....	....	....	9061.001
86–P2347‡	+0.84	1.20	1.08	0.79	....	....	16.12	15.28	14.08	13.00	12.21	.....	....	....	9064.925
86–P2347‡	+0.72	1.18	1.16	0.72	....	....	15.98	15.26	14.08	12.92	12.20	.....	....	....	9064.968
102–P2455†	+1.85	1.64	1.97	1.52	....	....	17.92	16.07	14.43	12.46	10.94	.....	....	....	9058.844
102–P2455†	+0.91	1.76	1.80	1.58	....	....	17.10	16.19	14.43	12.63	11.05	.....	....	....	9059.861
102–P2455†	+1.52	1.56	1.76	1.55	....	....	17.49	15.97	14.41	12.65	11.10	.....	....	....	9050.908
102–P2455†	+1.30	1.59	1.95	1.46	....	....	17.67	16.37	14.78	12.83	11.37	.....	....	....	9059.958
102–P2455‡	+0.90	1.91	2.01	1.35	....	....	17.26	16.36	14.45	12.44	11.09	.....	....	....	9062.850
102–P2455‡	+1.12	1.62	1.98	1.39	....	....	17.32	16.20	14.58	12.60	11.21	.....	....	....	9062.897
102–P2455‡	+1.66	1.80	1.83	1.53	....	....	17.92	16.26	14.46	12.63	11.10	.....	....	....	9062.944
102–P2455‡	+1.33	1.65	1.83	1.50	....	....	17.41	16.08	14.43	12.60	11.10	.....	....	....	9062.989

NOTE: The Flare star 25–P1353, by mistake appears as –P1352 in the original lists.
* Photometry made with a 36″ diaphragm.
† Photometry made with a 27″ diaphragm.
‡ Photometry made with a 18″ diaphragm.

TABLE 2

Apparent Variability of Seven Flare Stars

In The UBVRI Magnitudes

Flare Star No.	Δ^{mU}	Δ^{mB}	Δ^{mV}	Δ^{mR}	Δ^{mI}	*Diaphragm Size*	*J. D. 2430000+*
25–P1353	2.48	0.65	0.27	–0.22	0.15	18″ 36″	9063.901 –9032.956
,,	2.53	1.02	0.29	–0.01	–0.01	18″ 36″	9063.901 –9034.001
,,	1.56	0.27	0.10	–0.39	–0.11	18″ 27″	9063.901 –9034.913
,,	....	0.68	0.31	0.10	0.06	18″ 36″	9063.950 –9032.956
,,	....	1.05	0.33	0.31	–0.10	18″ 36″	9063.950 –9034.001
,,	....	0.30	0.14	–0.07	–0.20	18″ 27″	9063.950 –9034.913
,,	0.92	0.38	0.17	0.17	0.26	27″ 36″	9034.913 –9032.956
,,	0.97	0.75	0.19	0.38	0.10	27″ 36″	9034.913 –9034.001
,,		**0.03**	**0.04**	**0.32**	**–0 09**	18″ 18″	9063.950 –9063.901
25–P1353	**0.05**	**0.37**	**0.02**	**0 21**	**–0.16**	36″ 36″	9032.956 –9034.001
146–P1553	0.55	0.49	0.41	0.24	0.20	18″ 36″	9065.965 –9032.907
,,	1.30	0.32	0.21	0.12	0.05	18″ 36″	9065.870 –9032.907
,,	0.17	–0.01	–0.06	–0.11	–0.05	18″ 27″	9065.870 –9033.975
,,	0.47	–0.01	0.02	0.04	–0.02	18″ 27″	9065.870 –9034.967
,,	0.39	0.19	0.13	0.11	0.09	18″ 36″	9065.870 –9035.983
,,	0.25	0.13	0.04	0.08	–0.01	18″ 27″	9065.870 –9036.976
,,	1.21	0.34	0.22	0.13	0.04	18″ 36″	9065.913 –9032.907
,,	0.08	0.01	–0.05	–0.04	0.06	18″ 27″	9065.913 –9033.975
,,	0.38	0.01	0.03	0.05	–0.03	18″ 27″	9065.913 –9034.967
,,	0.30	0.21	0.14	0.17	0.08	18″ 36″	9065.913 –9035.983
,,	0.16	0.15	0.05	0.09	–0.02	18″ 27″	9065.913 –9036.976
,,	0.58	–0.16	–0.14	–0.07	–0.10	27″ 18″	9033.975 –9065.965
146–P1553	0.22	0.20	0.19	0.21	0.14	27″ 36″	9033.975 –9035.883

TABLE 2 (Continued)

Flare Star No.	Δ^{mU}	Δ^{mB}	Δ^{mV}	Δ^{mR}	Δ^{mI}	*Diaphragm Size*	*J. D. 2430000+*
146–P1553	1.13	0.33	0.27	0.17	0.10	27″ 36″	9033.975 –9032.907
,,	0.50	–0.30	–0.24	–0.20	–0.14	27″ 36″	9036.976 –9065.965
,,	1.05	0.19	0.17	0.04	0.07	27″ 36″	9036.976 –9032.907
,,	0.14	0.06	0.09	0.08	0.10	27″ 36″	9036.976 –9035.983
,,	0.36	–0.36	–0.33	–0.28	–0.24	36″ 18″	9035.983 –9065.965
,,	0.08	–0.20	–0.11	–0.12	–0.11	36″ 27″	9035.983 –9034.967
,,	0.28	–0.16	–0.22	–0.16	–0.13	27″ 18″	9034.967 –9065.965
,,	0.83	0.23	0.19	0.08	0.07	27″ 36″	9034.967 –9032.907
,,	**0.09**	**–0.02**	**–0.01**	**–0.01**	**–0.01**	18″ 18″	9065.870 –9065.913
,,	**0.75**	**–0.17**	**–0.20**	**–0.12**	**–0.15**	18″ 18″	9065.870 –9065.965
,,	**0.66**	**–0.15**	**–0.19**	**–0.11**	**–0.16**	18″ 18″	9065.913 –9065.965
,,	**0.30**	**0.00**	**0.08**	**0.09**	**0.03**	27″ 27″	9033.975 –9034.967
,,	**0.08**	**0.14**	**0.10**	**0.23**	**0.04**	27″ 27″	9033.975 –9036.976
,,	**0.22**	**–0.14**	**0.02**	**–0.04**	**–0.01**	27″ 27″	9036.976 –9034.967
146–P1553	**0.91**	**0.13**	**0.08**	**–0.04**	**–0.04**	36″ 36″	9035.983 –9032.907
58–P2078	2.83	0.72	0.13	0.10	–0.03	18″ 36″	9063.994 –9032.935
,,	2.74	0.84	0.13	–0.16	–0.06	18″ 36″	9063.994 –9033.939
,,	2.18	0.06	–0.02	–0.05	0.02	18″ 27″	9063.994 –9035.925
,,	2.72	1.02	0.14	–0.10	0.00	18″ 36″	9063.950 –9032.935
,,	2.63	1.14	0.14	–0.36	–0.03	18″ 36″	9063.950 –9033.939
,,	2.07	0.36	–0.01	–0.25	0.05	18″ 27″	9063.950 –9035.925
,,	0.65	0.66	0.15	0.15	–0.05	27″ 36″	9035.925 –9032.935
,,	0.56	0.78	0.15	–0.11	–0.08	27″ 36″	9035.925 –9033.939
58–P2078	**0.11**	**–0.30**	**–0.01**	**0.20**	**–0.03**	18″ 18″	9063.994 –9063.950

TABLE 2 (Continued)

Flare Star No.	Δ^{mU}	Δ^{mB}	Δ^{mV}	Δ^{mR}	Δ^{mI}	*Diaphragm Size*	*J. D. 2430000+*
58—P2078	**0.09**	**—0.12**	**0.00**	**0.26**	**0.03**	{36″ 36″	9033.939 —9032.935
63—P2172	0.27	—0.05	—0.01	—0.14	0.01	{27″ 36″	9061.953 —9056.979
,,	0.08	0.10	—0.05	0.23	—0.13	{27″ 36″	9061.999 —9056.979
,,	0.09	0.08	—0.01	0.22	0.00	{27″ 36″	9061.854 —9056.979
,,	0.21	—0.21	0.01	—0.19	—0.05	{36″ 27″	9056.979 —9061.902
,,	**0.23**	**—0.11**	**—0.04**	**0.04**	**—0.18**	{27″ 27″	9061.999 —9061.902
,,	**0.03**	**0.02**	**—0.04**	**0.01**	**—0.13**	{27″ 27″	9061.999 —9061.854
,,	**0.15**	**—0.15**	**0.04**	**0.09**	**0.14**	{27″ 27″	9061.953 —9061.999
,,	**0.48**	**—0.26**	**0.00**	**—0.05**	**—0.04**	{27″ 27″	9061.953 —9061.902
,,	**0.18**	**—0.13**	**0.00**	**—0.08**	**—0.01**	{27″ 27″	9061.953 —9061.854
63—P2172	**0.30**	**—0.13**	**0.00**	**0.03**	**0.05**	{27″ 27″	9061.854 —9061.902
77—P2305	0.42	0.05	0.03	0.02	0.01	{18″ 36″	9064.837 —9057.855
,,	0.25	0.11	0.05	—0.08	0.04	{18″ 27″	9064.837 —9057.915
,,	0.24	0.03	0.04	0.06	0.00	{18″ 36″	9064.880 —9057.855
,,	0.17	0.09	0.06	—0.04	0.03	{18″ 27″	9064.880 —9057.915
,,	0.20	—0.11	—0.02	—0.04	—0.03	{27″ 18″	9060.870 —9064.837
,,	0.38	—0.09	—0.03	—0.08	—0.02	{27″ 36″	9060.870 —9064.880
,,	0.54	—0.04	—0.01	—0.13	—0.10	{27″ 18″	9060.959 —9064.837
,,	0.72	—0.02	—0.02	—0.17	—0.09	{27″ 18″	9060.959 —9064.880
,,	0.96	0.01	0.02	—0.11	—0.09	{27″ 36″	9060.959 —9057.855
,,	0.62	—0.06	0.01	—0.02	0.02	{27″ 36″	9060.870 —9057.855
,,	0.07	—0.06	0.02	0.10	—0.03	{27″ 36″	9057.915 —9057.855
,,	**0.18**	**0.02**	**—0.01**	**—0.04**	**0.01**	{18″ 18″	9064.837 —9064.880
77—P2305	**0.34**	**0.07**	**0.01**	**—0.09**	**—0.07**	{27″ 27″	9060.559 —9060.870

TABLE 2 (Continued)

Flare Star No.	Δ^{mU}	Δ^{mB}	Δ^{mV}	Δ^{mR}	Δ^{mI}	*Diaphragm Size*	*J. D. 2430000+*
„	**0.89**	**0.07**	**0.04**	**−0.21**	**−0.06**	27″ 27″	9060.959 −9057.915
77−P2305	**0.55**	**0.00**	**0.03**	**−0.12**	**−0.04**	27″ 27″	9060.870 −9057.915
86−P2347	1.14	0.39	0.05	0.26	−0.04	18″ 36″	9064.925 −9057.978
„	1.25	0.40	0.22	0.17	0.17	18″ 36″	9064.925 −9060.915
„	1.19	0.40	0.16	0.34	....	18″ 36″	9064.925 −9061.001
„	1.00	0.37	0.15	0.18	−0.05	18″ 36″	9064.968 −9057.978
„	1.11	0.38	0.22	0.09	0.16	18″ 36″	9064.968 −9060.915
„	1.05	0.38	0.16	0.26	....	18″ 36″	9064.968 −9061.001
„	**0.14**	**0.02**	**0.00**	**0.08**	**0.01**	18″ 18″	9064.925 −9064.968
„	**0.06**	**0.00**	**0.06**	**−0.17**	....	36″ 36″	9061.001 −9060.915
„	**0.05**	**0.01**	**0.01**	**0.08**	....	36″ 36″	9057.978 −9061.001
86−P2347	**0.11**	**0.01**	**0.07**	**−0.09**	**0.21**	36″ 36″	9057.978 −9060.915
102−P2455	0.16	0.17	0.02	−0.19	0.04	18″ 27″	9062.850 −9059.861
„	0.22	0.01	0.15	−0.03	0.16	18″ 27″	9062.897 −9059.861
„	0.00	0.19	0.03	0.17	0.16	18″ 27″	9062.944 −9058.844
„	0.82	0.07	0.03	0.00	0.05	18″ 27″	9062.944 −9059.861
„	0.43	0.29	0.05	−0.02	0.00	18″ 27″	9062.944 −9059.908
„	0.25	−0.11	−0.32	−0.20	−0.27	18″ 27″	9062.974 −9059.958
„	0.31	−0.11	0.00	−0.03	0.05	18″ 27″	9062.989 −9059.861
„	0.41	0.01	0.33	0.39	0.29	27″ 18″	9059.958 −9062.850
„	0.35	0.17	0.20	0.23	0.16	27″ 18″	9059.958 −9062.897
„	0.26	0.29	0.35	0.23	0.27	27″ 18″	9059.958 −9062.989
„	0.23	−0.39	−0.04	0.21	0.01	27″ 18″	9059.908 −9062.850
102−P2455	0.17	−0.23	−0.17	0.05	−0.11	27″ 18″	9059.908 −9062.897

TABLE 2 (Continued)

Flare Star No.	Δ^{mU}	Δ^{mB}	Δ^{mV}	Δ^{mR}	Δ^{mI}	*Diaphragm Size*	*J. D. 2430000+*
102—P2455	0.08	—0.11	0.02	0.05	0.00	27″ 18″	9059.908 —9062.989
„	0.66	—0.29	—0.02	0.02	—0.15	27″ 18″	9058.844 —9062.850
„	0.60	—0.13	—0.15	—0.14	—0.27	27″ 18″	9058.844 —9062.897
„	0.51	—0.01	0.00	—0.14	—0.16	27″ 18″	9058.844 —9062.989
„	**0.06**	**—0.16**	**0.13**	**0.16**	**0.12**	18″ 18″	9062.897 —9062.850
„	**0.66**	**—0.14**	**0.01**	**—0.19**	**0.01**	18″ 18″	9062.944 —9062.850
„	**0.60**	**0.02**	**—0.12**	**0.03**	**—0.11**	18″ 18″	9062.944 —9062.897
„	**0.51**	**0.14**	**0.03**	**0.03**	**0.00**	18″ 18″	9062.944 —9062.989
„	**0.15**	**—0.28**	**—0.02**	**0.16**	**0.01**	18″ 18″	9062.989 —9062.850
„	**0.09**	**—0.12**	**—0.15**	**0.00**	**—0.11**	18″ 18″	9062.989 —9062.897
„	**0.57**	**0.18**	**0.35**	**0 20**	**0.32**	27″ 27″	9059.958 —9059.861
„	**0.18**	**0.40**	**0.37**	**0.18**	**0.27**	27″ 27″	9059.958 —9059.908
„	**0.39**	**—0.22**	**—0.02**	**0.02**	**0.05**	27″ 27″	9059.908 —9059.861
„	**0.82**	**—0.12**	**0.00**	**—0.17**	**—0.09**	27″ 27″	9058.844 —9059.861
„	**0.43**	**0.10**	**0.02**	**—0.19**	**—0.16**	27″ 27″	9058.844 —9059.908
102—P2455	**0 25**	**—0.30**	**—0.35**	**—0.37**	**—0.43**	27″ 27″	9058.844 —9059.958

In Table 2 we give for the seven flare stars observed by Mendoza the apparent variability in his *UBVRI* system, represented by the corresponding Δm's in each magnitude. The Δm's are obtained substracting from the magnitudes derived from the observations in a given J.D. the corresponding values of the other available dates. For the seven flare stars we present first the Δm's regardless of the different sizes of the diaphragms used in each series of observations in a given pair of dates, and then in boldface numbers the values obtained from two series of observations made with the same diaphragm at different dates. As in some instances there are —for the always positive Δm*U*— negative values for the *BVRI* Δm's, if desirable the signs can be inverted in such cases. It is possible that notwithstanding our checking and rechecking of the values given in Tables 1 and 2, there could still be a few minor numerical errors.

The comparison of the data contained in Tables 1 and 2 permits us to point out some of the more outstanding characteristics of Mendoza's results for each of the seven flare stars observed by him. According to Mendoza's private communication, the probable errors in his *JKL* photometry —if the *K*-magnitude is fainter than 7.0— is $\sim \pm 0.5$; the corresponding error for *U* and *B* is ± 0.1 and, for *VRI*, ± 0.06.

With the exception of flare star No. 102, of spectral type M2, all the others are of K types.

Flare Star No. 25 — Parenago 1353. This star was observed photoelectrically in five different dates and, apparently, behaves as a "normal" irregular variable. In some instances the *V* magnitudes do not vary —taking into account the probable error $= \pm 0.06$— in two different dates, but the *B*

and R magnitudes have amplitudes of more than 0.3. The more outstanding peculiarity refers to the negative and positive Δm's in R and I, which do not seem correlated to the other amplitudes. The maximum ΔmU observed $= 2.53$.

Flare Star No. 146 — Parenago 1553. Two possible flare-ups were detected in this star, one in J.D. 2439032.907 with positive Δm's in all magnitudes and the other in J.D. 2439065.965 with positive $\Delta mU \geq 0.66$ but with negative Δm's in $BVRI$. In general, this star behaves as a small amplitude strange irregular variable if one takes into consideration the positive and sometimes relatively large negative Δm's. The maximum $\Delta mU = 1.30$. This object was the only flare star observed more than once in JKL and shows, in the intercomparison of the three different series of observations, a maximum $\Delta mK = 0.15$; ΔmJ from 0.22 to 0.93 and ΔmL from -0.41 to 1.04.

Flare Star No. 58 — Parenago 2078. Apparently, this is indeed a very strange star. The ΔmU in the majority of the compared observations goes from 2.07 up to 2.83 magnitudes but, for the same series of comparisons ΔmB goes from 0.06 up to 1.14; ΔmV, from 0.02 to 0.14 and ΔmR from -0.36 to 0.10. The variability in I is practically inexistent. There are also several series of observations in which V does not vary and the U amplitude is as large as 2.18 magnitudes, and B and R have positive or negative amplitudes of more than 0.3 and 0.2, respectively.

Flare Star No. 63 — Parenago2172. This star does not vary at all in V (within the probable errors) and the Δm's in $UBRI$ are not understandable to us. The maximum $\Delta mU = 0.48$.

Flare Star No. 77 — Parenago 2305. The same as the previous star, with the aggravant that ΔmU in some cases is of the order of 1 magnitude. If we adopt errors of the order of ± 0.1 then practically the star does not vary in BVI.

Flare Star No. 86 — Parenago 2347. This star seems to behave not as a very "abnormal" irregular variable; it has small amplitudes in V (≤ 0.22) and relatively large fluctuations in U of more than one magnitude. There are amplitudes in B from 0.00 to 0.40 and in R from -0.17 to 0.34. The maximum $\Delta mI = 0.21$.

Flare Star No. 102 — Parenago 2455. This M2 type star, which is the faintest among the flare stars observed by Mendoza, behaves as a very peculiar irregular variable and in some instances shows very rapid variations of the order of more than half a magnitude in U. The Δm's in $UBVRI$ do not have any internal understandable possible correlation in the majority of cases. The range in ΔmU goes from 0.06 to 0.82; in ΔmB from 0.40 to -0.39; in ΔmV from 0.37 to -0.35; in ΔmR from 0.39 to -0.37 and in ΔmI from 0.32 to -0.43.

In all the seven flare stars observed by Mendoza we have found cases in which for the same given magnitude V in different series of observations, within the same J.D. series, there are outstanding variations (far larger than the expected probable errors) in some of the other colors, as if the stars behave —in such cases— quiescent in V and flickering erratically in the other magnitudes. Practically the same happens when we take as a reference quiescent point any of the $UBRIK$ magnitudes, which do not vary when passing from one J.D. series of observations to the others.

It is of some interest to mention that in 95 different three-color multiple exposure plates (UBV) taken from 1955 to 1960 at the Tonantzintla Observatory, using our Schmidt camera, none of the seven flare stars under discussion show intensity relation between their U and B images which could be interpreted in the sense of an appreciable negative $U-B$ color. Of course in some of these seven stars variations in magnitudes and colors have been detected in the photographic three-image plate material but in the more extreme cases — as for example flare stars Nos. 86 and 146, in which we have observed two different flare-ups— the strong positive $U-B$ color never goes down to less than $U-B = 0.00 \pm 0.2$. In four different Mount Palomar Schmidt plates (1958-1963), using the same technique of three consecutive exposures in UBV, the flare stars observed by Mendoza appear to have a strong positive $U-B$ color. In contrast, flare star No. 144 — Parenago 1530, observed photoelectrically by Walker (1969), although with conspicuous variations in magnitudes and colors, always shows in the above mentioned photographic material a negative $U-B$ color. Notwithstanding what has been said, it is clear to us that latetype stars with positive colors in the $UBVRI$ system during a flare-up always tend to show negative $U-B$ colors.

There is no doubt that flare stars Nos. 146 and 77 (spectral types $\approx$ K5) observed by Mendoza really show a $V-K$ color excess if the errors are indeed not much larger than ± 0.5 mag.

3. *Walker's Photoelectric Photometry of Orion Flare Stars*

In his three-color photoelectric observations of stars in the vicinity of the Orion Nebula, Walker included five of the flare stars listed by us. Walker's data are given in Table 3. The only flare star (No. 141 — P1410) which was observed in two different dates does not show in B and V —within the expected probable errors— any appreciable variation. Walker took Parenago's No. 1218

star (VY Ori) as Haro's flare star No. 18. This is due to a mistake in our original flare star lists. The real flare star No. 18 marked in the identification charts is not so far from VY Ori.

TABLE 3

Walker's Photoelectric Photometry of Orion Flare Stars

Flare Star Nº	*Magnitudes* U	B	V	*Colors* U−B	B−V	*Date (U.T.)*	*Name of the Variable*
141–P1410	17.45:	16.09	14.79	+1.36:	+1.30	Jan. 14, 1961	.....
„	.....	16.07	14.86	....	+1.21	Jan. 23, 1965	.....
144–P1530	15.50	15.88	14.87	−0.38	+1.01	Mar. 15, 1964	XX Ori
63–P2172	15.21	14.97	13.74	+0.24	+1.23	Feb. 7, 1967	V 569 Ori
66–P2211	17.24	16.26	14.98	+0.98	+1.28	Feb. 2, 1962	V 389 Ori
231–P2368	16.60	15.10	13.56	+1.50	+1.54	Nov. 18, 1958	A Z Ori

Note to Table 3: Flare star No. 63 – Parenago 2172 was observed photoelectrically by Mendoza (see Tables 1 and 2). The extreme values of the five observations listed by Mendoza are the following: $U-B = +0.31$ to $+1.05$; $B-V = +1.22$ to $+1.48$ although the star does not vary in V. It is to be noticed that in Mendoza's photometry of this particular star, to the minimum value $U-B = +0.31$ corresponds the maximum value $B-V = +1.48$.

Flare stars Nos. 141 and 66 have shown in our multiple exposure plate material two and three flare-ups, respectively. No. 66 behaves both as a "fast" and a "slow" flare star. In the 99 three-color multiple exposure plates *(UBV)* taken during the period 1955-1963 only flare star No. 144 –which at the same time can be classified as a typical T Tauri object– has a permanent negative $U-B$ color that may range from ~ -0.2 to ~ -1.0. The other four flare stars observed by Walker always appear in our three-color plates as having a more or less strong positive $U-B$ color although some of them behave as "normal" irregular variables in both magnitudes and colors between flare-ups.

4. *Summary*

Eleven flare stars have been observed by Mendoza (1968) and Walker (1969) during their photoelectric work, having in common only flare star No. 63. In four of the eleven stars, namely, Nos. 86, 144, 146 and 231, we detected Hα in emission during the non-flare stage but only one (No. 144) shows in our plates a permanent but variable negative $U-B$ color. This last star seems to lie below the main-sequence.

It is difficult to evaluate the internal consistency and accuracy of Walker's photometry of flare stars mainly due, as he says, to the small number of repeat measurements of these stars. Regarding Mendoza's photometry, we cannot help but to conclude that either his results lack of internal consistency and in some instances the errors may be rather large or the flare stars which he observed are fantastically peculiar, interesting objects.

It is very desirable to repeat and to extend to fainter magnitudes photoelectric photometry of high precision of the flare stars and T Tauri like objects in the Orion Nebula region.

REFERENCES

Andrews, A. D., 1968, *Planetarium.* Vol. I, No. 3, p. 62.
Haro, G., 1968, *Stars and Stellar Systems,* Vol. VII: *Nebula and Interstellar Matter,* ed. B. M. Middlehurst and L. H. Aller, p. 141, (Chicago University Press.).
Haro, G. and Chavira, E., 1969, in this same Bulletin pag. 59.
Mendoza, E., 1968, *Ap. J.,* **151**, 977.
Walker, M. F., 1969, *Ap. J.,* **155**, 447.