MULTICOLOR PHOTOMETRY OF TX CAMELOPARDALIS —A HETZLER OBJECT

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In 1937 Hetzler with a very simple photographic technique found many very red objects, among them TX Cam (Field II, object number 1). Using a much more complicated technique Neugebauer, Martz and Leighton (1965) re-discovered TX Cam as a very red object. It is of interest to mention that Hetzler, with his technique, would have found the two other objects listed by Neugebauer, Martz and Leighton (NML-objects), if he had surveyed those areas. This is indicated by the infrared survey by Haro and Chavira (HC-objects), under way at Tonantzintla.

We have made B, V, R, I, J, K, L photometric observations on TX Cam. B, V, R, I —measurements were obtained with the 40— inch telescope of the Observatorio Astronomico Nacional, University of Mexico, in March 1965, R, I, J, K, L —observations were secured with the 28— inch telescope of The Lunar and Planetary Laboratory, University of Arizona, in August and September 1965.

TABLE 1

Tonantzintla (R—I)-Color index of TX Cam

R—I	*J. D.*
4.53	2438837.6017
4.53	2438839.6476
4.56	2438841.6332
4.54	2438842.6532
4.54	Mean March 1965

The (R—I) color index, for each night, is given in Tables 1 and 2. These Tables also include the Julian Date. We notice from the March and August (R, I) observations a difference of 0.12 mag. on the average, and also a very good agreement among the individual values on each epoch. Since R and I were observed with identical detector and filters, the difference is most likely due to the variability of the star.

TABLE 2

Catalina (R—I)-Color index of TX Cam

R—I	*J. D.*
4.67	2438999.9039
4.63	2439003.9697
4.68	2439004.9323
4.66	Mean August 1965

We have chosen, in this discussion, the R, I, J, K, L values obtained at Catalina, because all the observations were made in only ten days.

The magnitudes of TX Cam are given in Table 3. The B and V values (obtained in March), probably, represent for this epoch, upper brightness limits, since a faint (but bluer) nearby star was included in the diaphragm during measurement. This can be seen by glancing at the blue and red plates of the 48-Schmidt camera survey. Perhaps, during our observations the star was near minimum light, and thus, during maxima the B and V magnitudes will be brighter (see, per example, Kukarkin *et al,* 1958) than the values given in Table 3.

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TABLE 3

The magnitudes of TX Cam

B	*V*	*R*	*I*	*J*	*K*	*L*
16.2:	14.7:	10.03	5.37	2.59	− 0.14	− 1.38

TABLE 4

Colors and effective temperatures of a group of selected infrared Stars

Object	*B–I*	*V–I*	*R–I*	*I–J*	*I–K*	*I–L*	*I*	$T_e(^\circ K)$
TX Cam	10.8:	9.3:	4.66	2.78	5.51	6.75	5.37	1290
NML (Cyg)	12.7:	9.7:	4.31	2.38	6.57	8.86	6.95	1260
NML (Tau)	12.78	9.44	4.00	2.22	4.53	5.66	3.33	1530
χ Cyg	12.42	9.89	3.98	2.08	3.71	4.51	1.95	1630
HC 1	——	9.49	3.75	2.47	5.34	6.12	6.38	1420
T Lyr	10.17	4.65	1.71	0.98	3.30	4.06	3.53	2380

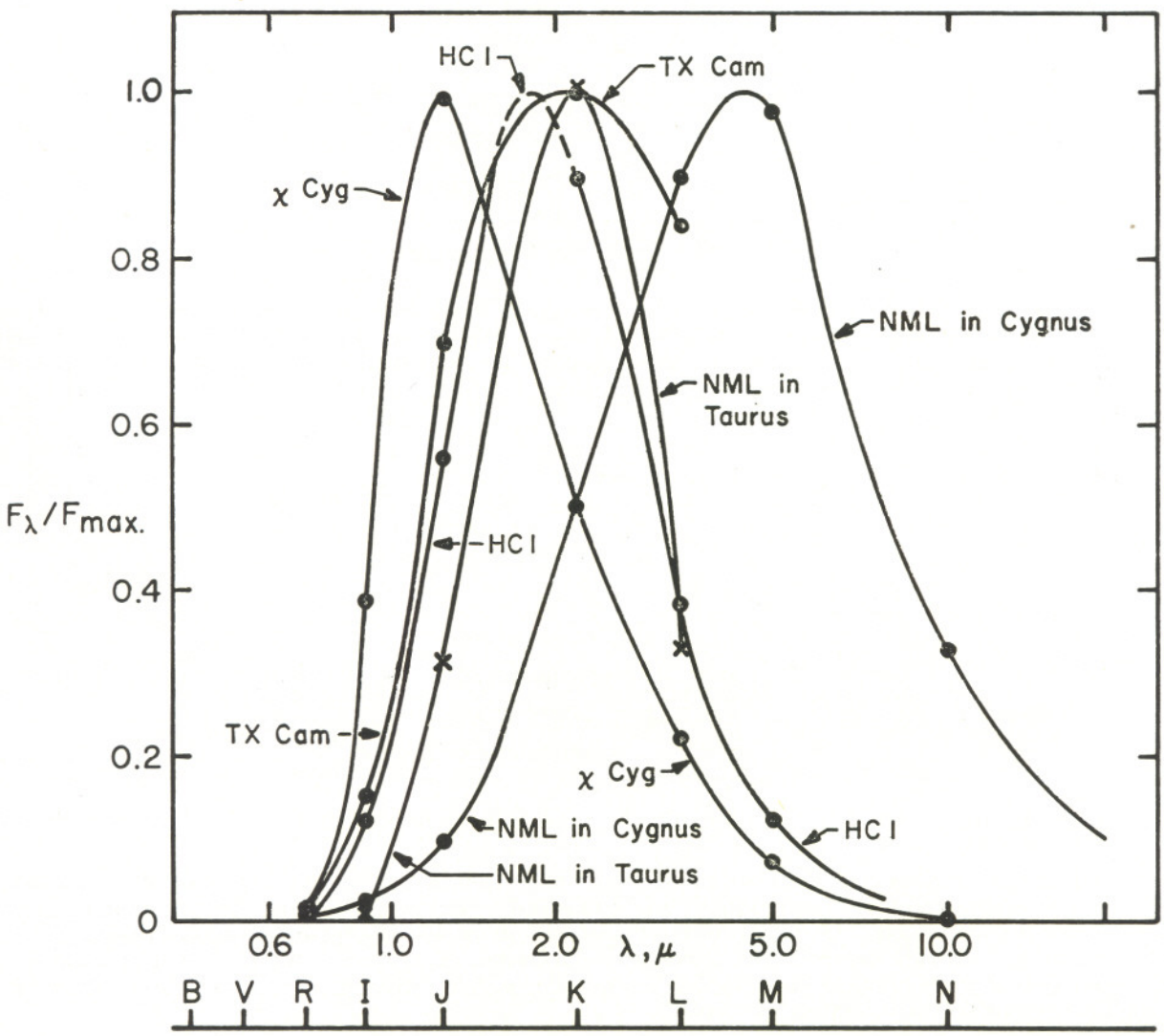

Figure 1.—*The spectral-energy curves for TX Camelopardalis, the Neugebauer-Martz-Leighton Taurus and Cygnus-objects, χ Cygn, and Haro-Chavira object No. 1.*

We have listed in Table 4 the colors of TX Cam with those of a selected group of bright infrared stars. The values of these stars were taken from Mendoza and Johnson (1965) and Johnson, Mendoza and Wisniewski (1965). We also have included in Table 4 provisional values on the NML-object in Taurus. These observations were made on the same nights that TX Cam was observed in R, I, J, K, L. The B and V magnitudes were measured in October 1965 with the 28-inch telescope of The Lunar and Planetary Laboratory, University of Arizona.

The spectral-energy curves for all the objects in Table 4 are shown in Figures 1 and 2. These curves were computed with the aid of the absolute calibration derived by Johnson (1965a) and have been normalized to unity at the maxima. The curves for χ Cyg, HC 1 and the NML-objects in Taurus and in Cygnus are quite similar (see Fig. 1). Quite a different energy distribution is shown by T Lyr (see Fig. 2). This already was noticed by Johnson, Mendoza and Wisniewski. The curve for TX Cam looks different from the rest of curves in Figure 1; however, it is not so different as is the curve for T Lyr (see Fig. 2).

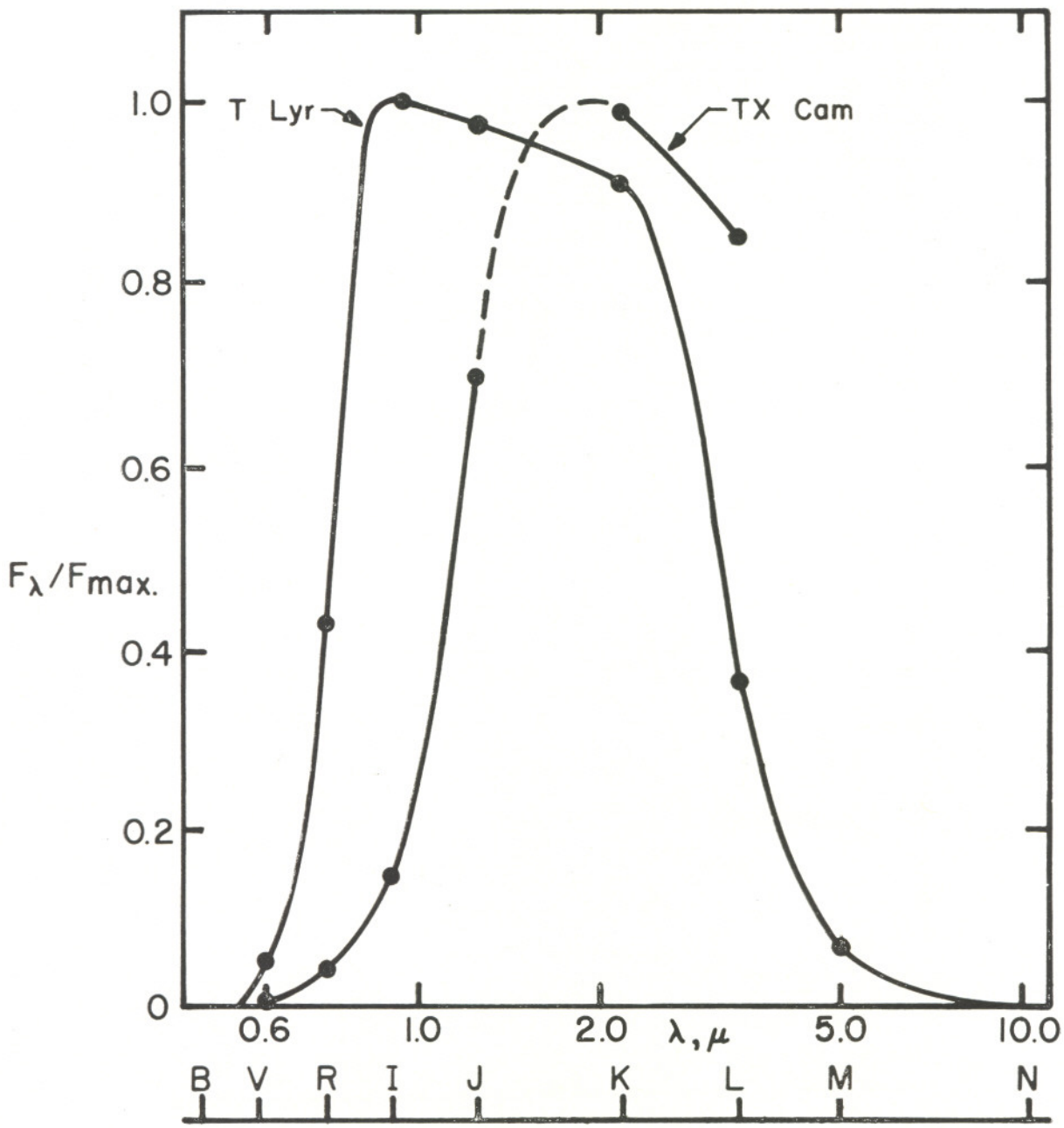

Figure 2.—*The spectral-energy curves for TX camelopardalis and T Lyra.*

Perhaps some of the differences between the stars of Table 4 are partly due to slight differences in their chemical content and partly due to interstellar extinction. We need many more observations on these objects to learn about their nature.

We also have listed in Table 4 the effective temperatures computed with the aid of the calibration derived by Johnson (1964, 1965b). We have not made an attempt to correct these temperatures, either for interstellar extinction, if any, or for any possible corrections to Johnson's calibration toward lower temperatures (see Johnson, Mendoza and Wisniewski). We notice from these values that TX Cam is the second coolest star so far found and that the NML-object in Taurus is hotter than several Haro-Chavira and Hetzler-objects, but cooler than χ Cyg at minimum light.

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