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CALÁN-TOLOLO SURVEY. VIII. ONE HUNDRED SOUTHERN QUASARS

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RESUMEN

Se presenta la octava lista de la Exploración Calán-Tololo. Contiene información acerca de 100 cuasares australes, cuyas magnitudes B están en el intervalo $16.5 \leq B < 20$, con 27 objetos más brillantes que $B = 18$. Los corrimientos al rojo z son tales que 57 objetos cumplen con $1.8 \leq z < 2.4$, 18 objetos tienen z tal que $2.4 \leq z < 3.4$ y 25 cuasares tienen un $z < 1.8$. Estos cuasares fueron encontrados en Cerro Calán explorando placas de prisma objetivo tomadas en el Observatorio Inter-Americano de Cerro Tololo, utilizando la cámara Curtis-Schmidt con el prisma ultravioleta delgado y placas IIIaJ. Se presentan cartas de identificación, coordenadas ecuatoriales, una estimación de la magnitud azul, B, y un corrimiento al rojo preliminar. Todos los cuasares de esta lista han sido confirmados espectroscópicamente, información que será publicada posteriormente (Maza 1996). Sólo diez de los quasares aquí reportados eran conocidos con anterioridad.

ABSTRACT

The eighth list of the Calán-Tololo Survey is presented. It contains information for 100 southern quasars with a B magnitude in the range $16.5 \leq B < 20$; 27 quasars are brighter than $B = 18$. The redshifts z of these quasars are such that for 57 objects $1.8 \leq z < 2.4$, for 18 objects $2.4 \leq z < 3.4$ and for 25 objects $z < 1.8$. These quasars were found at Cerro Calán, searching objective prism plates obtained at Cerro Tololo Inter-American Observatory, using the Curtis-Schmidt telescope, the thin UV prism and IIIaJ plates. Identification charts, equatorial coordinates, an estimated blue magnitude, B, and a preliminary redshift for every object are presented. All quasars in this list have been confirmed using slit spectroscopy. The spectroscopic data shall be presented elsewhere (Maza 1996). Only ten of these quasars were known before.

Key words: **QUASARS – GENERAL**

1. INTRODUCTION

The Calán-Tololo Survey (hereinafter CTS) is an objective prism survey conducted at Cerro Calán (Departamento de Astronomía, Universidad de Chile) in Santiago, using photographic plates obtained at Cerro Tololo Inter-American Observatory (CTIO). We have used the Curtis-Schmidt telescope, IIIaJ plates and the thin UV prism. The CTS is a southern extension to the Tololo Survey (Smith 1975; Smith, Aguirre, & Zemelman 1976) and to the Michigan Survey (MacAlpine, Lewis, & Smith 1977; MacAlpine, Smith, & Lewis 1977a, 1977b; MacAlpine & Lewis 1978; MacAlpine & Williams 1981). The main goal of the CTS is the discovery of new quasars and emission line galaxies. A description of the survey, the procedure used and other details can be found in Maza et al. (1988a,b, 1989, 1991, 1992, 1993, 1994, and 1995a,b).

The Calán-Tololo Survey has discovered and published 400 southern quasars: List No. 5 containing data for 200 quasars (Maza et al. 1993), List No. 6, for 100 objects (Maza et al. 1995a), and List No. 7,

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for 100 quasars (Maza et al. 1995b). The present list contains 100 additional quasars discovered recently by the CTS, fully confirmed by slit spectroscopy at CTIO.

2. OBSERVATIONS

Objective prism photographic plates have been obtained for 266 fields in the southern hemisphere at galactic latitude b such that $|b| \geq 20°$, covering 5150 deg^2.

We have used the Curtis-Schmidt telescope at CTIO equipped with the thin UV prism that yields a reciprocal dispersion of 1740 Å mm^{-1} at Hβ, 1340 Å mm^{-1} at Hγ, and 1100 Å mm^{-1} at λ3727 Å (Blanco 1974). We have used Eastman Kodak IIIaJ plates baked in 2% forming gas and exposed to the sky limit (90 min) with spectra oriented north-south, without trailing. Objects as faint as 19th mag in B are visible at the plate limit. The UV prism spectral resolution at the Curtis-Schmidt plate scale (97″ mm^{-1}) is $\sim$ 30 Å at Hβ and $\sim$ 20 Å at λ3727 Å for a 2″ seeing.

Our selection method for quasar candidates relies on the presence of emission lines in the spectrum. Strong emission lines present in the spectrum of a high redshift quasar (Lα, most of the time) are resolved in our objective prism spectra, allowing a clear separation between quasar candidates and high redshift starburst galaxies. The most favorable case to select a quasar candidate is when Lα lies near λ4000 Å and the C IV line (λ1549 Å) near λ5000 Å, corresponding to a quasar at a redshift $z \sim 2.2$. The lines used for candidate selection in the objective prism plates are: Lα ($\sim$ 75% of the time), C IV and Mg II (λ2798 Å). In a few cases, broad absorption lines quasars (BAL's) have been found because their spectrum looks conspicuous on the objective prism plates; they resemble carbon stars.

3. LIST No. 8

Figure 1 presents identification charts and Table 1 contains the corresponding data for 100 additional quasars found and confirmed in our survey. Quasar candidates were selected from the objective prism plates and they were confirmed using slit spectroscopy at the 4-m Blanco telescope at CTIO. Only ten quasars presented here were known before, according to the sixth edition of the catalogue of quasars by Véron-Cetty & Véron (1993); they are identified in Table 1 by an asterisk after the CT number.

Table 1 contains, for quasars numbered from 601 to 700, a name labeled "Object" obtained from a contraction of the letter designating the strip on the sky, the field number in the strip and the candidate number in that field. For example, object B1401 is the first candidate selected in area "B14" (forteenth field in strip "B") (see Figure 1 in Maza et al. 1989).

Equatorial coordinates (J2000.0) were obtained using the Digitized Sky Survey (DSS), the STSDAS software package and the corresponding tasks in the IRAF working environment at Cerro Calán. A preliminary set of coordinates for each candidate was obtained by overlaying a grid on the objective prism plate. Then a $15' \times 15'$ image was extracted from the DSS. The object was identified in that image and coordinates were obtained using the plate solution in the header of each image. The astrometric accuracy of these coordinates is better than 1 arcsecond.

Column 5 in Table 1 presents a B magnitude estimated from the ESO Quick Blue Chart for every object south of $-15°$. The CCD sequence F342–10 from Stobie, Sagar, & Gilmore (1985) was used for our eye estimates made by every one of us. Then these B magnitudes were compared with the instrumental magnitudes from the DSS, yielding a fit for 94 objects with a scatter of ± 0.39 mag. Using that relationship and the DSS, we estimated B values for objects 659, 660, 661, 663, 664, and 667, which are located north of $-15°$. The B magnitudes presented in Table 1 are the averages of our three estimates. For 68 objects the individual estimates agree within 1 mag from minimum to maximum value. For the remaining 26 objects we went back to the ESO Quick Blue Charts to resolve the discrepancy (always smaller than 1.5 mag). The final values are thought to be good up to ± 0.5 mag. As quasars in Table 1 could present photometric variability it is necessary to emphasize that the magnitudes quoted here correspond to an eye estimate made on direct plates taken at least 15 years ago; those magnitudes do not necessarily correspond to the apparent magnitudes of the quasars in the objective prism plates.

Column 6 in Table 1 presents preliminary values for the redshifts of these quasars. These values were obtained at the telescope when the spectroscopic confirmation of the quasars was made; they should be accurate to ± 0.02. (A comparison between the redshifts quoted here and those listed by Véron-Cetty & Véron (1993) for the ten known quasars produces a fit with an rms of 0.020). The details of the spectrophotometry shall be presented elsewhere (Maza 1996). The final redshift value will be reported there.

Finally the last column of Table 1 presents the ESO Quick Blue chart number where these quasars can be found.

4. STATISTICAL PROPERTIES OF LIST No. 8

In List No. 5 (Maza et al. 1993) a preliminary analysis of the statistical properties of quasars found in the CTS was performed. Figure 2 presents a histogram of the redshifts for these one hundred new quasars. In the lower part of Figure 2, four horizon-

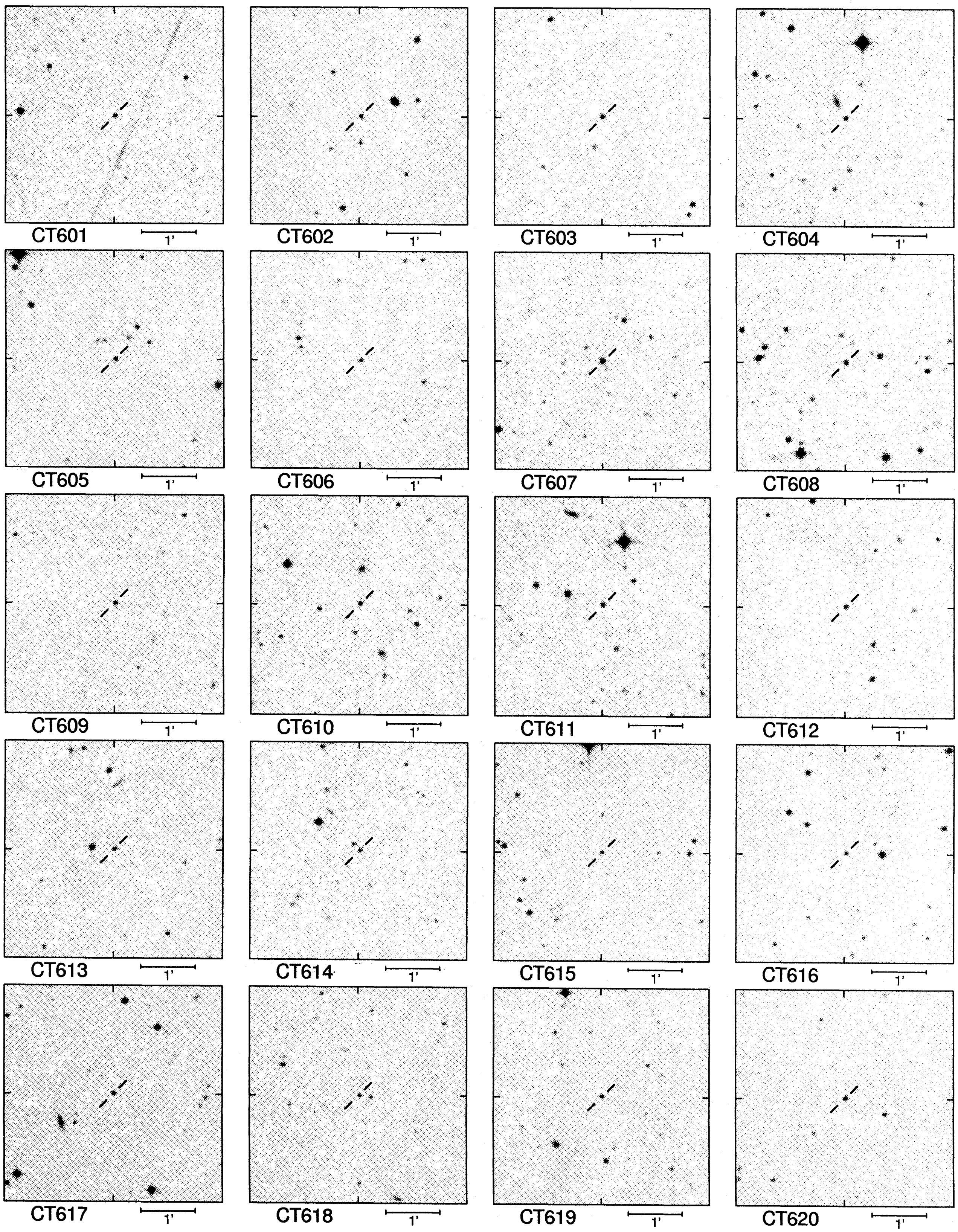

Fig. 1*a*. Objects 601–620. Finding charts for Calán-Tololo quasars from the Digitized Sky Survey. North is to the top and east to the left. Each chart covers $4' \times 4'$.

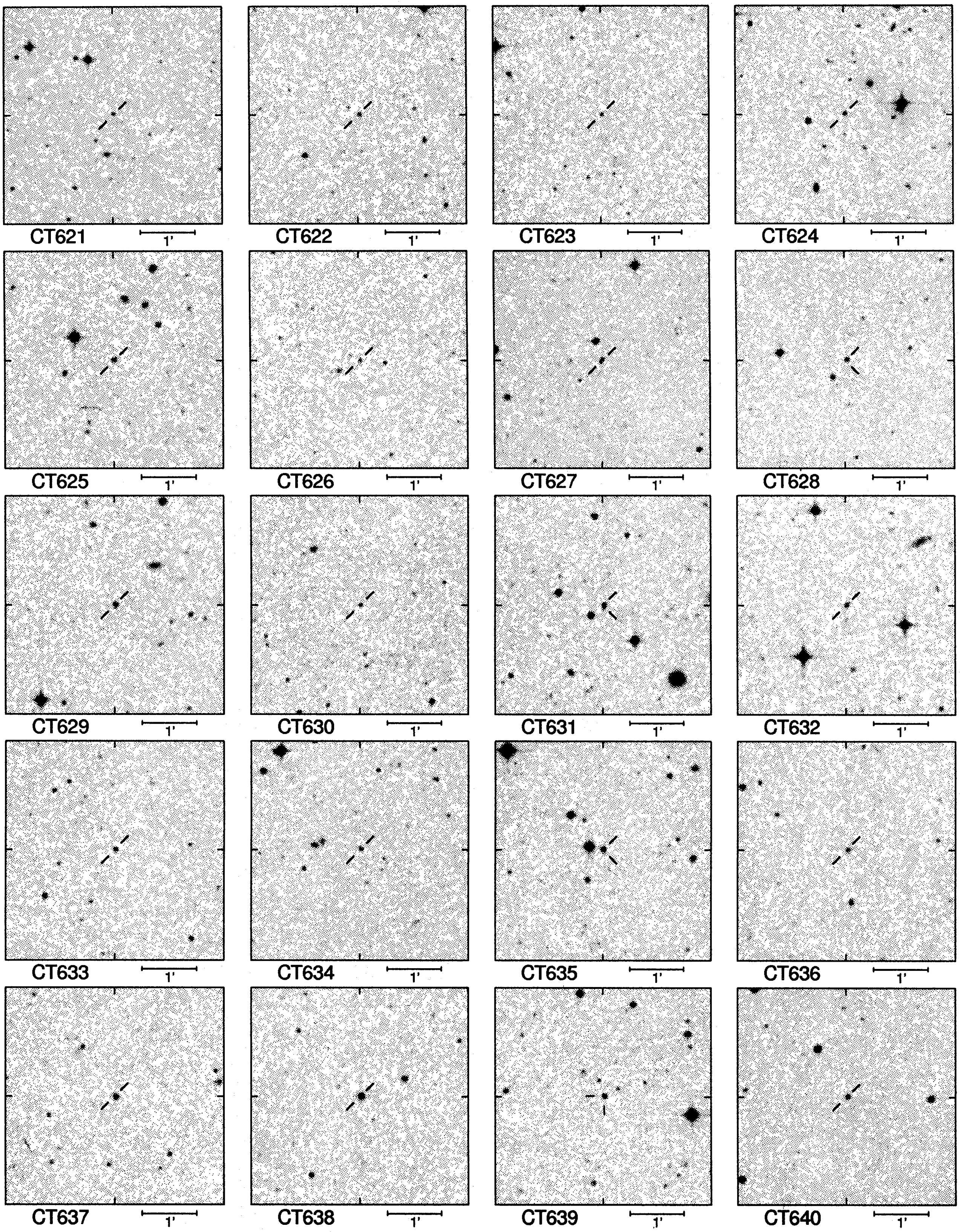

Fig. 1*b*. Same as Figure 1*a* for objects 621–640.

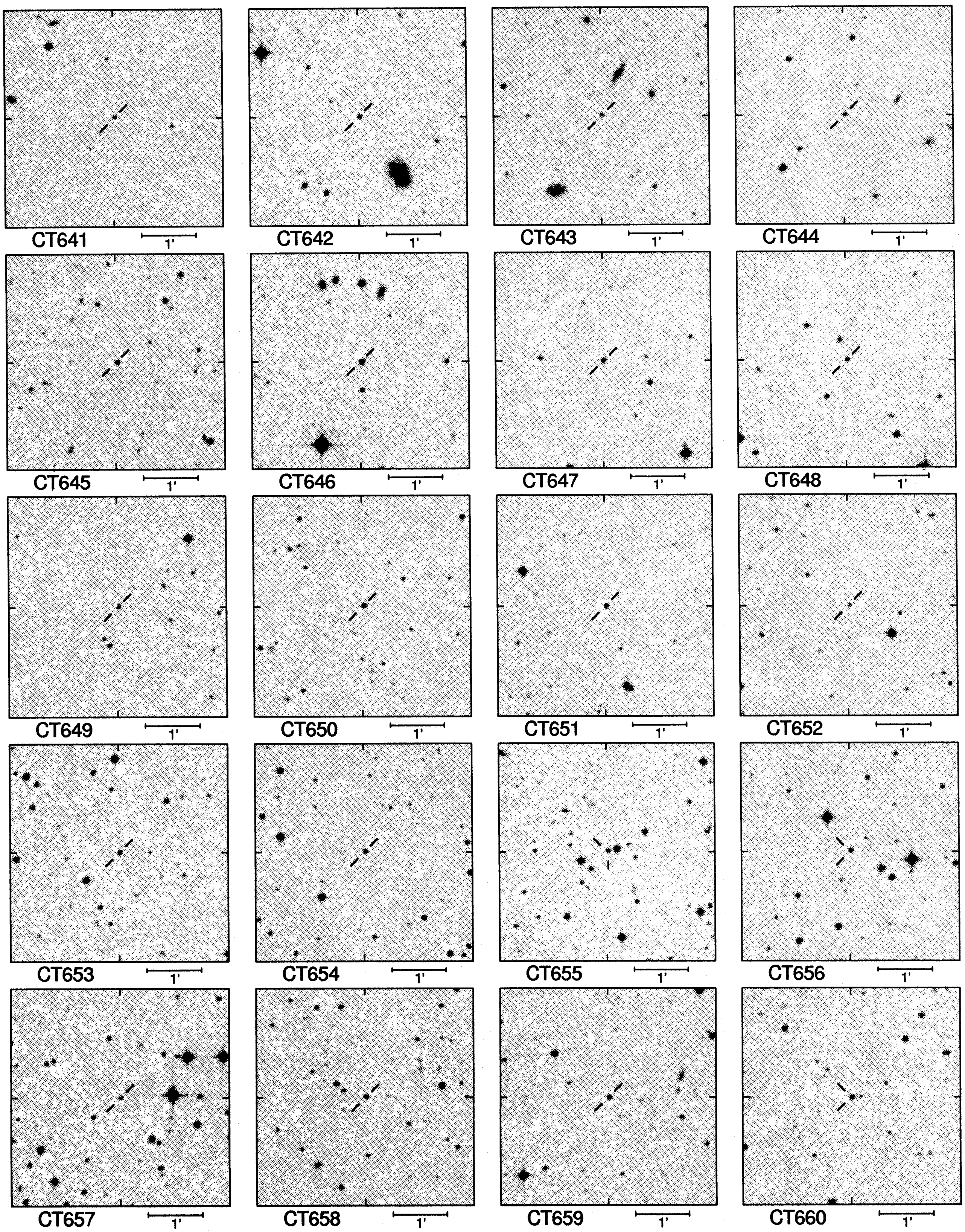

Fig. 1*c*. Same as Figure 1*a* for objects 641–660.

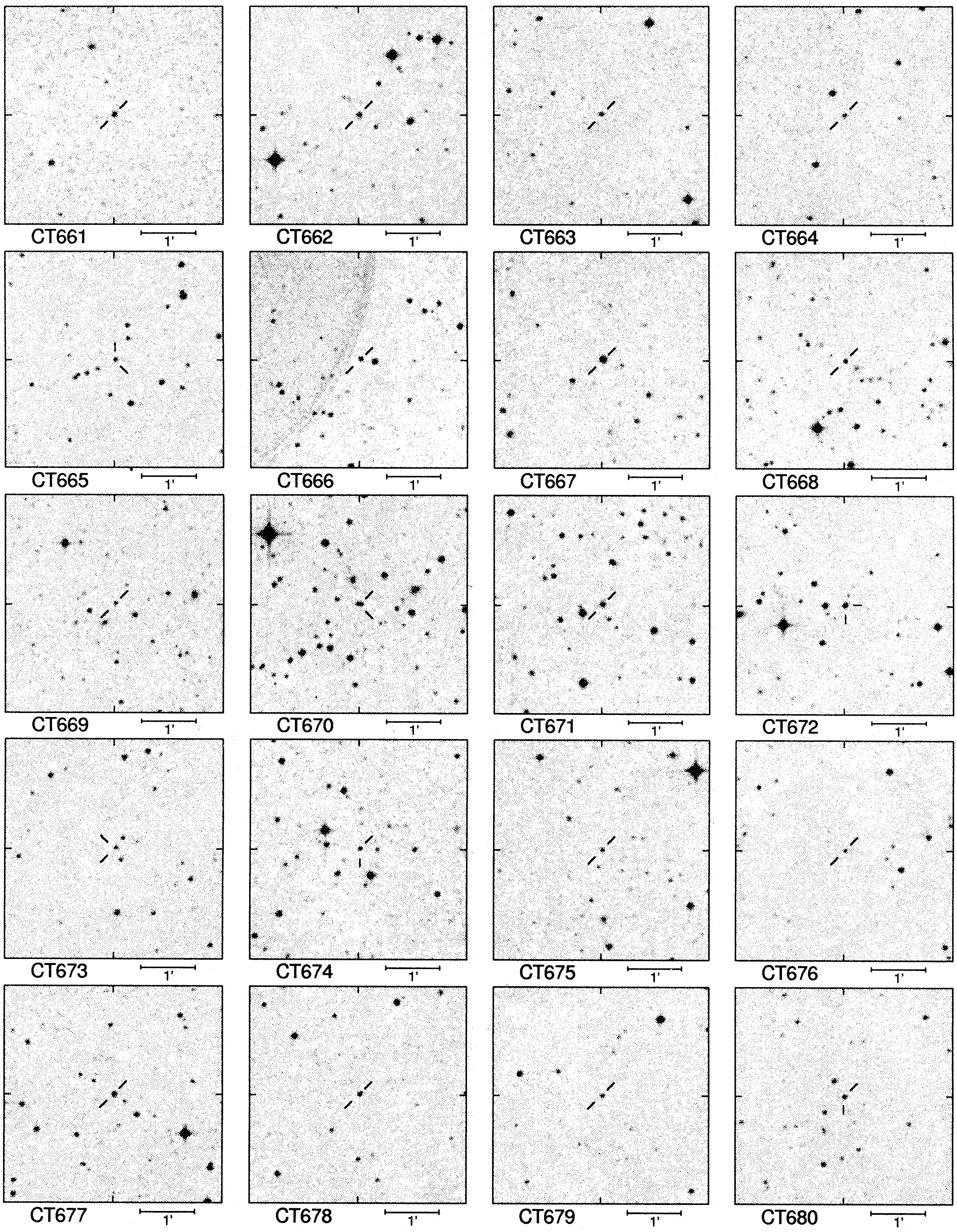

Fig. 1*d*. Same as Figure 1*a* for objects 661–680.

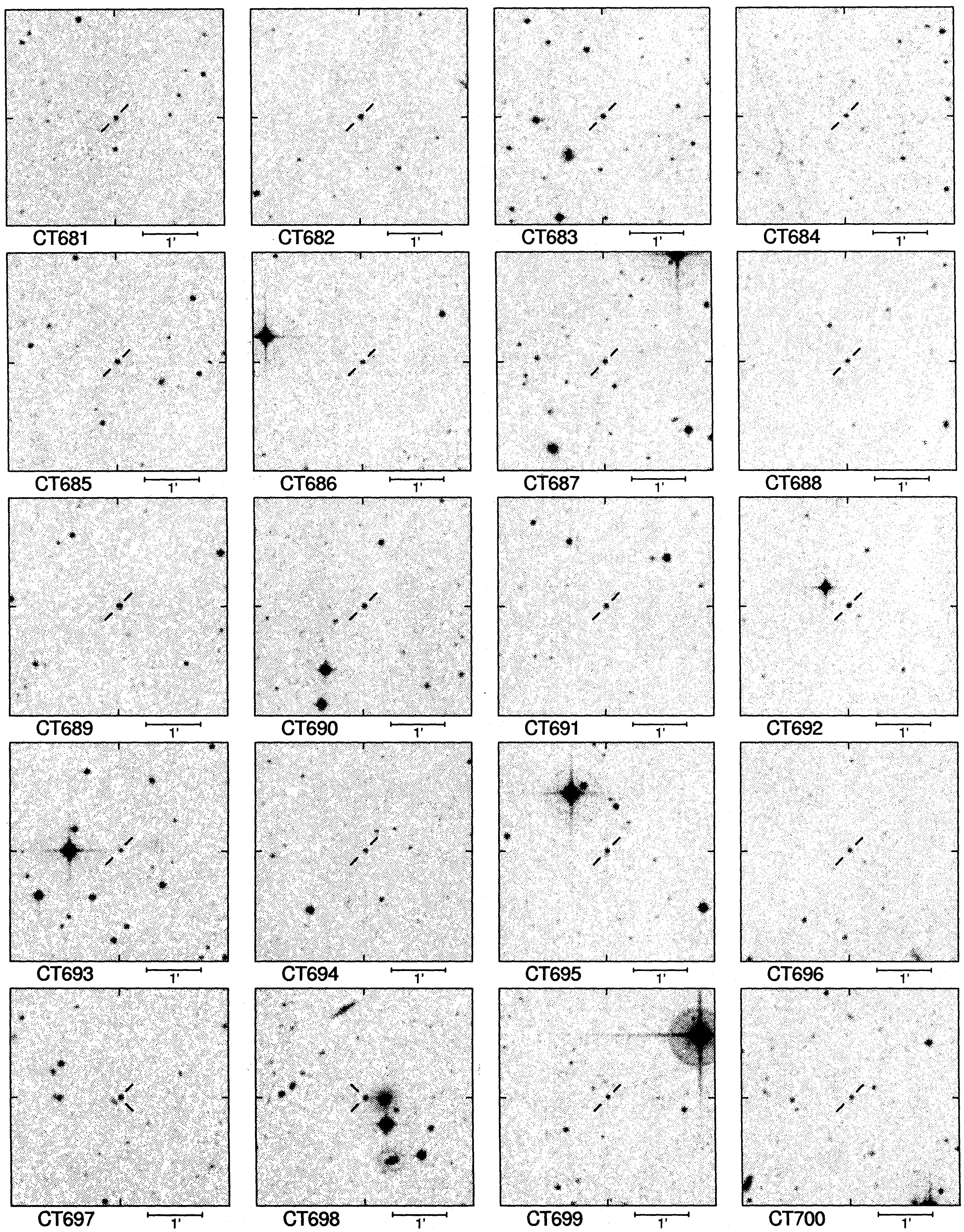

Fig. 1*e*. Same as Figure 1*a* for objects 681–700.

TABLE 1

CALÁN-TOLOLO SURVEY LIST NO. 8: QUASARS

CT#	Object	α (J2000.0) h	m	s	δ °	′	″	B	z	ESO
601	F1312	00	01	27.62	−29	55	13.9	19.2	0.38	409
602	G1702	00	18	09.79	−47	33	10.4	18.4	2.26	194
603	F1419	00	19	24.74	−29	52	56.2	18.2	2.05	410
604	B1401	00	23	13.55	−38	01	23.6	18.4	1.97	294
605	G1709	00	27	46.37	−48	24	31.6	18.5	1.36	194
606	F1402	00	28	32.36	−27	19	16.1	18.4	1.62	410
607	H1908	00	44	59.33	−55	08	09.7	17.3	0.41	150
608	H1909	00	45	37.46	−55	47	27.3	18.3	2.10	150
609*	F1505	00	45	40.56	−31	39	32.2	18.9	2.17	411
610	H1901	00	46	21.90	−52	40	33.8	18.3	2.07	150
611	H1902	00	46	39.65	−52	57	54.7	17.8	2.05	150
612	F1506	00	51	44.61	−30	54	53.3	18.5	2.13	411
613	H1906	01	00	04.66	−53	31	19.0	17.9	2.12	151
614*	F1603	01	03	02.62	−30	49	38.1	18.7	2.64	412
615	H2007	01	03	26.80	−54	33	35.0	19.0	2.17	151
616	H1917	01	08	06.75	−56	36	25.1	18.9	2.01	151
617	H2011	01	10	32.14	−55	54	24.1	17.9	1.91	151
618	H2016	01	16	52.40	−54	53	54.2	19.0	2.66	151
619	H2010	01	22	38.94	−55	08	12.5	18.5	2.00	151
620	H2002	01	27	44.63	−52	48	03.9	17.8	1.87	152
621*	H2019	01	28	22.12	−56	01	34.1	19.3	2.19	152
622	G2101	01	29	16.43	−48	32	02.9	19.9	3.16	196
623	G2102	01	32	57.90	−48	22	27.7	19.5	1.45	196
624	F1901	02	03	01.80	−28	13	17.8	18.5	2.32	414
625	A2140	02	08	30.91	−37	22	17.6	17.8	2.55	354
626	C2212	02	14	13.91	−46	11	59.4	19.5	2.81	246
627	F2007	02	16	26.07	−30	52	30.7	19.1	2.27	415
628	F2003	02	19	38.35	−29	13	31.7	18.3	2.81	415
629	H2302	02	24	51.02	−52	35	48.3	17.8	1.85	153
630	F2121	02	36	42.69	−28	10	14.7	19.1	2.11	416
631	F2104	02	45	11.77	−27	53	08.1	17.3	0.70	416
632*	F2109	02	45	49.05	−28	57	50.4	18.2	2.16	416
633	H2406	02	56	45.24	−52	25	26.5	18.7	2.15	154
634	H2407	02	57	45.10	−53	30	25.9	18.8	2.09	154
635	F2204	03	02	11.32	−31	40	30.8	17.7	2.37	417
636	A2415	03	05	50.39	−36	01	50.1	18.5	2.35	357
637	F2202	03	09	38.67	−29	45	53.2	17.5	2.13	417
638*	A2510	03	18	06.51	−34	26	37.1	16.6	0.26	357
639	C2608	03	22	28.53	−46	53	01.9	18.2	1.21	248
640*	A2516	03	23	37.96	−33	34	23.7	17.7	1.97	357
641	H2622	03	29	56.03	−53	24	15.7	18.4	1.59	155
642	G2606	03	33	37.70	−48	55	59.0	18.2	1.96	200
643	H2704	03	36	25.51	−52	27	56.7	18.8	2.23	156
644	F2411	03	39	26.73	−30	34	38.8	18.5	2.17	418
645	A2606	03	40	51.69	−34	28	10.9	18.2	2.30	358

TABLE 1 (CONTINUED)

CT#	Object	α (J2000.0) h	m	s	δ °	′	″	B	z	ESO
646	H2705	03	46	32.97	−55	20	26.3	17.6	2.12	156
647	G2801	03	58	27.54	−47	38	38.0	18.5	2.55	201
648	G3008	04	39	06.97	−50	47	40.1	18.8	2.94	202
649	A2924	04	42	22.91	−35	37	54.0	18.6	2.31	361
650*	C3103	04	55	22.98	−42	16	17.1	17.4	2.66	304
651	C3102	05	01	41.66	−43	55	24.2	18.4	2.17	252
652	A3206	05	40	51.50	−36	16	55.0	19.5	2.18	363
653	G3401	05	53	02.83	−47	44	56.7	18.7	2.03	205
654	C3414	05	57	15.30	−47	17	23.1	17.5	2.13	254
655	C3413	05	57	55.48	−46	47	26.1	18.2	1.03	254
656	G3410	06	00	08.07	−50	40	36.8	18.2	3.13	205
657	G3404	06	04	16.08	−48	59	04.2	19.5	3.13	205
658	G3510	06	27	45.03	−49	50	26.4	18.4	2.19	206
659	R0226	09	48	51.07	−13	47	19.7	18.0	0.26	...
660	R0317	10	02	07.12	−13	21	08.7	18.3	1.05	...
661	R0413	10	17	55.11	−14	09	37.0	17.6	0.26	...
662	K0006	10	36	37.13	−31	21	21.6	17.7	2.02	437
663	R0640	10	55	18.65	−16	23	39.3	18.3	2.11	...
664	R0642	10	56	16.14	−14	01	12.6	18.6	2.10	...
665	K0303	11	31	33.04	−28	23	13.3	18.7	2.13	439
666	K0308	11	31	51.07	−29	18	14.9	18.2	2.65	439
667*	R0805	11	39	10.72	−13	50	43.1	16.7	0.56	...
668	C0515	20	15	04.21	−45	20	35.7	18.3	2.14	284
669	A0515	20	34	26.30	−35	37	27.9	19.2	3.22	400
670	B0306w	20	36	50.28	−38	33	46.2	18.9	2.28	340
671	B0403	20	48	52.93	−37	34	50.7	17.2	1.87	341
672	G0756	20	59	33.05	−51	36	00.2	16.9	0.32	235
673	F0408	21	09	40.21	−32	55	41.6	18.7	2.83	402
674	B0510	21	18	44.57	−40	58	27.0	18.7	2.25	342
675	G0951	21	29	01.99	−51	01	36.1	18.2	1.56	236
676	B0612	21	37	06.09	−39	28	32.4	18.7	2.18	343
677	G0928	21	44	40.72	−49	21	23.2	16.9	1.44	236
678	A1140	22	43	23.67	−36	38	29.1	18.6	2.14	406
679*	B1002	22	50	47.22	−39	24	27.7	18.7	2.63	346
680	B1025	22	55	35.20	−40	36	28.1	18.0	1.52	346
681	H1303	23	06	45.52	−53	51	24.3	18.0	0.32	191
682*	B1005	23	07	17.18	−42	03	19.4	17.7	2.63	346
683	H1407	23	08	09.70	−53	50	10.3	17.2	1.84	191
684	H1413	23	11	30.37	−55	48	31.4	18.4	1.48	191
685	H1410	23	12	32.46	−55	03	49.7	17.5	1.63	191
686	F1203	23	36	38.97	−29	20	52.0	18.5	1.28	470
687	G1501	23	40	15.73	−47	26	36.1	17.6	1.96	240
688	F1206	23	42	13.33	−31	10	30.0	18.8	1.61	471
689	F1207	23	42	36.50	−30	49	08.7	17.3	0.37	471
690	F1211	23	45	10.36	−29	31	54.7	18.3	2.36	471
691	F1208	23	45	27.53	−31	18	42.1	18.5	2.06	471
692	B1207	23	47	20.03	−41	44	06.6	17.5	2.06	348

TABLE 1 (CONTINUED)

CT#	Object	α h	m	s	(J2000.0) δ °	′	″	B	z	ESO
693	F1303	23	53	11.50	−27	43	25.8	18.7	0.89	471
694	F1301	23	53	19.36	−27	12	12.3	18.5	2.30	471
695	F1302	23	53	45.74	−27	34	52.0	18.2	1.94	471
696	F1324	23	54	19.64	−30	17	45.5	19.5	3.18	471
697	F1311	23	54	43.57	−29	38	52.6	18.6	2.35	471
698	C1523	23	55	08.67	−45	46	55.9	18.8	2.32	292
699	F1309	23	59	09.73	−28	40	15.1	19.2	2.24	471
700	F1318	23	59	46.54	−31	48	28.2	19.0	2.50	471

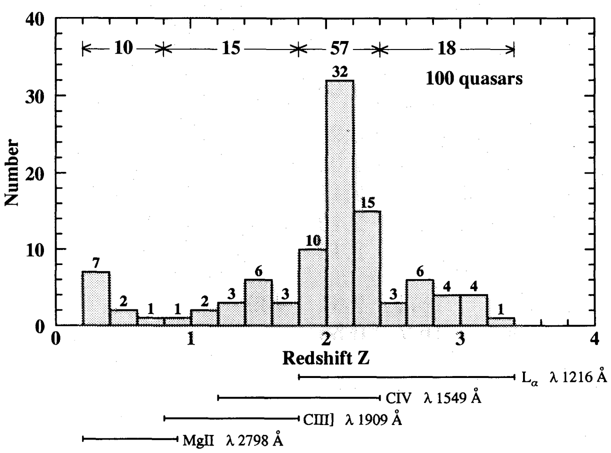

Fig. 2. Histogram of the redshift distribution of Calán-Tololo quasars contained in List No. 8. Horizontal lines at the bottom indicate the redshift range where the most prominent emission lines in quasars are found in our objective prism spectra.

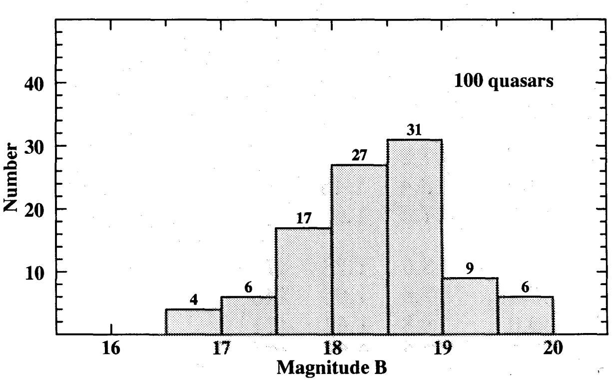

Fig. 3. Histogram of the B magnitude distribution of the Calán-Tololo quasars in List No. 8. Twenty seven objects have $B < 18$ and forty six have $B > 18.5$.

tal lines show the redshift interval of visibility in our objective prism spectra for the most prominent emission lines present in quasars; these lines are labeled to the right of the horizontal lines.

In the upper part of Figure 2 the redshift range has been divided in four intervals containing 10, 15, 57, and 18 objects respectively. If we subdivide in the same way the quasars presented in lists No. 5, 6, and 7 (Maza et al. 1994, 1995a,b) we obtain 23, 60, 214, and 103 for a total of 400 objects (or 5.8%, 15%, 53.5%, and 25.8%, respectively).

Figure 3 presents the histogram of the B magnitudes. A total of 75 quasars have a B mag in the interval (17.5, 19.0). A comparison between Figure 3 and those in List No. 5, List No. 6, and List No. 7 reveals that this new group of quasars has the same photometric properties than the first four hundred quasars. A description of the statistical properties of the 500 CTS quasars is in preparation (Maza 1996).

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