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LINE INTENSITIES IN THE SPECTRA OF REPRESENTATIVE STARS OF SPECTRAL TYPES B TO G

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ABSTRACT.—The equivalent widths of features in the spectra of twelve representative stars have been measured. The features comprise most atomic absorption lines, a few molecular lines and a few close blends in the wave-length region 3900A. to 4520A. The results are based primarily on 110 spectrograms obtained at the Dominion Astrophysical Observatory, and 22 spectrograms obtained at the Mount Wilson and Palomar Observatories. The numbers of lines measured in the spectra of stars of the various spectral classes are as follows: 173 in the spectra of the B-type stars ρ *Leonis*, γ *Pegasi* and ι *Herculis*; 511 in the spectra of the A-type stars γ *Geminorum*, θ *Leonis*, 68 *Tauri* and 15 *Vulpeculae;* 552 in the spectra of the F-type stars σ *Bootis*, α *Canis Minoris* and 110 *Herculis* and 361 in the spectra of the G-type stars γ *Serpentis* and μ *Herculis.*

Intensity tracings were made from all of the spectrograms. Because several different spectrographs were used at Victoria, two methods of measuring the tracings had to be used. One method, applied to most of the tracings, was to select suitable lines on the tracings to make up a set of standard profiles. The intensities of these standard lines were measured, and those of other lines were estimated by interpolation. Strong lines were measured directly with a planimeter. Tracings made from plates exposed through the Victoria three-prism spectrograph were treated differently. Profiles of weak lines were assumed to be triangular in shape. Corrections were applied to the areas deduced from these triangular profiles to make them agree with those corresponding to the observed Gaussian profiles. Tracings made from the Mount Wilson and Palomar spectrograms were also treated in this way. The results obtained from each spectrograph have been tabulated separately, but the mean intensity of each line in each stellar spectrum is also given. Available published data from high-dispersion spectrograms have usually been included in the adopted mean equivalent widths.

Comparisons have been made between the results obtained with the various spectrographs, and also with the results of other observers. From the available spectrograms it is found that the Victoria spectrographs all yield equivalent widths which differ from the mean value by an average of 5 per cent or less. A similar result was found from the Mount Wilson spectrograms. However the Victoria measures of equivalent width are usually higher, and the Mount Wilson measures usually lower, than the mean value. Differences of 25 per cent or more from the mean intensity are found, especially for weak lines, in intensities derived from spectrograms of dispersion 30 A/mm or lower.

The profiles of the Hγ line are presented in diagrams.

The equivalent widths adopted here, especially those of moderately strong, unblended lines in the spectra of A and F stars, and the Hγ profiles could be used for the comparison of intensities measured at different observatories. It seems highly desirable that all observatories should employ comparable scales of intensities, since studies of atomic abundances in stars largely depend on measurements of equivalent widths.

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RÉSUMÉ.—Les auteurs ont mesuré la largeur équivalente des raies dans les spectres de douze étoiles représentatives. On y trouve la majorité des raies d'absorption atomique, quelques raies moléculaires et quelques groupes serrés dans la région des longueurs d'onde de 3900A. à 4520A. Les auteurs ont tiré leurs résultats d'abord de 110 spectrogrammes obtenus à l'Observatoire d'astrophysique de Victoria et de 22 autres provenant des observatoires de Mont Wilson et Palomar. Voici le nombre des raies qu'ils ont mesurées dans le spectre des étoiles de différentes classes spectrales: classe B (ρ *Leonis*, γ *Pegasi* et ι *Herculis*) 173; classe A (γ *Geminorum*, θ *Leonis*, 68 *Tauri* et 15 *Vulpeculae*) 511; classe F (σ *Bootis*, α *Canis Minoris* et 110 *Herculis*) 552; classe G (λ *Serpentis* et μ *Herculis*) 361.

On a obtenu des diagrammes photométriques de tous les spectrogrammes. Parce que l'on a utilisé plusieurs spectrographes différents à Victoria on a dû employer deux méthodes pour mesurer les diagrammes. L'une, qui a servi presque partout, consistait à choisir des raies convenables dans les diagrammes pour en faire une série de profils-étalons. On a calculé l'intensité de ces étalons et celle des autres raies a été établie par interpolation. On a mesuré les raies fortes directement à l'aide d'un planimètre. On a traité de façon différente les diagrammes tirés des plaques obtenues au spectrographe à trois prismes de Victoria. On a supposé que les profils des raies faibles étaient de forme triangulaire. Il a fallu apporter des corrections aux aires déduites de ces profils triangulaires pour qu'elles soient conformes aux aires correspondantes tirées des profils Gaussiens observés. On a aussi traité de cette façon les diagrammes obtenues de spectrogrammes des Monts Wilson et Palomar. Les résultats concernant chaque spectrographe ont été établis séparément, mais on donne aussi l'intensité moyenne de chaque ligne pour chacun des spectres stellaires. On a aussi de façon générale tenu compte dans les largeurs équivalentes moyennes admises des données déjà publiées et obtenues de spectrogrammes à forte dispersion.

On a comparé entre eux les résultats obtenus aux différents spectrographes et on les a aussi comparés aux résultats obtenus par d'autres observateurs. Les spectrogrammes disponibles ont montré que les spectrographes de Victoria donnent tous des largeurs équivalentes qui diffèrent de la valeur moyenne jusqu'à 5 p. 100. Les spectrogrammes du Mont Wilson donnent des résultats semblables. Par contre les mesures des largeurs équivalentes de Victoria sont habituellement plus élevées, et celles du Mont Wilson, inférieures à la valeur moyenne. On a trouvé des différences d'intensité de 25 p. 100 ou plus par rapport à la valeur moyenne, surtout dans le cas des raies faibles, sur des spectrogrammes d'une dispersion de 30 A/mm, ou moins.

Les profils de la raie Hγ sont présentés sous forme de diagrammes.

Les largeurs équivalentes acceptées ici, surtout celles des raies non fondues et moyennement intenses dans le spectre des étoiles des classes A et F, et les profiles de la raie Hγ pourraient être utilisés pour comparer les intensités mesurées aux différents observatoires. Il serait souhaitable que tous les observatoires utilisent des échelles d'intensité semblables, puisque l'étude de l'abondance atomique dans les étoiles dépend pour la plupart de la mesure des largeurs équivalentes.

I. INTRODUCTION

Many years ago it was realized that the quantitative analysis of stellar spectra would yield important clues concerning the composition of stars in our galaxy and, eventually, even beyond. In recent years this fact has become even more evident and it has become important for studies of stellar evolution that detailed analyses of many stellar spectra be made, and that the results be as accurate as possible in order to detect small, as well as large, differences in stellar composition and structure.

Spectrophotometry, as applied to the quantitative measurement of line intensities in stellar spectra, has not yet become an exact technique and to many people it may appear as much an art as a science. In spite of the efforts of the pioneers in the technique and the standardization of procedures, it has been difficult to obtain an accuracy better than a few per cent for equivalent-width measurements using photographic methods; for references see Wright (1948, 1962b). Attempts have been made recently, by Oke and Greenstein (1961) to make photoelectric scans with high spectral resolution at the coudé spectrograph of the Mount Wilson 100-inch telescope and these have met with considerable success, although only about 75 angstroms can be scanned with one setting of the grating.

It seems probable, as Dunham (1956) has noted, that the photographic plate will be the most satisfactory medium for studying extensive wave-length regions in stellar spectra for some time to come. It is very important, however, that spectral scans be made in order to check the photographic results since most of the reduction procedures are bypassed when the spectral line profiles are recorded directly at the spectrograph.

There seemed to be a need to set up a system of line-intensity standards for stellar spectra, somewhat similar to the list of stars used for radial-velocity standards, in order that the observatories engaged in intensity measurements might be able to compare and correlate their results. A sub-commission of Commission 36 (Spectrophotometry) of the International Astronomical Union was organized at the Seventh General Assembly in Zurich in 1948 and interim reports have been presented at succeeding assemblies (Wright, 1954b, 1957, 1960, 1962). The present compilation contains mainly new data for line intensities in the spectra of selected stars but some older data have been included in the adopted mean intensities and these mean intensities are considered the best available to the authors at the present time. The results will undoubtedly be much improved as better techniques are evolved. Most of the data are based on spectrograms obtained at the Dominion Astrophysical Observatory and therefore the system is biased heavily in favour of the procedures and techniques practised there. In order to obtain additional comparisons, J. L. Greenstein invited K. O. Wright to spend six weeks in the spring of 1962 as a Research Associate of the Mount Wilson and Palomar Observatories to make tracings and measurements on spectrograms available there. Most of the Mount Wilson and Palomar data presented here are the result of that visit.

II. THE OBSERVATIONS

The selection of stars whose spectra were to be used as line-intensity standards was made initially (Wright, 1954b) to include main-sequence stars of types B to G, bright enough to be observed at high dispersion with large telescopes and which are within about thirty degrees of the equator, in order that they might be observed from both northern and southern hemispheres. Some of the stars were chosen because observations were being obtained at the Mount Wilson and Palomar Observatories. The spectra of all of the stars have fairly sharp lines. There are more stars of spectral types A and F in this list because it was considered that one of the principal problems was the determination of the continuum, which is somewhat more readily defined in these types. The continua of B-type spectra are usually well defined, but many of the strong helium lines in the spectra are blends and it is difficult to draw their profiles. Since most of the other lines are weak, any comparisons must rest on relatively few lines.

Although the primary purpose of this investigation was to obtain comparisons of equivalent widths of lines in the spectra of the selected stars at different observatories, it also seemed desirable to compare results obtained with different instruments at one institution. Therefore several series of spectrograms have been obtained at the Dominion Astrophysical Observatory; in the past, differences in measured equivalent widths have sometimes been related to the dispersion employed. Since the most definitive results for abundance calculations will undoubtedly be obtained from high-dispersion spectrograms,

TABLE 1. OBSERVATIONS OF STELLAR SPECTRA OBTAINED FOR LINE-INTENSITY STANDARDS

Plate No.	Date U.T.	Region	Instrument	Dispersion	Emulsion	Exposure	Remarks
		λλ		A/mm.		min.	
	H.D. 91316	ρ LEONIS	B1 Ib	$10^h27^m.5$	+ 9°49′	$3^m.85$	
39615	1949 Mar 11.354	4061–4520	IIILA	7.5	Cr HS	142	
39650	Apr 12.275	4123–4520			Cr HS	180	
40829	1950 Apr 7.323	4042–4520			Cr HS	162	
40844	Apr 14.245	4003–4520			Cr HS	166	
40870	Apr 29.238	4001–4488			Cr HS	150	
44566	1953 Feb 15.370	3907–3960;3994–4084	BL84	4.6	Cr HS	140	
567		4224–4495			Cr HS	140	
44725	1953 Mar 20.331	3900–3957;3992–4095			Cr HS	124	
726		4220–4495			Cr HS	124	
53339	1959 Mar 13.338	3907–3960;3995–4073	BL169	3.4	IIa O	106	
340		4218–4477			IIa O	106	
53406	Mar 29.335	3905–3962;4002–4083			IIa O	180	
407		4215–4477			IIa O	180	
53437	Apr 3.276	4192–4480			IIa O	68	
53452	Apr 6.338	3907–3957;4002–4078			IIa O	128	
453		4225–4282			IIa O	128	
54857	Dec 4.502	3901–3960;4001–4086			IIa O	46	
858	Dec 4.500	4216–4486			IIa O	40	
55004	1960 Feb 19.346	3900–3960;3990–4085	BL496	3.4	IIa O	106	
005		4180–4485			IIa O	106	
55006	Feb 19.407	3900–3960;3990–4082			IIa O	68	Clouds at end
007		4232–4483			IIa O	68	Clouds at end
55051	Feb 28.372	3900–3960;3990–4084			IIa O	110	
052		4180–4484			IIa O	110	
7927	1952 Apr 16.322	3911–4190;4227–4490	Ce	2.9	IIa O	30	
7928	Apr 16.365	3911–4190;4227–4490			IIa O	22	

	H.D. 886	γ PEGASI	B2 IV	$0^h08^m.1$	+ 14°38′	$2^m.87$	
46832	1954 Aug 28.319	4000–4490	IIILA	7.5	Cr HS	60	
46833	Aug 28.365	4000–4492			Cr HS	60	
42689	1951 Sept 24.443	3902–3959;3995–4084	BL84	4.6	Cr HS	140	
690		4247–4534			Cr HS	140	
42877	Nov 16.304	3906–3958;3994–4085			Cr HS	150	Dense
878		4202–4535			Cr HS	150	
42908	Nov 23.278	3903–3957;3989–4083			Cr HS	80	
909		4198–4533			Cr HS	80	
52639	1958 Oct 26.314	3910–4101	BL169	3.4	IIa O	152	Clouds
52931	Dec 12.104	3910–4077			III O	128	
52933	Dec 12.193	3909–4079			III O	127	
934	Dec 12.204	4162–4483			III O	160	
54947	1960 Jan 22.122	3907–4075	BL496	3.4	IIa O	74	
948	Jan 22.134	4143–4483			IIa O	110	
8919a	1953 Oct 21.222	3900–4190;4220–4520	Ce	2.9	IIa O	30	
8919b	Oct 21.244	3900–4189;4222–4488			IIa O	31	

	H.D. 160762	ι HERCULIS	B3 V	$17^h36^m.6$	+ 46°04′	$3^m.79$	
42098	1951 May 18.390	4000–4500	IIILA	7.5	Cr HS	178	
42291	July 22.328	4000–4500			Cr HS	124	
46054	1954 May 15.333	3901–3966;3997–4112	BL169	3.4	Cr HS	100	
055		4185–4460			Cr HS	100	
46114	June 9.365	3899–3966;3996–4095			Cr HS	61	
115		4168–4461			Cr HS	61	
46138	June 23.354	3901–3965;3992–4084			Cr HS	40	
139		4168–4452			Cr HS	40	
78	1962 June 11.292	3900–4490	9643	3.3	IIa O	84	
81	June 12.258	3900–4490			IIa O	94	
127	July 3.344	3900–4490			IIa O	62	

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TABLE 1. OBSERVATIONS OF STELLAR SPECTRA OBTAINED FOR LINE-INTENSITY STANDARDS (Continued)

Plate No.	Date U.T.	Region	Instrument	Dispersion	Emulsion	Exposure	Remarks
		λλ		A/mm.		min.	
		γ GEMINORUM	A0 IV	$6^h31^m.9$	+ 16°29′	1.93	
53434	1959 Apr 3.168	3922–3946;4009–4082	BL169	3.4	IIa O	90	
435		4167–4496			IIa O	90	
53446	Apr 6.157	3912–3951;3995–4083			IIa O	42	
447		4167–4496			IIa O	42	
53448	Apr 6.186	3928–3947;3995–4082			IIa O	34	
449		4160–4490			IIa O	34	
	H.D. 97633	θ LEONIS	A0 V	11^h09^m0	+ 15°59′	3^m41	
42074	1951 May 4.215	4000–4483	$IIIL_A$	7.5	Cr HS	100	Weak below 4100A.
42097	May 18.262	4020–4495			Cr HS	170	Weak below 4100A. Clouds.
46052	1954 May 15.236	3910–3949;3996–4082	BL169	3.4	Cr HS	90	
053		4197–4459			Cr HS	90	
47392	1955 Jan 28.417	3910–3950;3996–4083			IIa O	149	
393		4180–4449			IIa O	149	
47501	Mar 18.369	3910–3946;3992–4080			IIa O	197	Clouds.
502		4158–4494			IIa O	197	Clouds.
48507	1956 Jan 27.494	3908–3948;3991–4083			IIa O	43	
508		4166–4452			IIa O	43	
48599	Feb 27.396	3910–3947;3993–4081			IIa O	80	
600		4180–4462			IIa O	80	
48661	Mar 16.315	3911–3947;3992–4082			IIa O	26	
662		4170–4461			IIa O	26	
4394	1959 Mar 2.299	3900–4516	Pb	4.5	IIa O	10	Clouds.
4395	Mar 2.347	3901–4520			IIa O	22	
4396	Mar 2.374	3895–4503			IIa O	43	Clouds.

	H.D. 27962	68 TAURI	A2 V	$4^h19^m.7$ + 17°42′		$4^m.24$	
47223	1954 Oct 29.461	3992–4312	BL169	3.4	IIa O, Bkd	140	BL169a
224		4383–4525			IIa O, Bkd	140	
47300	Nov 28.391	3995–4308			IIa O, Bkd	324	Clouds at end.
301		4385–4525			IIa O, Bkd	324	Clouds at end.
49766	1956 Oct 8.391	4161–4484	BL169	3.4	IIa O, Bkd	91	BL169b
49857	Nov 16.310	3911–3955;3995–4081			IIa O, Bkd	126	
858		4163–4495			IIa O, Bkd	126	
50121	1957 Jan 18.160	3908–3947;3995–4081			IIa O, Bkd	124	
122		4184–4517			IIa O, Bkd	124	
50223	Jan 25.175	3911–3947;3996–4081			IIa O, Bkd	120	
224		4180–4517			IIa O, Bkd	120	
52562	1958 Oct 17.435	3909–3947;3995–4078			IIa O	202	
563		4171–4455			IIa O	202	
54904	1959 Dec 21.312	3909–3948;3995–4080	BL496	3.4	IIa O	228	
905		4187–4485			IIa O	228	
54949	1960 Jan 22.242	3909–3948;3995–4074			IIa O, Bkd	192	Clouds.
950		4147–4478			IIa O, Bkd	192	Clouds.
54975	Feb 8.133	3903–3948;3995–4075			IIa O, Bkd	110	
976		4178–4490			IIa O, Bkd	110	
55000	Feb 19.170	3907–3948;3992–4080			IIa O, Bkd	200	
001		4178–4483			IIa O, Bkd	200	
	H.D. 189849	15 VULPECULAE	A5 m	$19^h57^m.0$ + 27°29′		$4^m.74$	
47670	1955 May 27.403	4002–4525	IIIL$_A$	7.5	IIa O, Bkd	70	
671	May 27.454	4002–4525			IIa O, Bkd	76	
46058	1954 May 16.426	3901–3948;3997–4105	BL169	3.4	Cr HS	180	
059		4182–4459			Cr HS	180	
46530	Aug 8.385	3901–3950;3996–4078			IIa O	250	
531		4153–4485			IIa O	250	
46721	Aug 13.363	3901–3946;3995–4073			IIa O	246	
722		4153–4460			IIa O	246	
54637	1959 Oct 23.191	3995–4204	Mt. W. 71B	2.8	IIa O, Bkd	286	Clouds.
638		4271–4503			IIa O, Bkd	286	Clouds.
56575	1961 July 14.367	3996–4133			IIa O, Bkd	346	Grainy plate. Lines sl. broadened.
576		4107–4503			IIa O, Bkd	346	
4062b	1958 Sept 28.22	3890–4525	Pb	4.5	IIa O	170	Heavy Clouds.

TABLE 1. OBSERVATIONS OF STELLAR SPECTRA OBTAINED FOR LINE-INTENSITY STANDARDS (Continued)

Plate No.	Date U.T.	Region	Instrument	Dispersion	Emulsion	Exposure	Remarks
		λλ		A/mm.			
	H.D. 128167	σ BOOTIS	F2 V	$14^{h}30^{m}.3$	+ 30°11′	$4^{m}.48$	
47667	1955 May 27.237	4003–4520	IIIL$_A$	7.5	IIa O, Bkd	124	
47668	May 27.305	4003–4520			IIa O, Bkd	72	
47669	May 27.353	4245–4520			IIa O, Bkd	65	
46048	1954 May 14.337	3896–3948;3995–4112	BL169	3.4	Cr HS	150	
049		4181–4457			Cr HS	150	
46056	May 16.306	3900–3954;3992–4110			Cr HS	160	
057		4177–4464			Cr HS	160	
46136	June 23.281	3900–3954;3993–4088			Cr HS	150	
137		4162–4451			Cr HS	150	
47394	1955 Jan 28.545	3899–3952;3995–4115	BL169	3.4	IIa O, Bkd	190	
395		4153–4452			IIa O, Bkd	190	
47503	Mar 18.509	3901–3951			IIa O	194	
504		4180–4449			IIa O	194	Grainy plate.
53342	1959 Mar 13.409	4152–4470			IIa O	82	Weak:Clouds.
55008	1960 Feb 19.512	3896–3954;3991–4087	BL496	3.4	IIa O, Bkd	140	
009		4170–4496			IIa O, Bkd	140	
55055	Feb 28.563	3900–3953;3995–4088			IIa O, Bkd	106	
056		4170–4498			IIa O, Bkd	106	
55101	Mar 18.446	3895–3960;3885–4080			IIa O, Bkd	230	
102		4170–4498			IIa O, Bkd	230	
55181	Mar 25.454	3898–3956;3988–4083			IIa O, Bkd	240	Clouds at end.
182		4168–4497			IIa O, Bkd	240	Clouds at end
55226	1960 Apr 22.410	3895–3958;3995–4082			IIa O	140	
227		4170–4493			IIa O	140	
7938^1	1952 May 2.401	3990–4202	Ce	2.9	IIa O	80	
7938^2	May 2.401	4245–4460			IIa O	80	
3785a	1958 May 9.483	3889–4105	Pb	4.5	IIa O	100	Clouds.
3785b	May 9.483	4132–4525			IIa O	100	
3787a	May 10.438	3889–4525			IIa O, Bkd	150	
3849a	June 9.389	3889–4525			IIa O	44	

	H.D. 61421	α CANIS MINORIS	F5 IV-V	$7^h34^m.1$	$+5^\circ 29'$	$0^m.48$	
27600	1938 Feb 25.209	4001–4525	IIIL$_A$	7.5	E 33	8	
27601	Feb 25.217	4001–4525			E 33	4	
30037	1941 Feb 14.306	4001–4525			Cr HS	4	
33308	1944 Mar 10.267	4167–4525	Wood	4.6	Cr HS	30	
33310	Mar 10.292	4178–4525			Cr HS	36	
43164	1952 Mar 1.140	4205–4525	BL84	4.6	Cr HS	16	
43167	Mar 1.204	4208–4525			Cr HS	64	
43169	Mar 1.247	4215–4525			Cr HS	60	
55202	1960 Apr 8.154	3899–3955;3995–4083	BL496	4.6	IIa O	22	
203		4171–4497			IIa O	22	
55204	1960 Apr 8.172	3899–3955;3995–4083			IIa O	28	
205		4172–4498			IIa O	28	
55206	Apr 8.193	4172–4497			IIa O	30	
55209	Apr 9.215	3899–3955;3995–4085			IIa O	40	
210		4171–4497			IIa O	40	
469uv	1962 Dec 22.392	3902–4080	9663	2.2	IIa O	30	
469v	Dec 22.388	4169–4492			IIa O	40	
509uv	1963 Jan 12.396	3899–4120			IIa O	46	
509v	Jan 12.392	4139–4525			IIa O	36	
510uv	Jan 12.437	3902–4120			IIa O	64	
510v	Jan 12.431	4140–4525			IIa O	48	
2501^1	1941 Feb 10.326	3898–4360	Ce	2.9	HS	61	Thick clouds.
2501^2	Feb 10.326	4381–4525			HS	61	
3309^1	1943 Dec 8.505	3995–4055			103a O, Bkd	14	
3309^2	Dec 8.505	4120–4520			103a O, Bkd	14	
8728^1	1953 Apr 3.219	3898–4203			IIa O	10	
8728^2	Apr 3.219	4222–4525			IIa O	10	

TABLE 1. OBSERVATIONS OF STELLAR SPECTRA OBTAINED FOR LINE-INTENSITY STANDARDS (Concluded)

Plate No.	Date U.T.	Region	Instrument	Dispersion	Emulsion	Exposure	Remarks
		λλ		A/mm.			
	H.D. 173667	110 HERCULIS	F6 V	$18^h41^m.4$	+ 20°27′	$4^m.26$	
43382	1952 June 3.395	3997–4100	BL84	4.6	IIa O	236	
383		4202–4445			Cr HS	236	
43474	June 24.422	4000–4100			Cr HS	152	
475		4210–4445			Cr HS	152	
43581	July 13.367	3998–4100			IIa O	282	
582		4210–4448			IIa O	282	
46050	1954 May 14.435	3995–4104	BL169	3.4	Cr HS	120	BL169a
051		4177–4460			Cr HS	120	
46822	Aug 24.240	3994–4085			Cr HS	120	
823		4158–4460			Cr HS	120	
49759	1956 Oct 8.133	3998–4078	BL169	3.4	IIa O, Bkd	112	BL169b
760		4170–4474			IIa O, Bkd	112	
49761	Oct 8.218	3998–4061			IIa O, Bkd	124	
762		4170–4474			IIa O, Bkd	124	
49863	Nov 16.118	3995–4080			IIa O, Bkd	170	
864		4169–4475			IIa O, Bkd	170	
13062	1959 Nov 8.149	3910–4525	Ce	10.3	IIa O	8	

	H.D. 141004	λ SERPENTIS	G0 V	$15^h41^m.6$	+ 7°40′	$4^m.42$		
46112	1954 June 9.292	4000–4096	BL169	3.4	Cr HS	120		BL169a
113		4167–4460			Cr HS	120		
46719	Aug 13.223	4000–4076			IIa O	148	Weak plate.	
720		4154–4460			IIa O	148	Weak plate.	
47585	1955 Apr 29.382	4005–4088	BL169	3.4	IIa O, Bkd	120		BL169b
586		4167–4484			IIa O, Bkd	120		
47609	May 6.338	4003–4087			IIa O, Bkd	166		
610		4168–4485			IIa O, Bkd	166		
47624	May 13.404	4002–4088			IIa O, Bkd	58		
625		4169–4478			IIa O, Bkd	58		
48509	1956 Jan 27.569	3995–4093	BL169	3.4	IIa O, Bkd	154		BL169c
510		4171–4462			IIa O, Bkd	154		
48714	Apr 6.425	3997–4096			IIa O, Bkd	240		
715		4174–4460			IIa O, Bkd	240		
6299^1	1950 June 5.325	3995–4385	Ce	2.9	IIa O, Bkd	35		
6299^2		4412–4520			IIa O, Bkd	35		
6391^1	July 31.235	3995–4345			IIa O, Bkd	75		
6391^2		4430–4500			IIa O	75		
7110	1951 July 12.313	4040–4300			IIa O, Bkd	58		
	H.D. 161797	μ HERCULIS	G5 IV	$17^h42^m.5$	+ 27°47′	$3^m.48$		
46140	1954 June 23.411	3995–4092	BL169	3.4	Cr HS	155		BL169a
141		4165–4454			Cr HS	115		
46846	Sept 2.210	3993–4087			Cr HS	135		
847		4164–4463			Cr HS	135		
46858	Sept 4.174	3995–4096			IIa O	100		
859		4168–4463			IIa O	100		
47588	1955 Apr 29.473	4170–4488	BL169	3.4	IIa O	130		BL169b
47612	1955 May 6.958	4171–4486			IIa O, Bkd	172	Plate dark.	
5735^1	1949 July 9.303	3995–4381	Ce	2.9	IIa O, Bkd	30		
5735^2		4423–4525			IIa O, Bkd	30		
5847^1	Aug 14.330	3997–4350			IIa O	70		
5847^2		4364–4525			IIa O	70		

only plates having a dispersion of 10 A/mm or higher have been used in determining the mean equivalent widths published in this paper. However comparisons have been made with published data based on lower-dispersion spectrograms.

The pertinent data concerning the plates on which the present measurements are based are listed in Table 1. These include the mean time of observation (U.T.), the wavelength region for which intensity tracings were made; the spectrograph with its dispersion at Hγ in A/mm, the emulsion, the exposure time and any remarks required concerning observing conditions or plate exposures. The Victoria plates were taken with the following spectrographic combinations:

IIIL$_A$: three prisms long camera, astro-triplet lens, focal length 96 cm;

Wood: Wood grating with 600 grooves per mm using the Littrow mounting (Beals et al. 1946) with the collimator-camera lens of focal length 114 cm computed for the prism; this combination gives good, but not quite perfect focus over the two 4-inch plates which are placed on either side of the slit; the focus falls off at the ends of the plates near 4090A. and 4200A. This grating was one of the first ruled by R. W. Wood, blazed to give maximum efficiency about 4100A. in the third order.

BL84: same arrangement as above, but the grating was replaced by one made by Bausch and Lomb with 600 grooves per mm and blazed to give maximum efficiency at 3700A. in the third order.

BL169: Littrow mounting with a quartz-fluorite collimator-camera lens of 114 cm focal length computed to give a flat field over both 4-inch plates. This Bausch and Lomb grating was ruled with 1200 grooves per mm with the blaze set at 3700A. in the second order.

BL496: same arrangement as BL169. This grating is similar to BL169 but has considerably lower ghost intensities, though the efficiency is slightly less.

Mt. W. 71B: same arrangement as above using a Mount Wilson grating ruled by H. W. Babcock with 600 grooves per mm with low ghost intensities and a longer focal length (185 cm) glass collimator-camera lens.

9643: coudé spectrograph of the 48-inch telescope. The camera holds a 16-inch plate. No Schmidt corrector plate is used. The Mount Wilson grating has 400 grooves per mm and the blaze is set for 3700A. in the third order.

9663: same arrangement as above but the Mount Wilson grating is replaced by a similar one with 600 grooves per mm.

The Ce series of plates was taken at the coudé spectrograph of the 100-inch Mount Wilson telescope, and the Pb series was taken by Greenstein with the coudé spectrograph of the 200-inch telescope. The plates of θ *Leonis* σ *Bootis*, λ *Serpentis*, and μ *Herculis* were obtained primarily for use in this investigation. The Mount Wilson plates were those available at the time of Wright's 1962 visit.

It had been hoped to extend the equivalent-width measurements to the red of the normal photographic region of the spectrum, but this would have delayed publication by several years. Therefore the present data cover only the region from 3900A. to 4500A., omitting the region near Hε, and, for most of the Victoria grating plates, the region 4090A. to 4170A., which is occupied by the slit between the two plates. A shorter list of lines had been considered for publication, but once a preliminary study of the observed line profiles had been made, the more extensive list presented here did not require an unduly greater effort. Therefore for all but the G-type stars nearly all the features observed in the spectra and identifiable as individual lines or very close blends have been measured in the hope that this large body of data may be of some value in the interpretation of these stellar spectra and in comparisons between measurements made at other observatories.

III. THE INTENSITY MEASUREMENTS

All measurements included here were made on intensity tracings of the spectra. With the exception of the 9643 plates of *ι Herculis,* all Victoria tracings were rectified on a ten-inch scale with the adopted continuum set at the ten-inch level; this was accomplished with the Beals intensitometer (1944) by first converting the density tracings obtained with the Beals microphotometer (1936) into logarithmic tracings and, in a second stage, rectifying the continuum (*see* Wright, 1954a, 1962b). All tracings from plates taken with the 72-inch telescope were rectified in this manner. Tracings of the 48-inch coudé plates of *Procyon* were made with the direct-intensity microphotometer recently completed by D. H. Andrews, which, through the use of a characteristic curve plotted on a Moseley X-Y recorder, permits the recording of either direct intensities or logarithmic intensities in a single step. Comparisons between the two microphotometers show no significant differences in the results. All intensity tracings were made with the aid of characteristic curves determined near the middle of the region being studied. Most of the Victoria tracings were limited to regions of 200A. for each characteristic curve, so that no part of the tracings was made more than 100A. from the wave-length of the characteristic curve.

The Victoria calibration system employs a step sector rotating about 3600 rpm and has been shown, e.g. by Petrie and McKellar (1937), to give intensities comparable with those obtained using other methods of calibration. The calibrations for plates taken with the 72-inch telescope were obtained using an auxiliary prism spectrograph. An example of a recent comparison of the rotating sector with a Hilger step-weakener, consisting of steps of sputtered platinum of known intensity on a quartz plate, is shown in Figure 1.

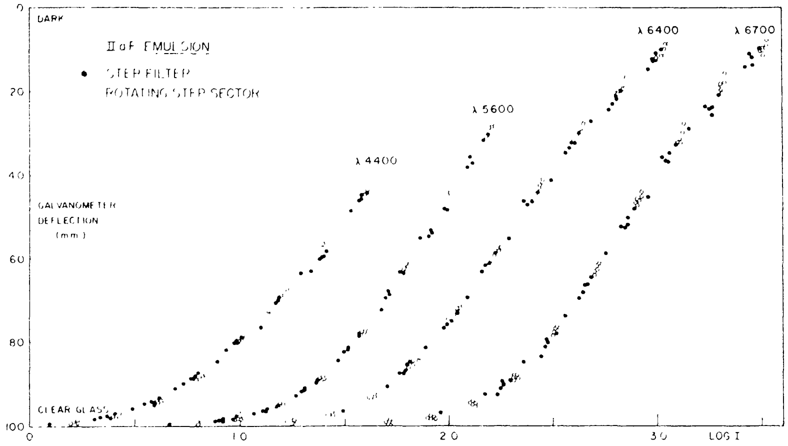

Figure 1

Comparison of characteristic curves obtained with the Victoria rotating step sector and with a Hilger step weakener, using the auxiliary spectrograph in the 72-inch telescope dome.

The calibration system for the 48-inch coudé spectograph was designed by E. H. Richardson and utilizes a small light source placed about 15 feet from the slit of the spectrograph. The light is reflected by a 45-degree mirror, passes through the openings of the sector and a broad slit and is again reflected just above the slit for the stellar beam, from which point it follows the same optical system. A comparison of this system has recently been made by D. Koelbloed using the platinum-on-quartz step-weakener specially calibrated at Heidelberg by H. Kienle and J. P. Mehlstretter for Sub-commission 29b of the International Astronomical Union. The results of measurements made at wave-lengths 4225A., 4300A. and 4550A. are shown in Figure 2; no real differences can be detected between the rotating step-sector and the step-filter calibrations.

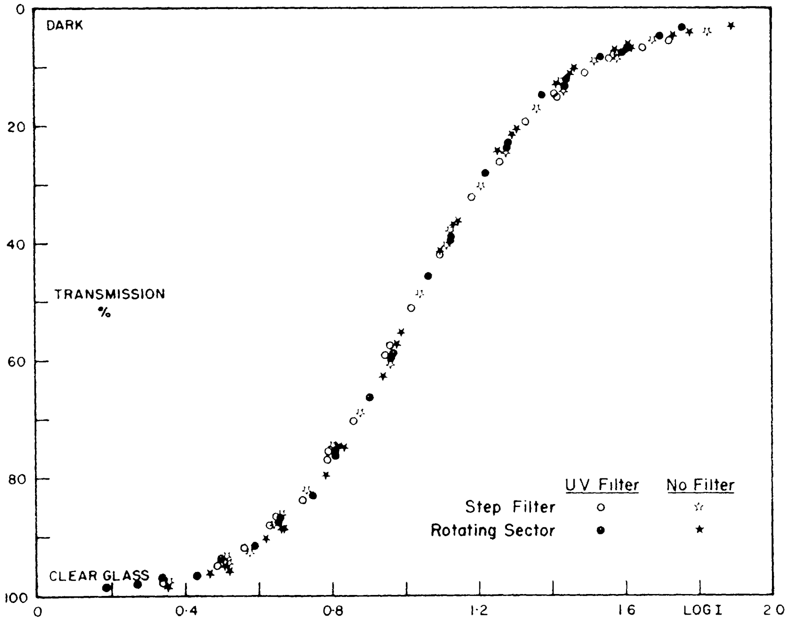

Figure 2

Comparison of characteristic curves obtained with the Victoria rotating step sector and with the Heidelberg step weakener using the coudé spectrograph of the 48-inch telescope.

The first gratings obtained at Victoria were observed to have numerous Rowland ghosts on either side of the principal line when emission lines were photographed. This problem was discussed by Minnaert (1927). Minnaert, Mulders and Houtgast (1940) applied his result in their study of the solar spectrum. The sum of the ghost intensities plus scattered light in the grating is considered as additional light in the spectrum. Thus if the position of the continuum is called 100, and the scattered light is x in the same units, the zero intensity on a tracing is placed at a distance x above the observed clear glass of the plate and the observed continuum is then set at $100 + x$. The anti-logarithm curves for the intensitometer were calculated separately for each grating and allowance was made for the ghosts. Measures made in the laboratory spectrograph for the gratings indicated the following values for the scattered-light correction, x for the order used:

Grating	Wood	BL84	BL169
x %	8	5	5

Gratings BL496 and Mt. W. 71B have very low ghost intensities and no scattered-light corrections have been made for these gratings or for the Mount Wilson gratings used in the 48-inch coudé spectrograph. There may be some general scattered light in the spectrographs, including reflections from the sides of the camera etc., but it has not been possible to detect and measure it, although attempts have been made to do so. Therefore no additional corrections have been applied to the observations.

The problem of drawing the continuum is fundamental in the study of stellar line intensities. In the present analysis the best observed continuum has been considered adequate. Recently, however, Searle and Oke (1962) have compared observed and computed profiles of the Hγ line, and suggested that in the spectrum of a main sequence star of type F5, the continuum should be raised about two percent from the usually adopted position. For the B- and A-type spectra it seems probable that the observed and real continua are approximately the same, at least in the region to the red of 4000A., although it is possible that for some A-type spectra the wings of the hydrogen lines may overlap. Certainly for the G-type stars, the presence of molecular band lines in the ultraviolet region, superposed on the multitude of atomic lines makes the probability of finding even a short stretch of spectrum free from lines very remote—and Redman (*see* Wright, 1954b) among others has questioned whether the term "continuum" under such circumstances really has a meaning. It has been decided, however, that the present measures should be made available using the adopted apparent continuum as the background for the line absorptions even though it is almost certain that better approximations will be made in the future.

The "continuum" adopted here is the mean of the plate grain observed over short stretches of spectrum where no lines, or in a few cases only very weak lines, could be identified. On the logarithmic tracings of the Victoria plates, and on the direct-intensity tracings of the other plates, these short regions were joined by straight lines. It was required only that the slope did not change appreciably at the junction points, and that the slope did not change sign more than once over the region covered. Where several plates of the same star were available, the continuum was usually drawn on all tracings at the same time in order to obtain a uniform continuum and also to eliminate obvious irregularities in the plate sensitivity, marks on the plate, etc.

There are at least two advantages in preparing rectified intensity tracings even though an additional step in the reduction process is involved. Several tracings of spectra obtained with the same dispersion can be superposed. Thus much of the plate grain can be removed by drawing mean profiles of the lines on the superposed tracings. In addition, the shape of the profiles remains effectively the same over extended regions of the spectrum, so that blending effects can be, at least partially, allowed for by a comparison of lines of similar central depths.

The shape of most of the lines in these stellar spectra seems to be almost independent of the type of atom producing the line. The profiles of all but the strongest lines are effectively determined by the slit of the spectrograph. Exceptions to this statement are the lines in the spectra of ρ *Leonis*, θ *Leonis* and 110 *Herculis* which are broadened either by turbulence or by rotation, and hence are broader than the effective slit width. From the rectified intensity tracings of the Victoria grating spectra, therefore, a set of mean profiles was obtained for each star, each instrument and each region of two hundred angstroms width within the spectrum. Although the profiles are very similar from star to star, separate sets of mean profiles were made for each region in each spectrum. The profiles were derived from superposed tracings of several spectra. They were made from lines showing little or no blending affects, or at least from lines of which one side of the profile appeared to be free from blends. The profiles of all such lines were sketched on a sheet of squared paper and drawn with a common centre. Lines of the same central intensity were found to be very similar in shape. For lines of a given intensity, the narrowest observed profile was usually adopted as the true observed profile, since blending can only broaden a line unless the lines in the blend have precisely the same wave-length. All known blends of that sort were eliminated from the mean profiles. Each set of mean profiles was thus built up into a series with increasing central depth. The difference in intensity between consecutive members of a set was made small enough to enable the intensities of lines of intermediate strength to be estimated by simple interpolation. If the difference between adjacent observed mean profiles was large, estimated intermediate profiles were sometimes sketched in. The areas of these mean profiles were determined by direct planimeter measurement. Thus the intensities of the many lines in the spectra could be obtained quickly, and with sufficient accuracy, by interpolating from the observed measured areas and multiplying by the appropriate dispersion factor, which varies slightly with wave-length. This method of using standard profiles assumes an identical shape for all line profiles on a given set of tracings. Systematic errors may be introduced by this method, and differences in the shapes of the lines of different elements may be hidden.The increase in the consistency of measurements of equivalent width, however, and the use of all parts of the line in these measurements are considered more important than any possible systematic error.

For strong lines with definite wings, equivalent widths were obtained by direct planimeter measurement. Where blends were known to be present, yet so close that it was difficult to separate the lines, allowance for such blending was made in determining the equivalent width. For such lines the values of the equivalent widths listed in Tables 2–5 appear in a row spaced between the two or more blending wave-lengths. Where lines were blended but readily separable with the resolution available, separate equivalent widths were estimated as given in the tables. Representative sets of mean profiles obtained from Victoria BL169 spectra are shown in Figure 3. The slight wings drawn for most weak lines as well as for the strong lines near the continuum have little theoretical significance since weak comparison lines, which are effectively images of the slit, are almost triangular in shape; however the wings, which do not affect the equivalent widths to any large extent, do appear to be real on the tracings, and have been drawn on the mean profiles as they appear; they may be related to the weak ghost lines.

Tracings from the Mount Wilson and Palomar spectrograms were made on the direct-intensity microphotometer of the California Institute of Technology as modified by J. B. Oke. This instrument is strictly linear and has a library of some forty characteristic curves. One such curve could usually be found to agree with the curve for a given plate. However for about half of the plates for which tracings were made, new curves were drawn. For a few of the plates a V-shaped wedge calibration (*see* Bowen, 1962), exposed on a separate plate in an auxiliary spectrograph, but developed with the stellar spectrum, was used to obtain the characteristic curve. For most of the plates, however, no wedge calibration was

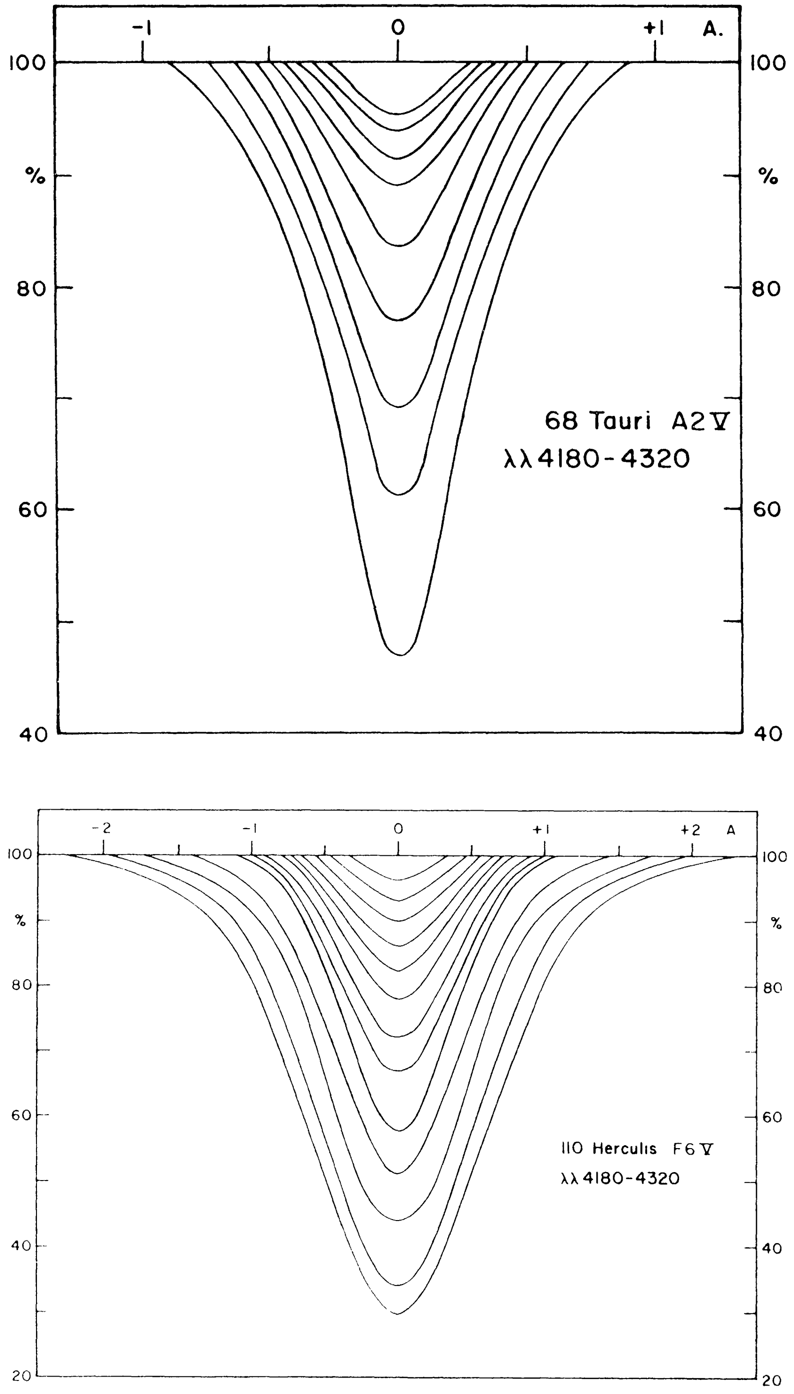

Figure 3

Representative standard profiles of lines observed in the spectra of (a) 68 *Tauri* and (b) 110 *Herculis* on Victoria intensity tracings in the region 4180A to 4320A.

available and the usual calibration, consisting of two sets of six steps produced by slits of different aperture placed above and below the slit for the stellar spectrum, was employed (*see* Dunham, 1956).

The tracings from the California Institute of Technology have an intensity profile with a slowly-varying continuum which can be drawn as a nearly-straight line. Since many lines were being measured, it was necessary to assume that the absorption profile was effectively triangular in shape; the equivalent width, or total absorption, of a given line was then obtained by multiplying the central depth of the line, measured relative to the observed continuum, by the measured width of the line at the continuum, and applying an appropriate factor for the dispersion. In all cases, short stretches of the spectrum were traced with higher magnification and selected strong and weak lines were measured with the planimeter. The planimeter measures were compared with the triangle measurements, to which appropriate correction factors have been applied in Tables 2-5. The areas of strong lines, showing appreciable wings, were measured with the planimeter, on all the tracings.

For the hydrogen lines, a smooth profile was drawn through regions where no other absorption line could be detected, and smooth curved lines were drawn to complete the profiles. Therefore profiles and equivalent widths presented here are those that would appear if no other line were present.

The spectral scanner used at the 100-inch telescope of the Mount Wilson Observatory has been described briefly by Oke and Greenstein (1961). Two series of scans were available for inclusion in this study. J. B. Oke worked with the photoelectric scanner during the night of November 19-20, 1961. He included scans of γ *Pegasi* and γ *Geminorum* in his program for that night and has generously lent the tracings to us for measurement. Greenstein and Wright were able to use the photoelectric scanner during the night of February 21-22, 1962 at the 100-inch telescope, and scans were made for γ *Geminorum*, ρ *Leonis* and ι *Herculis*. Conditions were rather poor during this night as the humidity was high. A few clouds interfered with the results obtained from some of the scans. The tracings were measured and the results, for the lines that were suitable for measurement, are presented in Tables 6a and 6b. The adopted equivalent widths determined from the photographic measurements have also been listed in these tables. The 75-angstrom region covered by each scan is barely enough to cover the extreme wings of the hydrogen lines, especially in the spectra of A-type stars. However the continua were drawn on the scanner tracings using the tracings obtained from the photographic spectra as guides. The profiles of Hγ determined from the spectral scans are included in Tables 10a and 10b.

IV. EQUIVALENT-WIDTH DATA

The principal results of this investigation are presented in Tables 2 to 5. These give the adopted equivalent widths in milliangstroms for most of the lines in the spectra of the B-, A-, and F-stars listed in Table 1 in the regions 3900A-3950A. and 3995A-4522A., and selected lines in the G-type spectra in the region 3995A-4520A. Equivalent widths of lines in the wings of the hydrogen lines and of a few other strong lines are given relative to that wing as the observed continuum. In order to show the differences that may be expected, and therefore approximate errors, the results from each instrument are given in separate columns. The adopted mean equivalent width, including other published data in a few cases, is given in the last column if more than one measurement was available.

In order to illustrate the types of spectra studied and the resolution usually obtained, sample spectra are reproduced in Plates I to V. Each of the original spectra was obtained with the BL169 grating in the Cassegrainian-Littrow spectrograph attached to the 72-inch telescope, and had an original dispersion of 3.4 A/mm. Wave-length scales, and the positions of representative lines are shown above and below each set of spectra; the iron arc comparison spectrum is also shown in the plates. The identifications at the top of each plate refer to the B-type spectra; those at the bottom refer to the spectra of later type.

Intensity tracings to show the types of lines on which the measurements were made, and also the approximate position of the adopted continuum, are shown in Figures 4 to 12. The original magnification in the wave-length coordinate was 200 times, but the tracings shown here were reduced by a special gear in the intensitometer in order to reproduce longer stretches of the spectrum. These diagrams were made from single tracings of each stellar spectrum. The lines appear less conspicuous, especially for the B-type spectra, than when several tracings are superposed, and the grains appear more conspicuous. The tracings are representative but may not be the best available for each star, and the mean continuum may differ slightly from that shown on the diagrams. Wave-lengths and identifications are given above and below the tracings for each diagram. The identifications at the top refer to the tracings of earlier type, and those at the bottom refer to the tracings of later type.

The line identifications given in the first column of each table may not be complete but are the atomic (or occasionally molecular) transitions considered, at present, most likely to produce the observed stellar features. In some cases detailed studies of multiplet strengths would probably indicate that other lines should be included or that the present identifications should be omitted. A few lines are unidentified. For all the lines examined the principal source of wave-lengths has been the *Revised Multiplet Table* prepared by Moore (1945). For the B-type stars most of the lines have been observed by Aller and his collaborators (Aller, 1956; Aller and Jugaku, 1958 a). The wave-lengths for Fe III and C II have been taken from papers by Glad (1956, 1953). For the A-type stars, identifications have been checked against lists published by Struve and Swings (1943) for α^2 *Canum Venaticorum*, as well as against those giving equivalent-width data that will be discussed separately. For the F-type stars the best list of wave-lengths for main-sequence spectra is probably the compilation for α *Canis Minoris* by Swensson (1946), but the *Revised Rowland Table of Solar Wave-lengths* by St. John et al. (1928) was also consulted. For the G-type stars, the *Revised Rowland Table* was used as a standard, together with the Utrecht *Photometric Atlas of the Solar Spectrum* (Minnaert, Mulders and Houtgast, 1940). In order to check the importance of strong molecular lines, the list for the spectrum of the M2 giant, β *Pegasi*, prepared by Davis (1947) was also consulted.

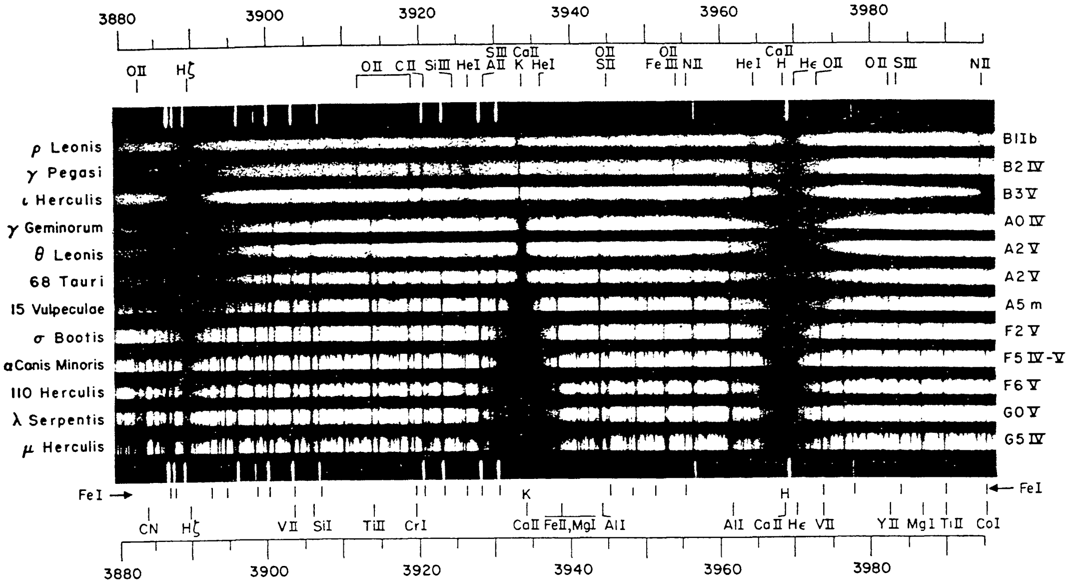

Plate I

Spectra of representative stars of types B to G in the region 3880A. to 3995A.

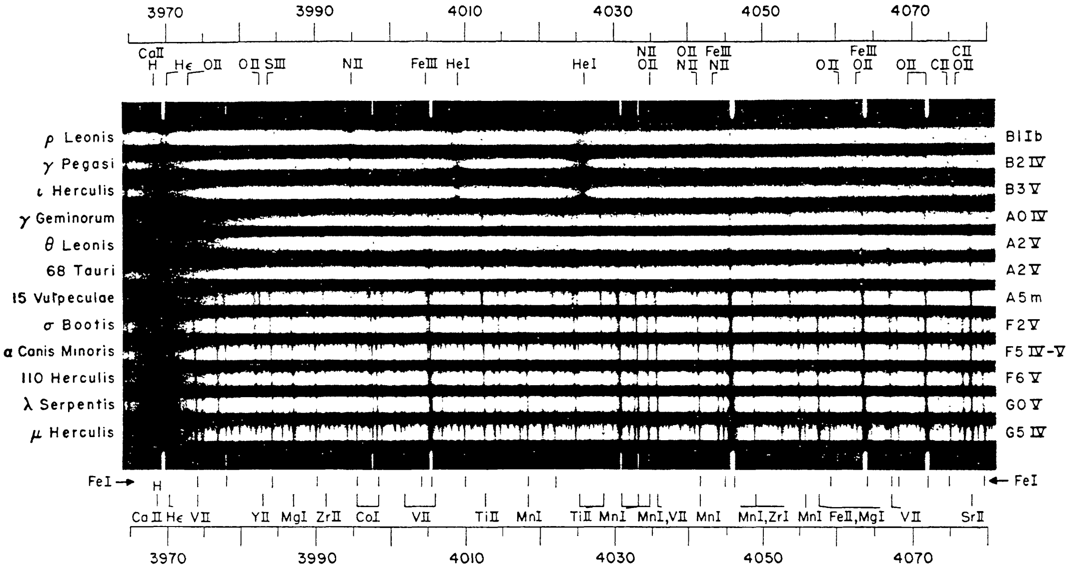

Plate II

Spectra of representative stars of types B to G in the region 3965A. to 4080A.

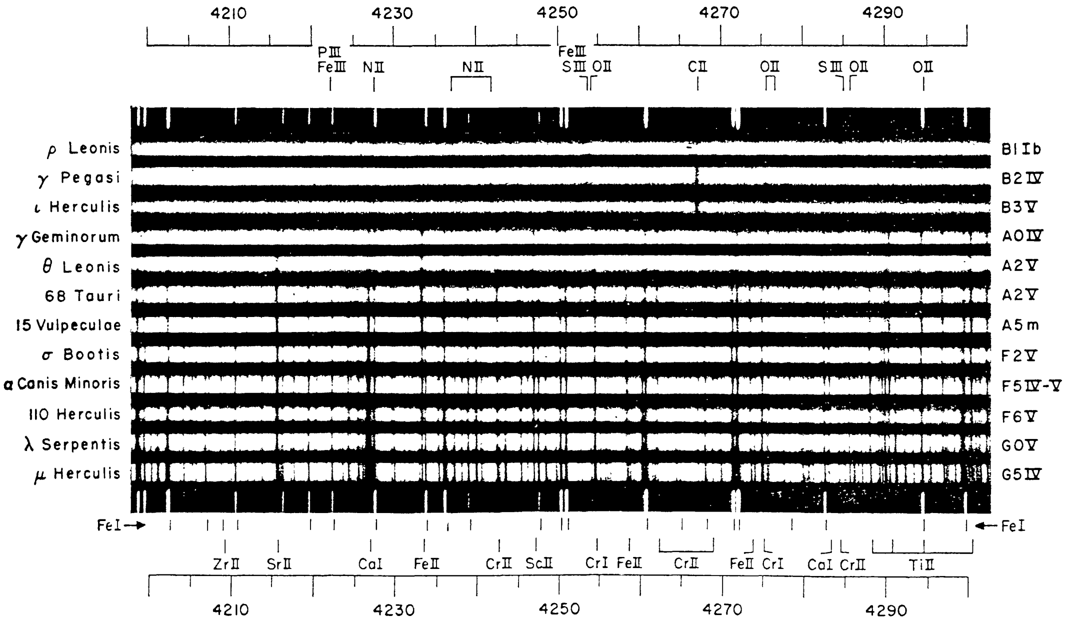

Plate III

Spectra of representative stars of types B to G in the region 4200A. to 4300A.

The identifications listed above the spectra refer to lines observed in the B-type spectra; those below the spectra refer to lines found in spectra of later type. The emission lines immediately above and below the stellar spectra are iron arc comparison spectra.

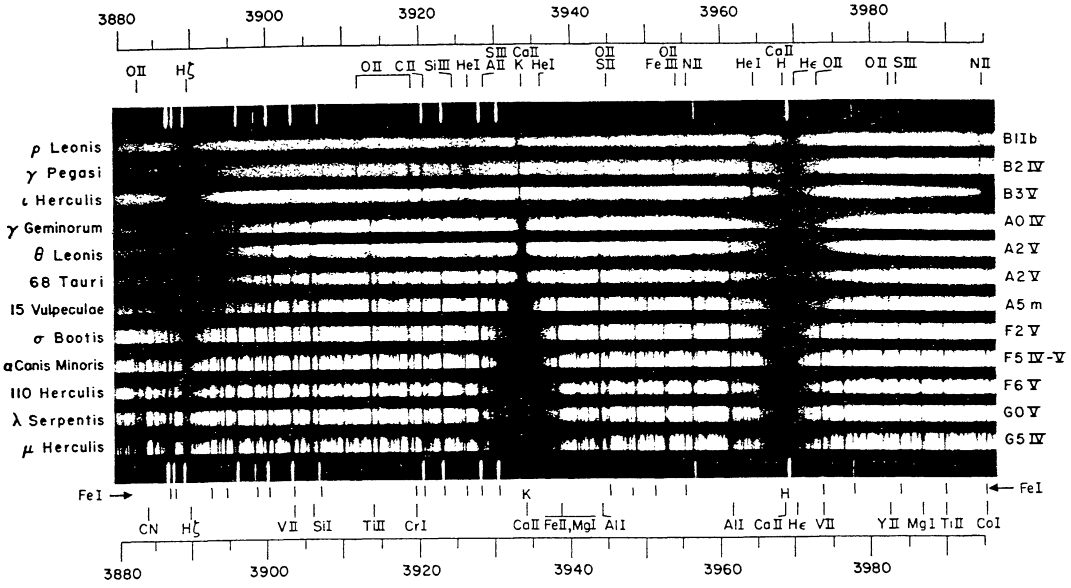

Plate I

Spectra of representative stars of types B to G in the region 3880A. to 3995A.

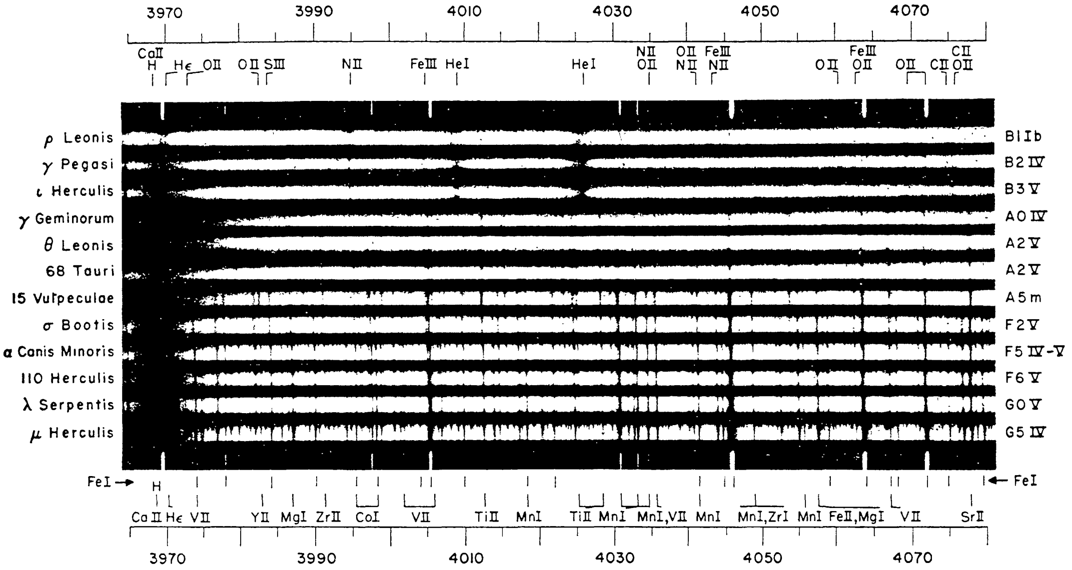

Plate II

Spectra of representative stars of types B to G in the region 3965A. to 4080A.

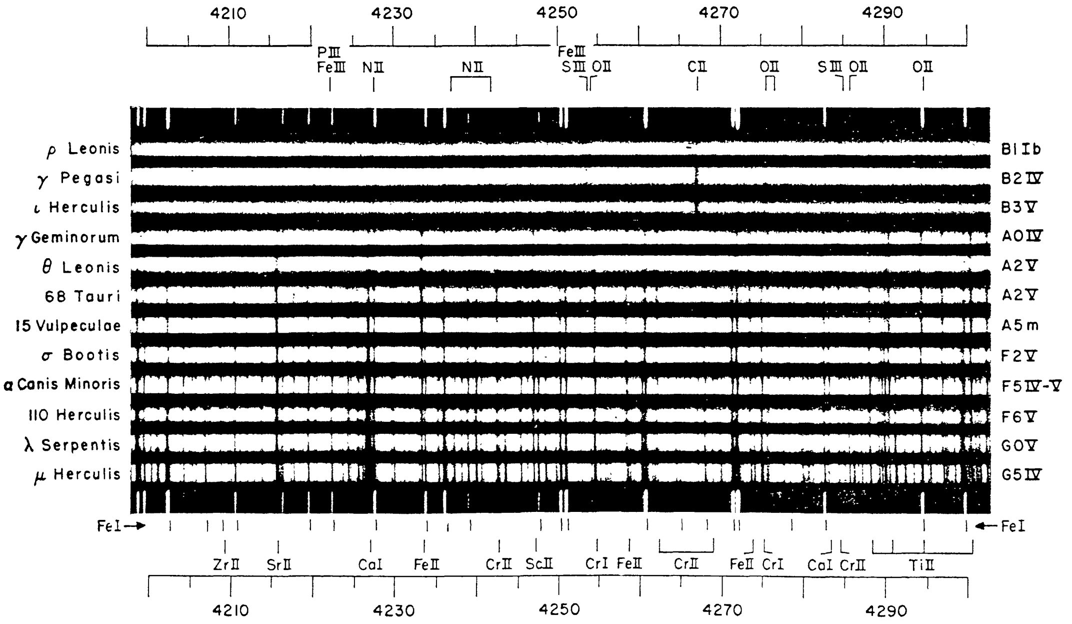

Plate III

Spectra of representative stars of types B to G in the region 4200A. to 4300A.

The identifications listed above the spectra refer to lines observed in the B-type spectra; those below the spectra refer to lines found in spectra of later type. The emission lines immediately above and below the stellar spectra are iron arc comparison spectra.

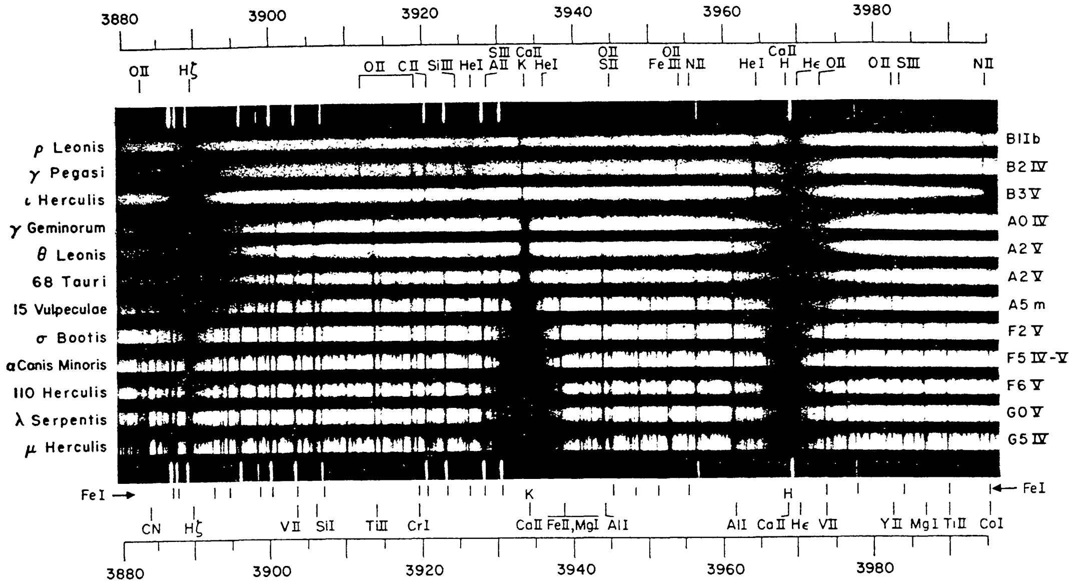

Plate I

Spectra of representative stars of types B to G in the region 3880A. to 3995A.

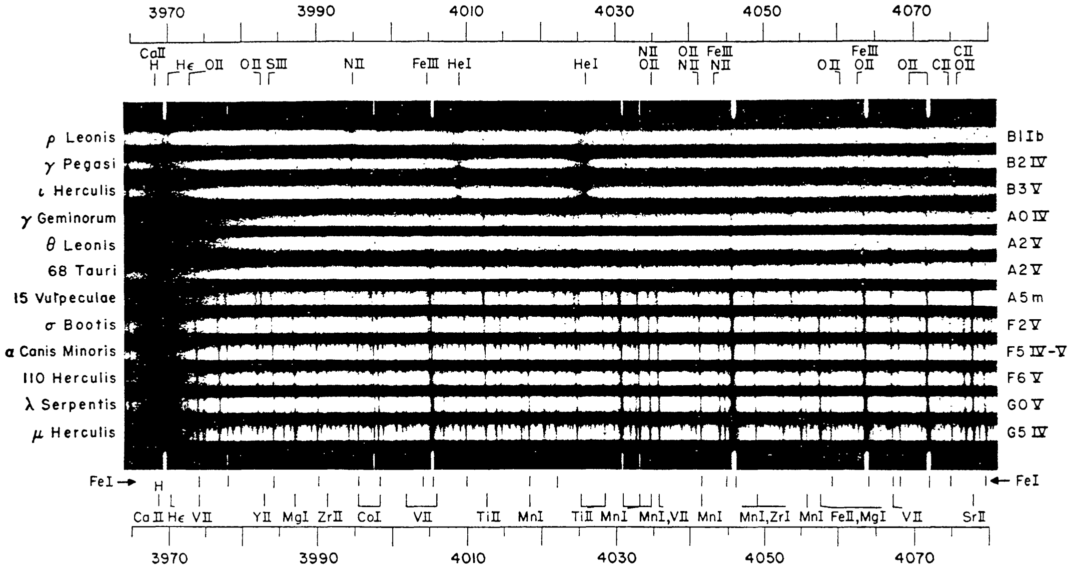

Plate II

Spectra of representative stars of types B to G in the region 3965A. to 4080A.

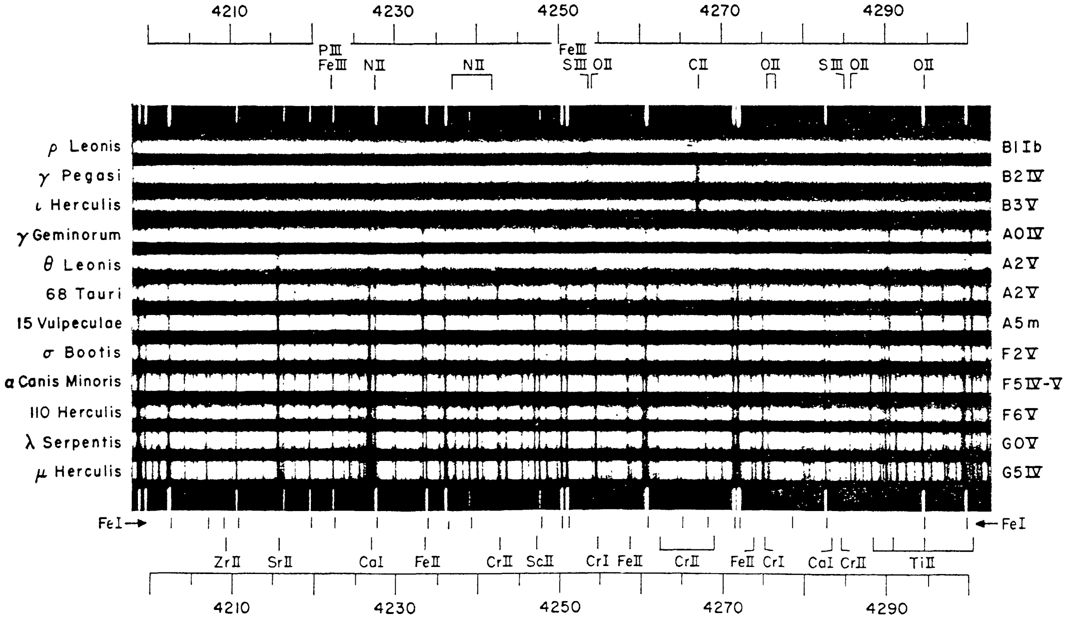

Plate III

Spectra of representative stars of types B to G in the region 4200A. to 4300A.

The identifications listed above the spectra refer to lines observed in the B-type spectra; those below the spectra refer to lines found in spectra of later type. The emission lines immediately above and below the stellar spectra are iron arc comparison spectra.

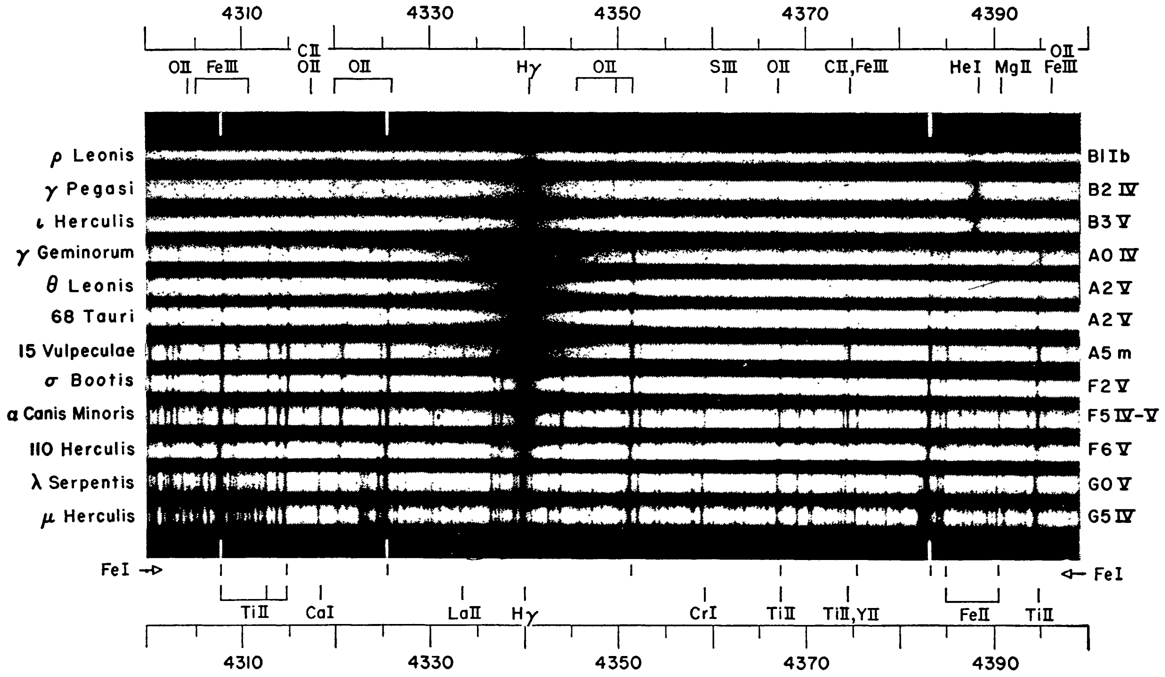

Plate IV

Spectra of representative stars of types B to G in the region 4300A. to 4400A.

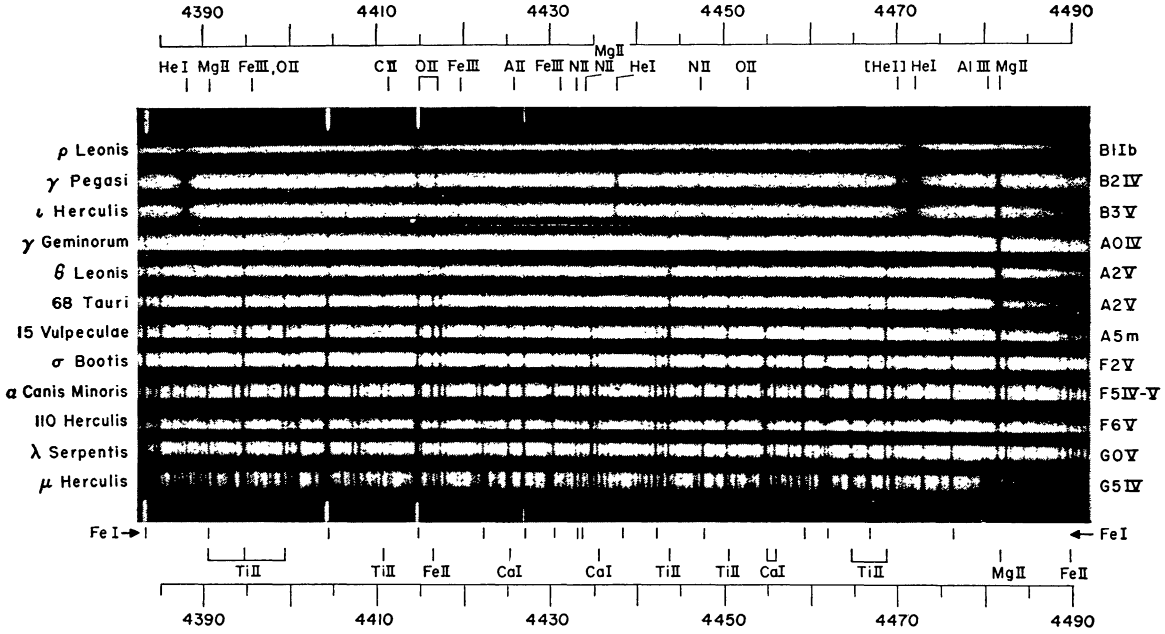

Plate V

Spectra of representative stars of types B to G in the region 4385A. to 4490A.

The identifications listed above the spectra refer to lines observed in the B-type spectra; those below the spectra refer to lines found in spectra of later type. The emission lines immediately above and below the stellar spectra are iron arc comparison spectra.

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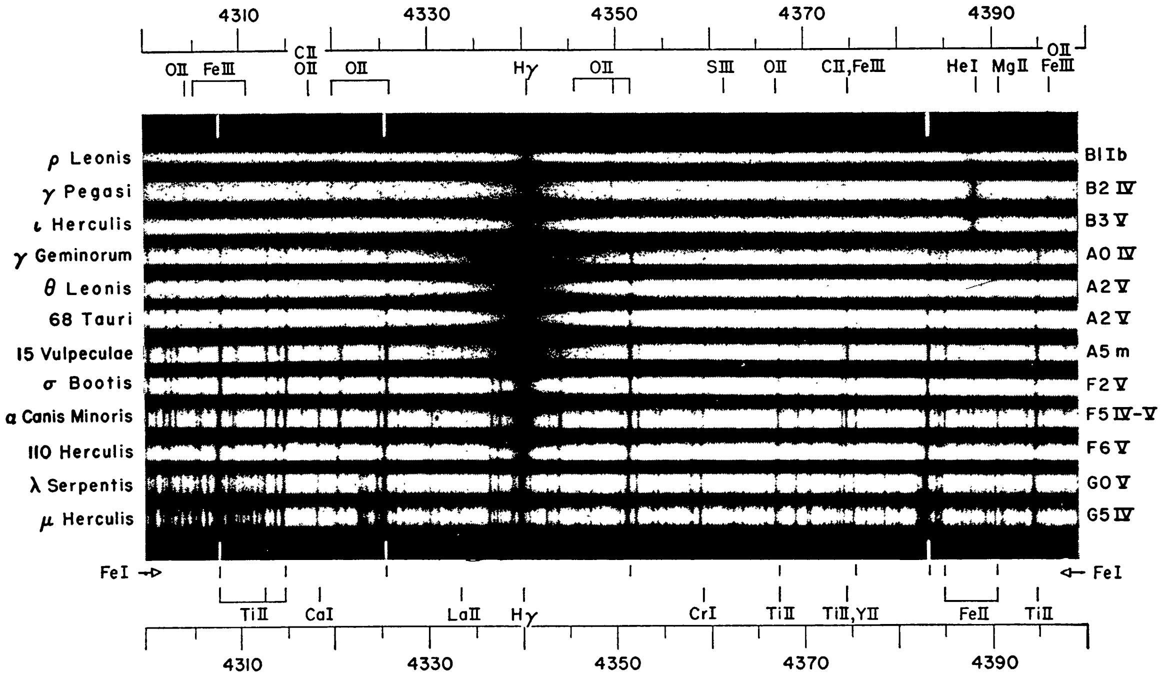

Plate IV

Spectra of representative stars of types B to G in the region 4300A. to 4400A.

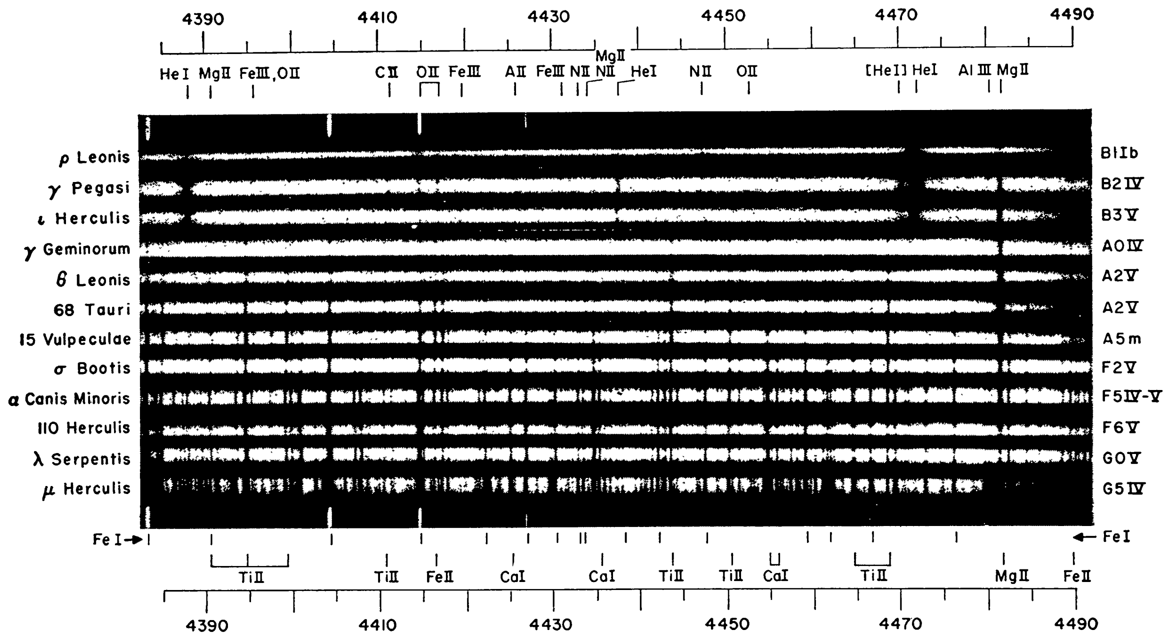

Plate V

Spectra of representative stars of types B to G in the region 4385A. to 4490A.

The identifications listed above the spectra refer to lines observed in the B-type spectra; those below the spectra refer to lines found in spectra of later type. The emission lines immediately above and below the stellar spectra are iron arc comparison spectra.

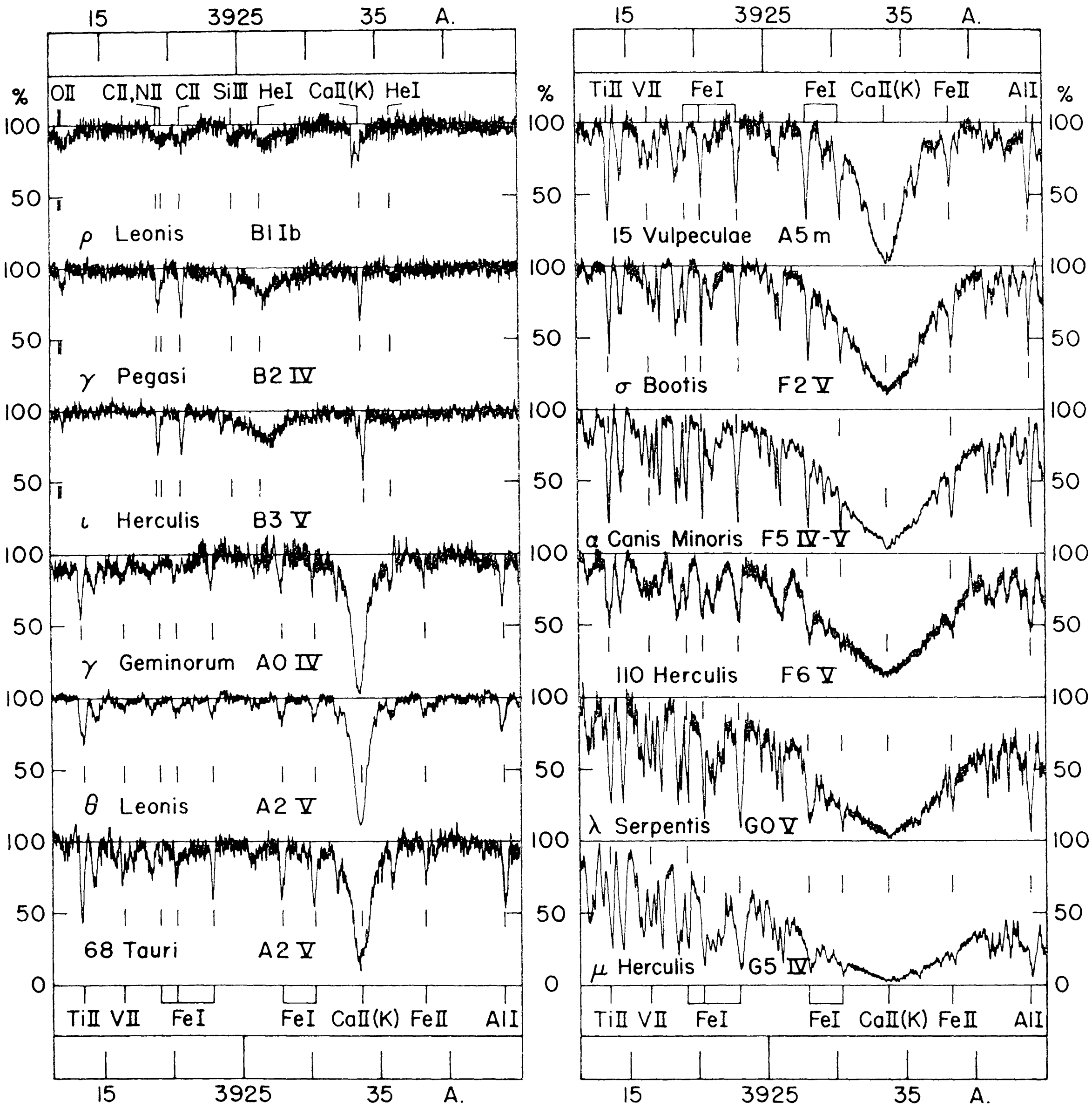

Figure 4. Intensity tracings of representative B- to G-type stellar spectra in the region 3912A. to 3945A. The identifications above the tracings refer to lines observed in the earlier type spectra; those below the tracings refer to lines found in the spectra of later type. The tracings have been rectified to set the adopted continuum at 100 per cent intensity. All tracings were made from Victoria grating spectra having an original dispersion of 3.4 A/mm.

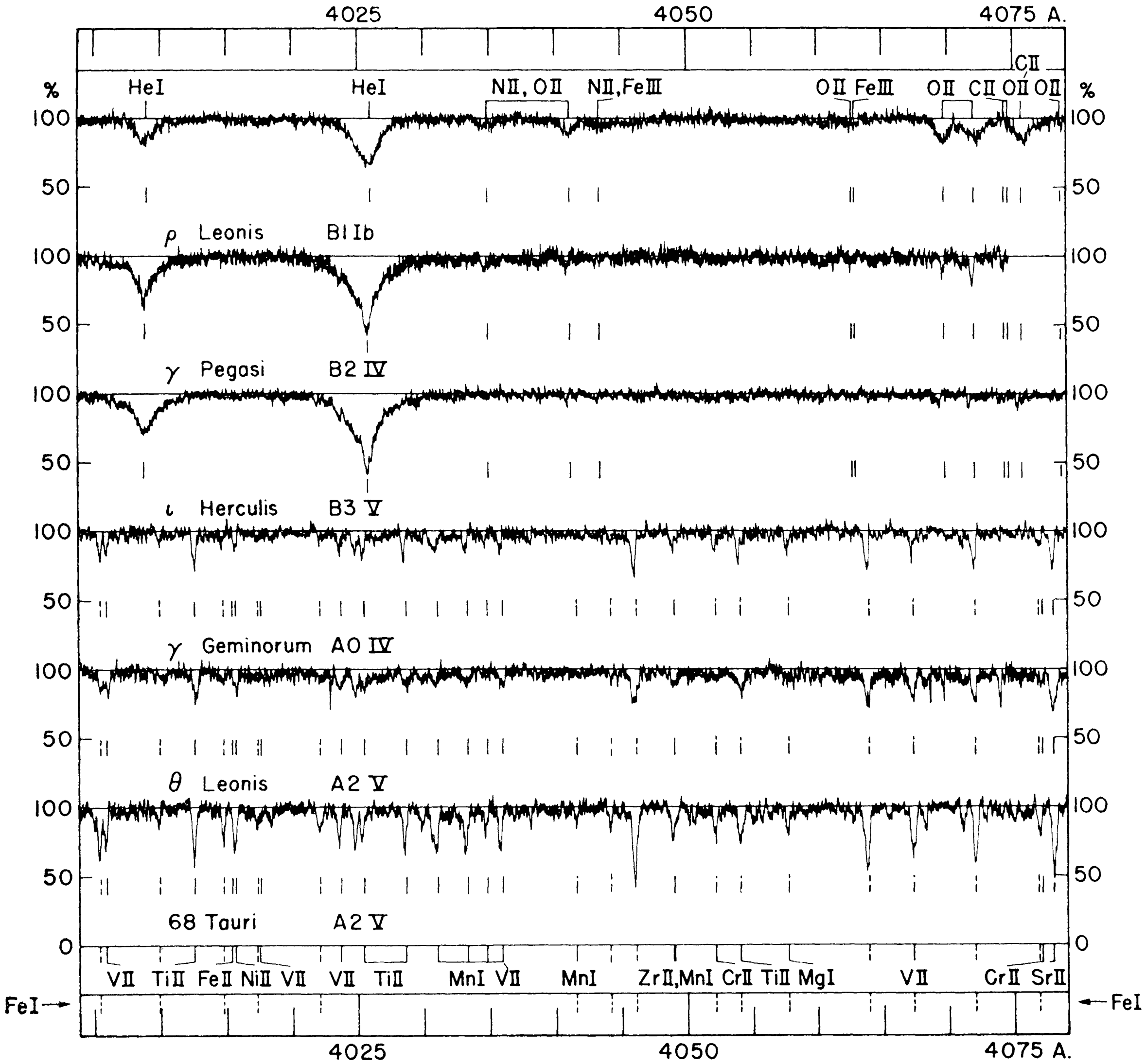

Figure 5. Intensity tracings of representative B- and A-type stellar spectra in the region 4004A. to 4079A. The identifications above the tracings refer to lines observed in the earlier type spectra; those below the tracings refer to lines found in the spectra of later type. The tracings have been rectified to set the adopted continuum of 100 per cent intensity. All tracings were made from Victoria grating spectra having an original dispersion of 3.4 A/mm.

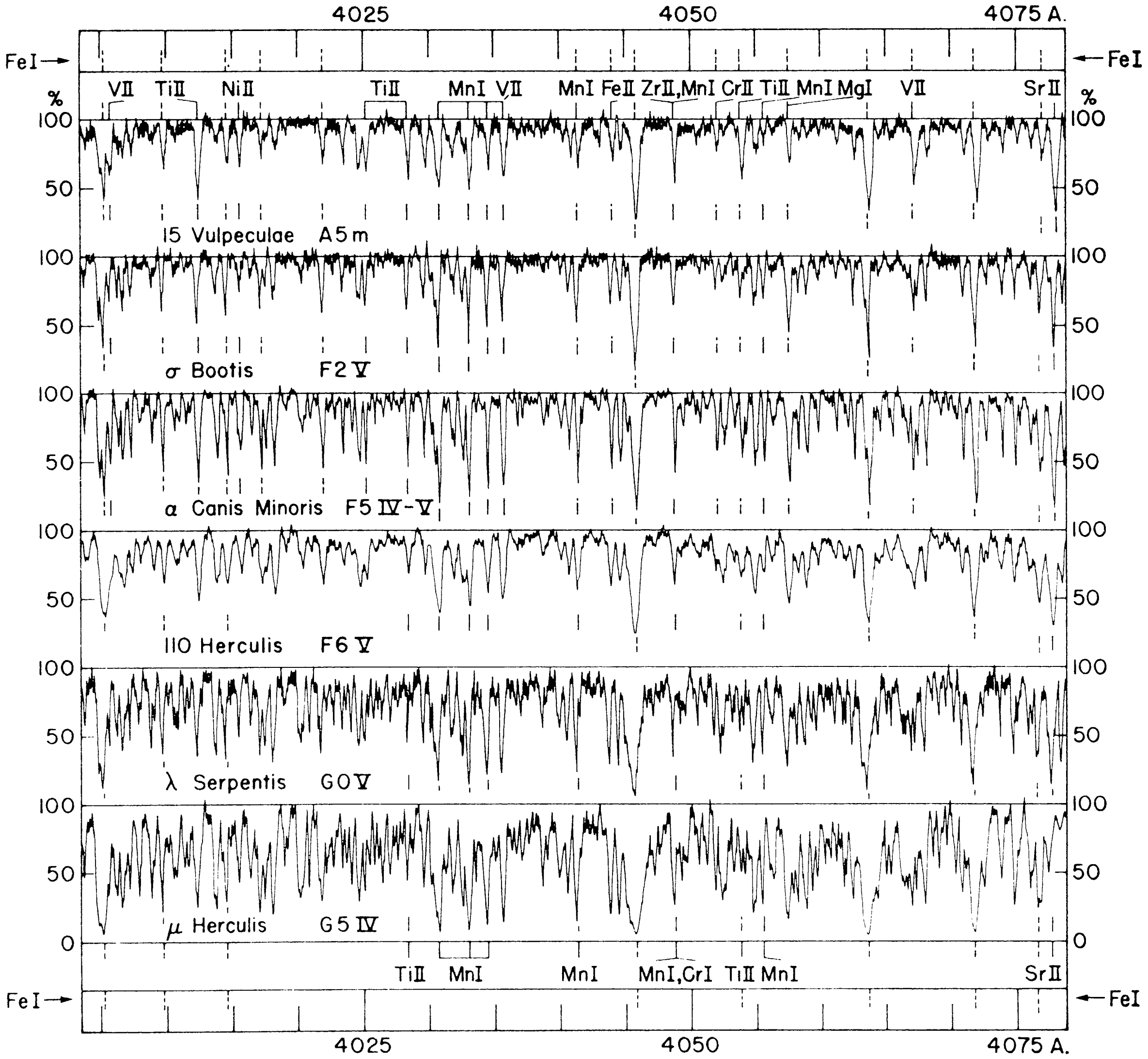

Figure 6. Intensity tracings of representative A- to G-type stellar spectra in the region 4004A. to 4079A. The identifications above the tracings refer to lines observed in the earlier type spectra; those below the tracings refer to lines found in the spectra of later type. The tracings have been rectified to set the adopted continuum at 100 per cent intensity. All tracings were made from Victoria grating spectra having an original dispersion of 3.4 A/mm.

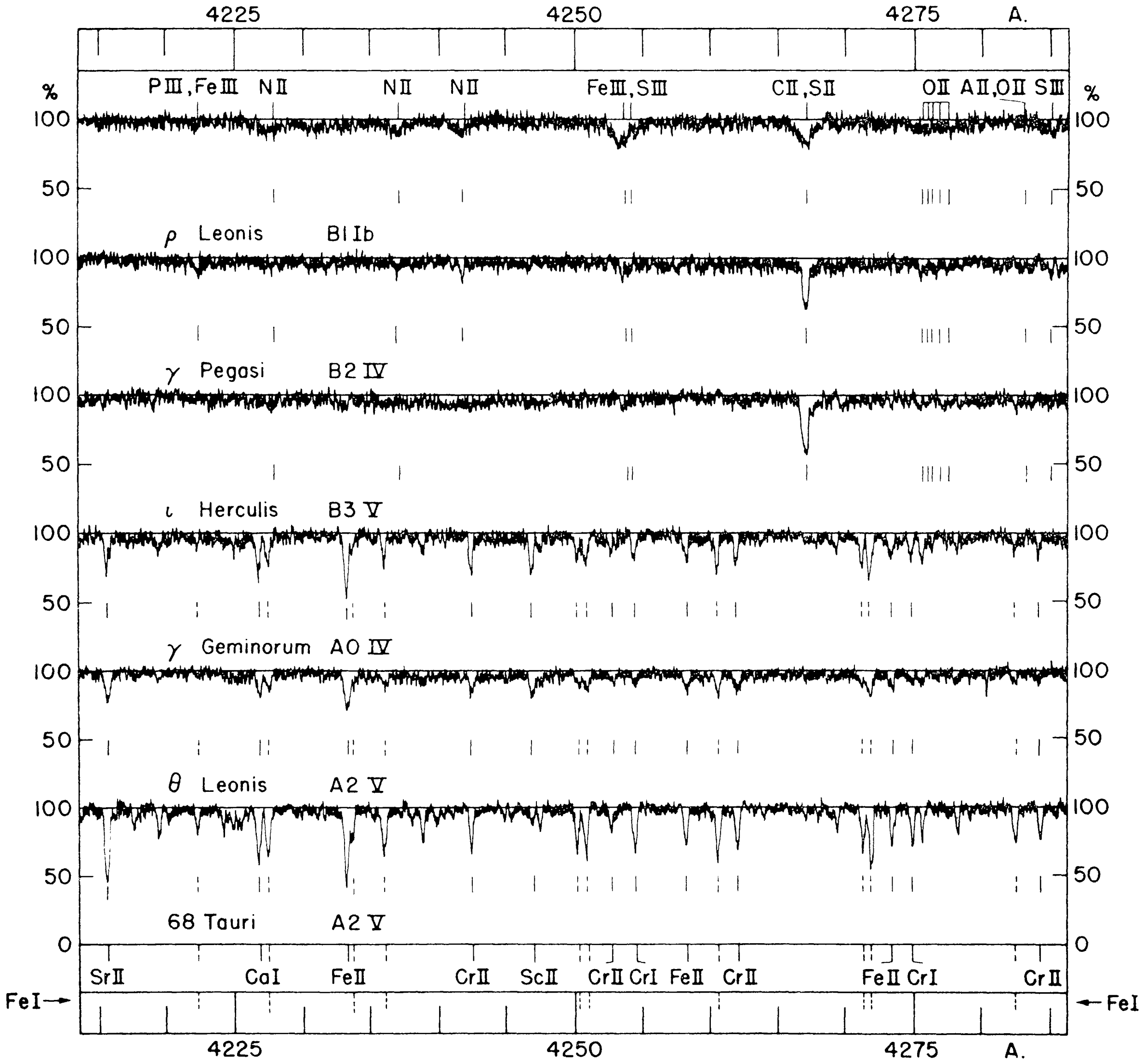

Figure 7. Intensity tracings of representative B- and A-type stellar spectra in the region 4214A. to 4286A. The identifications above the tracings refer to lines observed in the earlier type spectra; those below the tracings refer to lines found in the spectra of later type. The tracings have been rectified to set the adopted continuum at 100 per cent intensity. All tracings were made from Victoria grating spectra having an original dispersion of 3.4 A/mm.

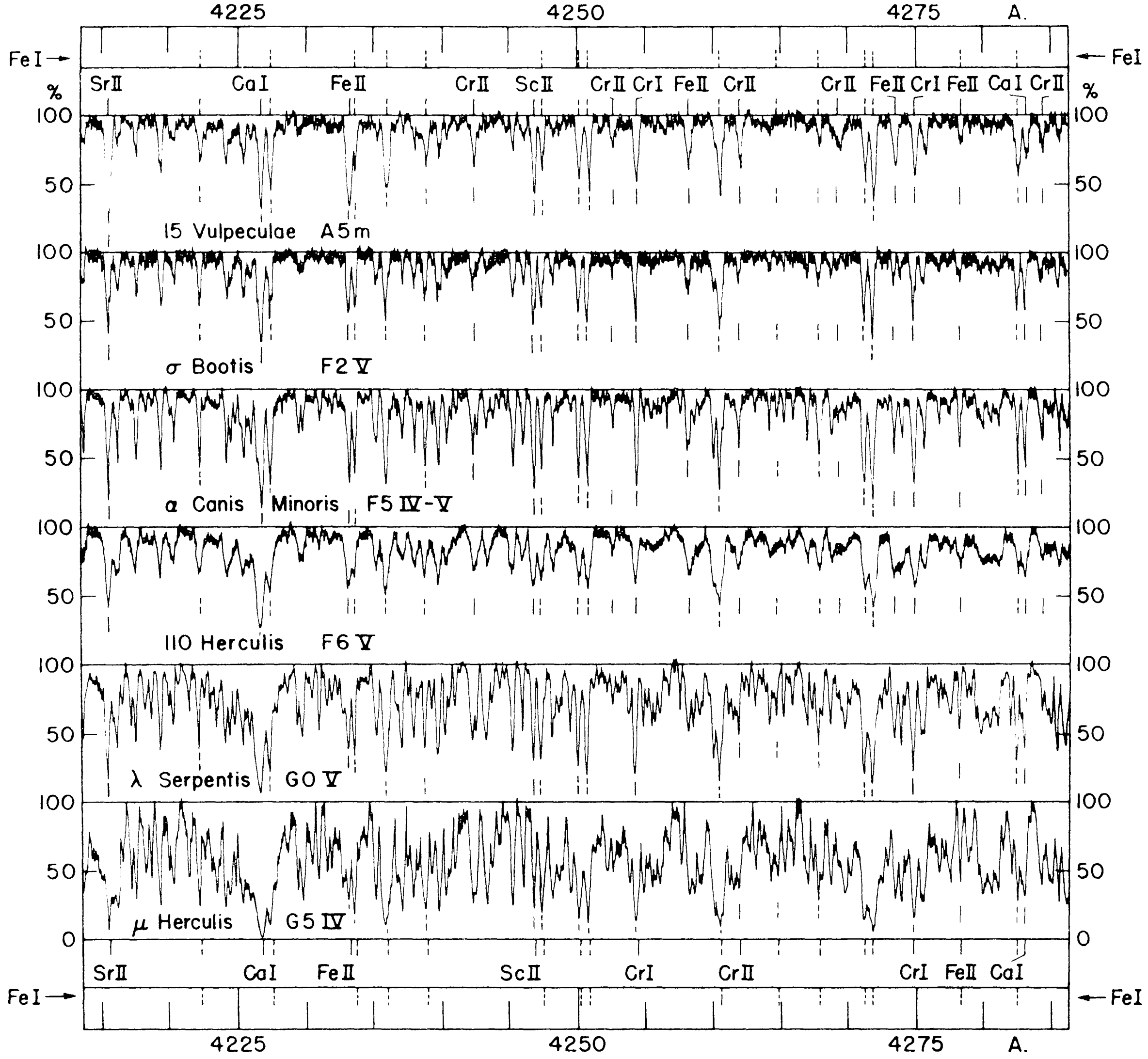

Figure 8. Intensity tracings of representative A- to G-type stellar spectra in the region 4214A. to 4286A. The identifications above the tracings refer to lines observed in the earlier type spectra; those below the tracings refer to lines found in the spectra of later type. The tracings have been rectified to set the adopted continuum at 100 per cent intensity. All tracings were made from Victoria grating spectra having an original dispersion of 3.4 A/mm.

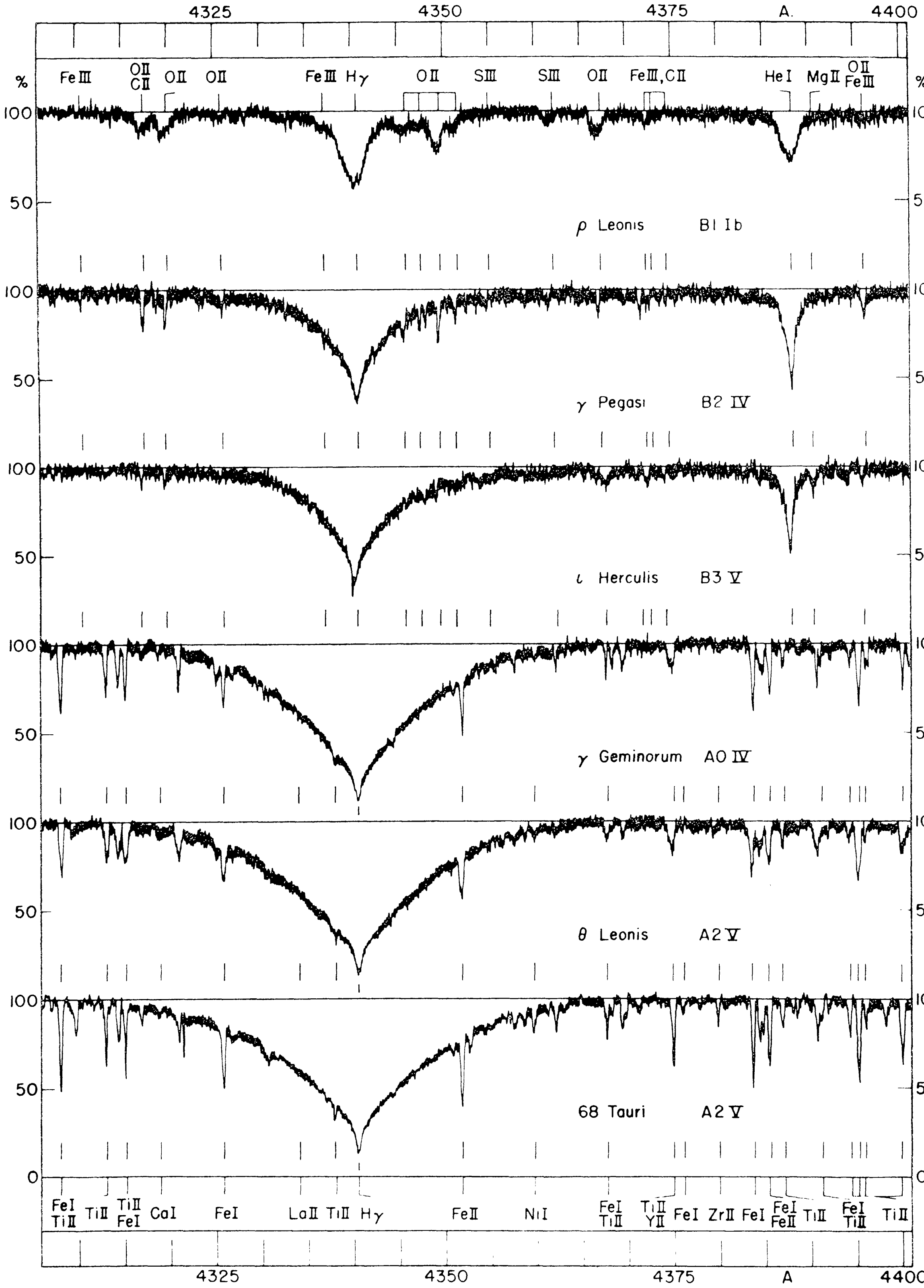

Figure 9. Intensity tracings of representative B- and A-type stellar spectra in the region 4300A. to 4400A. The identifications above the tracings refer to lines observed in the earlier type spectra; those below the tracings refer to lines found in the spectra of later type. The tracings have been rectified to set the adopted continuum at 100 per cent intensity. All tracings were made from Victoria grating spectra having an original dispersion of 3.4 A/mm.

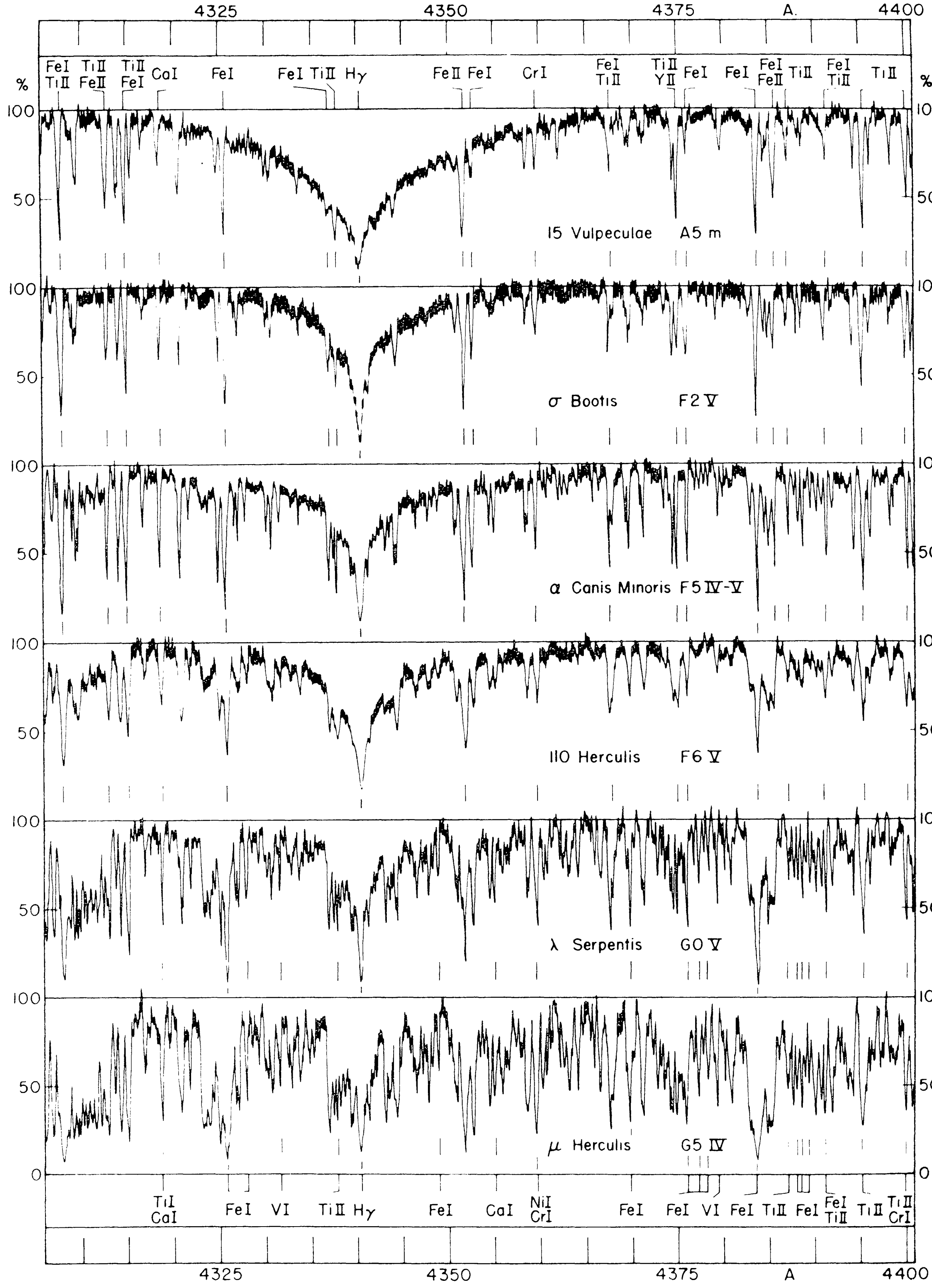

Figure 10. Intensity tracings of representative A- to G-type stellar spectra in the region 4300A. to 4400A. The identifications above the tracings refer to lines observed in the earlier type spectra; those below the tracings refer to lines found in the spectra of later type. The tracings have been rectified to set the adopted continuum at 100 per cent intensity. All tracings were made from Victoria grating spectra having an original dispersion of 3.4 A/mm.

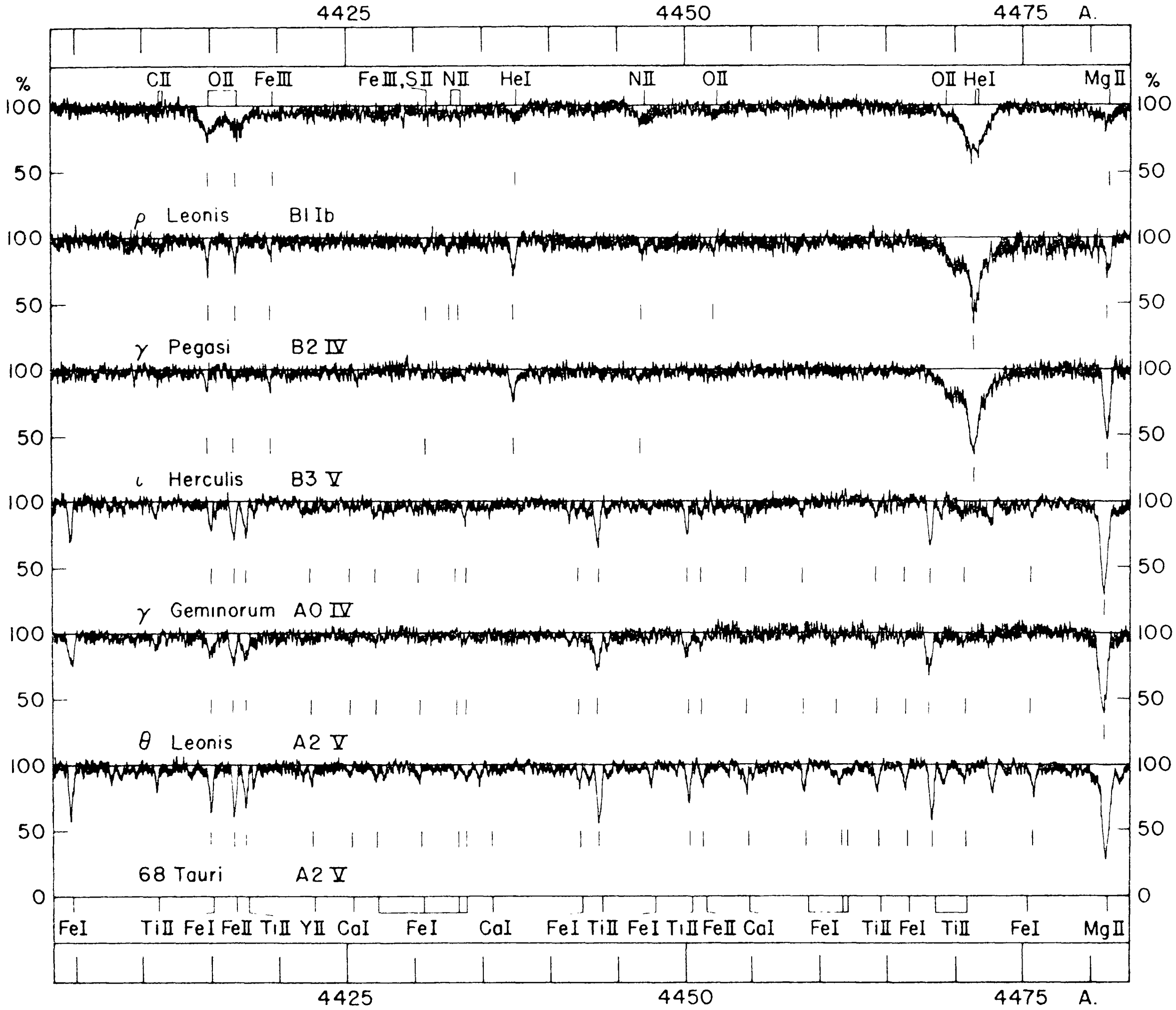

Figure 11. Intensity tracings of representative B-and A-type stellar spectra in the region 4404A. to 4483A. The identifications above the tracings refer to lines observed in the earlier type spectra; those below the tracings refer to lines found in the spectra of later type. The tracings have been rectified to set the adopted continuum at 100 per cent intensity. All tracings were made from Victoria grating spectra having an original dispersion of 3.4 A/mm.

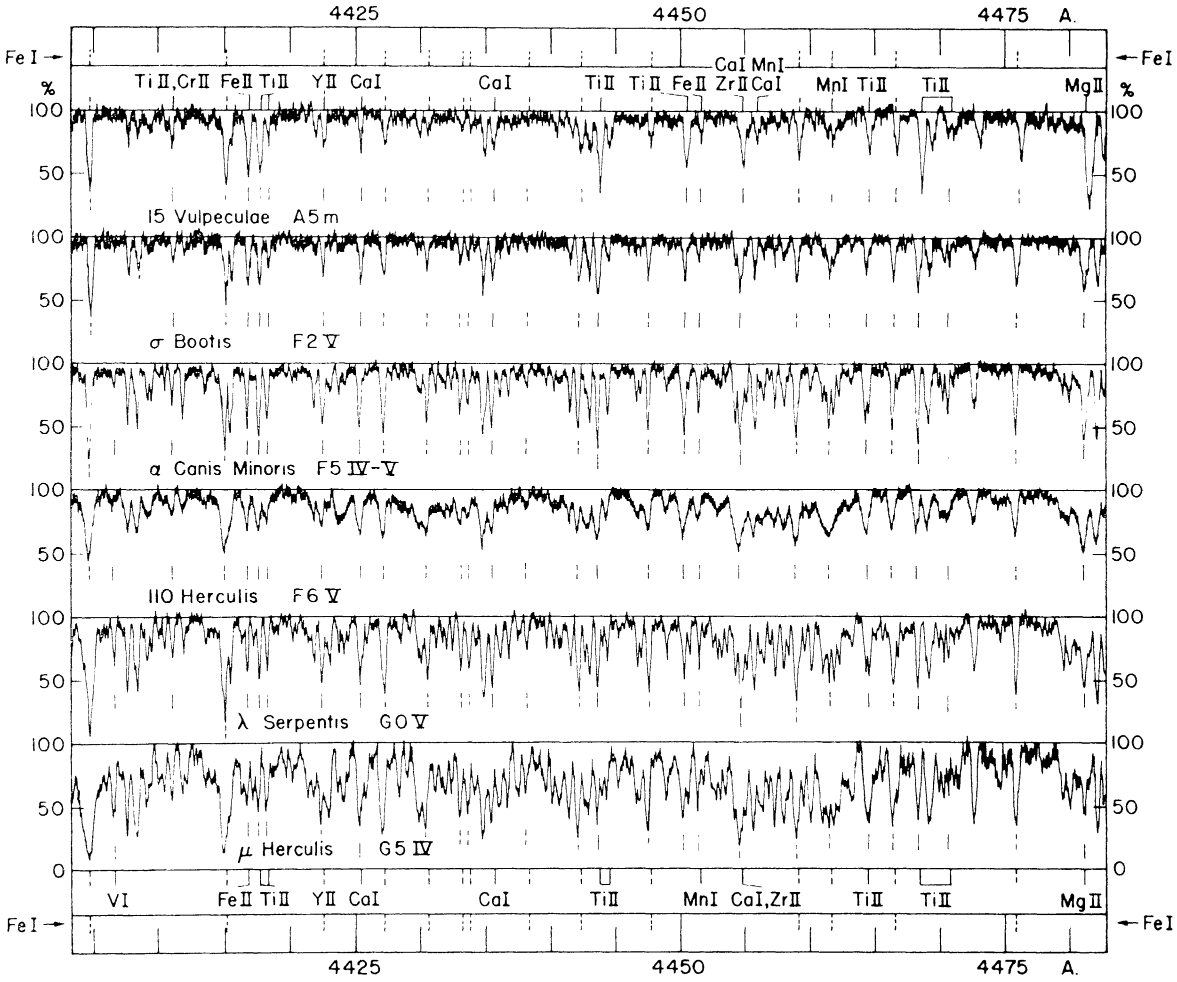

Figure 12. Intensity tracings of representative A- to G-type stellar spectra in the region 4404A. to 4483A. The identifications above the tracings refer to lines observed in the earlier type spectra; those below the tracings refer to lines found in the spectra of later type. The tracings have been rectified to set the adopted continuum at 100 per cent intensity. All tracings were made from Victoria grating spectra having an original dispersion of 3.4 A/mm.

TABLE 2. EQUIVALENT WIDTHS OF LINES IN B-TYPE SPECTRA

λ	Atom	R.M.T.	ρ LEONIS						γ PEGASI					ι HERCULIS			
			IIIL$_A$	BL84	BL169	BL496	Mt. Wilson	Mean	IIIL$_A$	BL84	BL169 BL496	Mt. Wilson	Mean	IIIL$_A$	BL169	9643	Mean
3911.96	O II	17	—	119	116	130	135	125	—	50	44	51	48	—	9	13	11
12.09	O II	17															
18.98	C II	4	—	—	—	—	—	—	—	99	82	79	85	—	71	90	80
19.00	N II	17															
19.29	O II	17	—	147	142	128	147	141	—	28	24	24	28	—	—	—	—
20.69	C II	4	—	110	100	95	96	100	—	105	96	113	102	—	82	96	89
23.48	S II	55	—	18	15	12	21	16	—	19	10	16	16	—	16	35	26
24.44	Si III	—	—	102	80	93	82	89	—	55	36	36	42	—	7	15	11
26.53	He I	58	—	238	204	204	239	221	—	498	548	519	534	—	495	484	490
28.62	S III	8	—	54	62	67	62	61	—	21	19	23	21	—	—	—	—
28.62	A II	10															
33.29	S II	55	—	—	—	—	—	—	—	14	22	17	18	—	29	18	23
33.66	Ca II	1	—	145	109	127	121	125	—	97	82	93	91	—	101	122	111
33.66	Ca II	1	—	52	70	54	65	60*	—	—	—	—	—	—	—	—	—
33.66	Ca II	1	—	17	19	23	36	24*	—	—	—	—	—	—	—	—	—
35.91	He I	57	—	—	—	—	38	—	—	21	20	34	27	—	82	58	70
45.05	O II	6	—	65	65	69	63	65	—	41	34	38	38	—	20	15	18
54.33	Fe III	120	—	—	—	—	—	—	—	55	59	57	54	—	23	17	20
54.37	O II	6															
70.07	Hϵ	1	—	—	—	—	2050	—	—	—	—	4130	4450	—	—	—	—
95.00	N II	12	—	314	—	384	344	347	—	89	80	87	83	—	52	51	52
3998.79	S II	59	—	—	—	—	—	—	—	9	—	—	—	—	14	15	14
4005.02	Fe III	45	—	—	—	—	—	—	—	21	22	21	23	—	—	—	—
09.27	He I	55	308	305	315	402	339	334	600	731	601	664	663	585	572	657	605
26.19	He I	18	835	819	741	826	780	800	1360	1445	1285	1305	1325	1255	1325	1525	1350
26.36	He I	18															
32.81	S II	59	—	—	—	—	—	—	—	—	—	—	—	14	17	14	15
35.09	N II	39	68	74	66	83	95	77	47	38	30	25	31	16	9	15	13
35.09	O II	51															
41.31	O II	50	96	110	136	159	126	125	48	46	34	43	41	16	22	21	20
41.32	N II	39															
43.54	N II	39	59	57	93	96	76	76	19	26	27	23	25	13	17	13	14
43.54	Fe III	—															
4044.75	N II	39	—	—	—	—	19	—	7	10	8	10	11	13	15	20	16

*Interstellar line.

TABLE 2. EQUIVALENT WIDTHS OF LINES IN B-TYPE SPECTRA (Continued)

λ	Atom	R.M.T.	ρ LEONIS						γ PEGASI					ι HERCULIS			
			IIIL$_A$	BL84	BL169	BL496	Mt. Wilson	Mean	IIIL$_A$	BL84	BL169 BL496	Mt. Wilson	Mean	IIIL$_A$	BL169	9643	Mean
4060.58	O II	97	36	—	28	—	12	30	16	14	14	8	13	—	—	—	—
60.98	O II	97					14		8	9	10	10	11	—	—	—	—
62.90	O II	50	—	—	32	25	—	28	18	13	18	17	17	—	—	—	—
63.08	Fe III	—															
69.64	O II	10	—	—	—	—	—	—	125	37	40	38	41	13	17	13	14
69.90	O II	10	267	235	205	265	246	244		74	54	49	58	17	24	14	18
71.20	O II	49	—	—	—	—	—	—	10	6	12	11	11	—	—	—	—
72.16	O II	10	245	240	189	221	230	230	54	80	58	67	69	19	29	28	25
74.52	C II	36	—	—	—	—	—	—	41	33	25	20	26	16	16	18	17
74.84	C II	36	—	—	—	—	—	—	26	12	14	17	16	9	15	11	12
75.85	C II	36	269	315	213	258	268	265	86	86	69	92	83	44	33	55	44
75.87	O II	10															
78.86	O II	10	—	—	—	—	64	—	38	29	—	32	30	13	10	12	12
82.28	N II	38	—	—	—	—	34	—	—	—	—	10	—	—	—	—	—
83.91	O II	49	—	—	—	—	34	—	—	31	—	17	23	—	—	—	—
85.12	O II	10	45	55	—	—	73	58	—	—	—	29	33	—	—	—	—
87.16	O II	48	—	—	—	—	47	—	—	—	—	13	18	—	—	—	—
4089.30	O II	48	246	228	—	—	268	247	—	—	—	29	31	—	—	—	—
4101.74	Hδ	1	2195	—	—	—	1960	2075	4900	—	—	4400	4650	5180	—	5730	5450
16.10	Si IV	1	151	—	—	—	165	158	—	—	—	—	—	—	—	—	—
19.22	O II	20	155	—	—	—	120	138	67	—	—	66	64	12	—	34	23
20.81	He I	16	377	—	—	—	425	401	289	—	—	276	288	234	—	202	218
20.99	He I	16															
28.05	Si II	3	—	—	—	—	14	—	34	—	—	35	36	74	—	59	67
28.07	Ne I	—															
30.88	Si II	3	—	—	—	—	25	—	38	—	—	26	33	88	—	73	80
31.70	Fe III	—	—	—	—	—	—	—	—	—	—	—	—	8	—	13	10
31.73	A II	—															
32.81	O II	19	107	—	—	—	59	—	37	—	—	29	33	9	—	11	10
33.67	N II	65	—	—	—	—	20	—	—	—	—	—	—	—	—	—	—
37.76	Fe III	118	—	—	—	—	20	—	30	—	—	16	23	14	—	11	12
39.35	Fe III	118	—	—	—	—	27	—	31	—	—	13	21	—	—	—	—
43.76	He I	53	525	—	—	—	445	485	585	—	—	730	730	705	—	905	805
49.90	Al III	5	—	—	—	—	—	—	33	—	—	17	34	11	—	7	9
50.14	Al III	5							—			14		—	—	10	—
53.10	Fe III	—	120	—	—	—	135	128	25	—	34	22	26	39	—	52	46
53.10	S II	44															

4153.30	O II	19	—	—	—	—	—	—	33	—	45	36	37	—	—	—	—
56.54	O II	19	—	—	—	—	43	—	16	—	—	15	15	—	—	11	—
62.70	S II	44,65	—	—	—	—	25	—	34	—	29	26	28	36	—	47	42
64.73	Fe III	118	44	—	—	—	49	46	29	—	41	27	33	11	—	9	10
66.84	Fe III	118	—	—	—	—	—	—	25	—	25	14	19	6	—	10	8
68.97	He I	52	99	—	—	—	108	104	100	—	105	86	96	92	81	70	81
71.61	N II	43	33	—	—	—	42	38	—	—	—	—	—	—	—	10	—
74.04	S II	64	—	—	—	—	—	—	28	—	15	6	10	12	22	30	21
74.26	Fe III	—									24	12	17	20	18	24	21
76.16	N II	42	—	—	—	—	94	—	32	—	22	27	25	9	17	12	13
79.67	N II	50	56	—	—	—	61	59	16	—	12	9	11	11	11	12	11
85.46	O II	36	66	—	—	86	100	84	40	—	33	30	31	12	21	12	15
89.71	S II	44,64	74	—	—	106	72	84	50	—	41	39	40	—	29	23	26
4189.79	O II	36															
4211.65	Fe III	—	—	—	—	—	—	—	—	—	—	—	—	—	13	5	9
17.23	S II	44	—	—	—	—	—	—	13	—	10	5	8	10	8	10	9
22.15	P III	3	—	—	—	—	—	—	20	31	31	15	25	8	12	5	8
22.27	Fe III	—															
27.75	N II	33	73	81	63	86	72	75	16	20	12	12	17	12	12	8	11
30.98	S II	67	—	—	—	—	—	—	10	11	5	7	8	7	10	11	9
35.56	Fe III	—	—	—	—	—	—	—	14	11	14	6	10	11	8	7	9
36.93	N II	48	96	125	117	113	107	112	42	32	32	34	32	17	19	28	21
37.05	N II	48															
41.79	N II	47,48	164	157	147	170	158	159	46	35	34	35	35	19	24	23	22
43.71	A II	63,79	—	—	—	—	—	—	—	8	10	5	8	—	9	8	8
43.75	Fe III	—															
46.68	P III	3	—	—	—	—	—	—	—	18	10	7	12	—	10	10	10
53.48	Fe III	—	256	255	225	246	222	240	47	52	43	44	46	12	22	17	17
53.59	S III	4															
53.74	O II	101	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
53.98	O II	101	—	—	—	—	—	—	23	18	21	10	19	—	—	—	—
57.42	S II	66	—	—	—	—	—	—	10	12	10	5	9	6	11	5	7
61.40	Fe III	121	—	—	—	—	—	—	—	6	9	3	7	4	10	4	6
67.00	C II	6	238	220	208	249	198	223	217	220	202	194	208	203	221	199	208
67.26	C II	6															
67.80	S II	49	—	—	—	—	—	—	13	11	14	10	12	22	35	17	25
73.40	Fe III	121	—	—	—	—	10	—	12	9	9	6	9	12	14	13	13
75.52	O II	67	—	50	57	62	36	51	34	31	33	34	31	8	19	12	13
75.90	O II	68	—	36		57	45	46	—	—	—	—	—	—	—	—	—
76.71	O II	54,67	—	36	—	54	32	41	21	18	17	17	18	—	—	5	—
77.40	O II	67,68	—	38	52	54	29	43	15	11	19	14	14	6	11	14	10
77.90	O II	67	—	—	—	—	—	—	18	11	5	9	9	—	—	—	—
82.63	S II	49	—	—	—	—	—	—	—	—	—	—	—	13	23	16	17
82.90	A II	7	—	—	—	—	33	—	28	16	8	16	14	—	—	—	—
82.96	O II	67															

TABLE 2. EQUIVALENT WIDTHS OF LINES IN B-TYPE SPECTRA (Continued)

λ	Atom	R.M.T.	ρ LEONIS						γ PEGASI					ι HERCULIS			
			IIIL$_A$	BL84	BL169	BL496	Mt. Wilson	Mean	IIIL$_A$	BL84	BL169 BL496	Mt. Wilson	Mean	IIIL$_A$	BL169	9643	Mean
4283.70	S III	—	50	—	—	62	24	45	28	22	21	10	17	—	—	—	—
83.75	O II	67															
84.99	S III	4	—	77	107	126	114	106	22	32	24	31	29	—	—	6	—
85.70	O II	78	152	—	—	—	—	—	18	19	15	16	16	—	—	—	—
86.16	Fe III	121		34	53	60	32	42	—	14	8	8	10	10	12	5	9
88.83	O II	54	—	—	—	—	—	—	20	12	9	10	10	—	23	—	—
91.25	O II	55	—	—	—	—	—	—	18	16	13	12	14	—	6	6	6
92.23	O II	78	—	—	—	—	—	—	—	—	10	14	10	—	—	—	—
94.43	S II	49	—	—	—	—	11	—	46	23	16	13	17	—	8	—	—
94.82	O II	54	—	44	46	55	25	42		25	21	21	22	22	42	26	30
4296.85	Fe III	121	—	—	—	—	—	—	20	15	20	12	16	12	19	8	13
4303.82	O II	54	58	42	22	—	47	42	32	34	30	18	29	11	10	12	11
04.78	Fe III	121	62	48	19	—	21	38	11	12	15	14	14	7	9	5	7
07.20	Al II	85	—	—	—	—	—	—	9	14	12	14	13	—	—	—	—
07.31	O II	53															
08.96	O II	64	—	—	—	—	—	—	13	9	10	12	11	—	—	—	—
10.36	Fe III	121	30	20	11	—	19	20	13	17	12	13	14	6	8	9	8
13.43	O II	78	15	—	—	—	25	20	—	—	—	—	—	—	—	—	—
15.80	O II	78	—	—	—	—	—	—	—	6	—	5	6	—	—	—	—
17.14	O II	2	165	172	120	124	176	175	64	67	52	61	59	20	24	20	21
17.26	C II	28			62	54			—	—	—	—	—	—	—	—	—
17.65	O II	53															
18.60	C II	28	—	—	—	—	—	—	17	8	10	5	11	10	11	15	12
18.68	S II	49															
19.63	O II	2	194	214	191	176	195	194	70	60	46	41	50	20	12	22	18
25.77	O II	2	33	56	47	26	41	41	—	18	16	18	20	6	5	9	7
27.48	O II	41	—	—	—	—	—	—	—	11	—	12	13	—	—	—	—
40.47	Hγ	1	1835	1910	1710	1755	1835	1810	4275	4765	4285	3980	4380	5055	5650	6385	5700
45.56	O II	2	175	192	150	183	162	172	—	17	20	23	22	—	—	—	—
47.42	O II	16	94	117	92	89	107	100	—	10	22	25	20	—	—	—	—
49.43	O II	2	388	343	366	332	347	355	60	45	48	59	54	10	15	16	14
51.27	O II	16	177	141	110	139	158	145	49	29	30	46	40	8	5	15	9
52.57	Fe III	4	—	—	—	—	—	—	12	9	17	18	13	7	4	12	8
54.56	S III	7	—	45	—	—	28	37	—	10	12	15	13	—	—	—	—
61.53	S III	4	44	45	54	37	69	50	22	20	14	15	17	6	9	10	8

4366.90	O II	2	208	168	180	178	207	188	60	61	40	50	53	12	17	18	16
69.28	O II	26	—	—	—	—	—	—	16	17	7	11	13	4	12	8	8
71.34	Fe III	4	—	—	—	—	—	—	—	—	27	11	14	—	—	—	—
71.36	A II	1															
72.09	A II	86															
72.14	Fe III	122	—	—	—	—	—	—	22	11	25	12	14	7	15	11	11
72.16	Ne I	—															
72.31	Fe III	122															
72.35	C II	45	59	—	61	55	77	63	55	33	14	14	18	9	13	19	14
72.49	C II	45															
72.81	Fe III	122	—	—	—	—	—	—	—	16	12	11	13	—	—	—	—
74.27	C II	45	—	—	—	—	—	—	23	14	25	19	21	9	19	22	17
74.28	Fe III	—															
79.74	A II	7	—	—	—	—	—	—	—	—	—	—	—	8	13	10	10
82.51	Fe III	4	—	—	—	—	—	—	9	8	17	8	10	10	11	20	14
83.24	[He I]	—	—	—	—	—	—	—	—	—	—	—	—	17	35	22	25
84.64	Mg II	10	—	—	—	—	—	—	—	14	—	10	11	21	18	21	20
87.93	He I	51	603	501	508	517	514	530	754	863	957	704	820	692	790	828	770
90.58	Mg II	10	—	—	—	—	—	—	6	10	—	18	16	29	35	27	30
91.84	S II	43	—	—	—	—	—	—	—	—	—	—	—	10	14	10	11
95.76	Fe III	4,—	—	—	—	—	—	—	43	54	12	41	47	—	5	13	9
4395.95	O II	26	59	51	50	57	60	55			35			21	25	18	21
4409.98	C II	40	—	—	—	—	—	—	10	16	13	12	12	—	—	9	—
11.16	C II	39	—	—	—	—	—	—	27	24	18	21	22	13	21	12	15
11.51	C II	39	—	—	—	—	—	—	22	21	16	16	18	11	10	10	10
14.91	O II	5	290	310	255	260	300	285	67	84	81	77	79	28	39	31	33
16.98	O II	5	205	243	194	203	219	215	68	64	65	69	66	18	40	29	29
19.60	Fe III	4	86	80	54	59	78	71	41	29	37	41	34	24	39	25	29
20.90	A II	1	—	—	—	—	—	—	—	—	—	—	—	7	11	5	8
25.40	Ne I	—	—	—	—	—	—	—	—	—	—	—	—	18	7	7	11
26.01	A II	7	—	—	—	—	—	—	—	10	5	19	11	10	11	10	10
27.21	N II	56	43	32	19	32	34	32	—	8	4	7	7	—	—	—	—
27.97	N II	55	32	18	19	35	35	28	—	6	4	6	6	—	—	—	—
28.00	Mg II	9	—	—	—	—	—	—						20	8	14	14
30.18	A II	7	—	—	—	—	—	—	—	7	5	8	7	—	8	16	12
31.02	Fe III	4	21	28	19	35	26	26	—	14	28	20	21	18	16	18	17
31.02	S II	32															
31.02	A II	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
31.82	N II	55	—	11	10	23	26	18	—	—	—	—	—	—	9	4	7
32.74	N II	55	58	60	52	65	53	58	—	16	27	21	20	18	9	15	14
33.48	N II	55	72	45	60	40	47	53	—	8	14	7	9	—	4	5	5
33.99	Mg II	9	—	—	—	—	—	—	—	—	—	8	7	14	24	16	18
37.55	He I	50	106	80	104	77	121	98	144	139	116	132	131	143	174	156	158
39.87	S III	7	10	5	12	6	19	10	—	—	8	—	8	8	9	10	9
41.99	N II	55	16	13	15	10	26	16	—	8	8	10	9	7	6	8	7
43.05	O II	35	28	18	18	14	22	20	—	16	12	12	14	—	—	9	—

TABLE 2. EQUIVALENT WIDTHS OF LINES IN B-TYPE SPECTRA (Concluded)

λ	Atom	R.M.T.	ρ LEONIS						γ PEGASI					ι HERCULIS			
			IIIL$_A$	BL84	BL169	BL496	Mt. Wilson	Mean	IIIL$_A$	BL84	BL169 BL496	Mt. Wilson	Mean	IIIL$_A$	BL169	9643	Mean
4447.03	N II	15	172	145	160	160	172	162	—	51	39	50	47	16	27	25	23
48.21	O II	35	30	20	21	15	28	23	—	17	15	16	16	—	—	9	—
52.38	O II	5	82	45	68	58	70	65	—	33	22	38	29	7	11	10	9
63.58	S II	43	—	—	—	—	—	—	—	20	10	15	15	—	—	10	—
65.40	O II	94	—	17	22	8	24	18	—	—	—	—	—	—	—	14	—
66.32	O II	87	—	—	—	—	—	—	—	9	10	16	11	—	—	8	—
69.32	O II	59,94	82	51	90	56	65	69	—	—	—	—	—	—	—	—	—
69.92	[He I]	15	—	—	—	—	—	—	1400	1320	1110	1235	1270	1150	—	1325	1240
71.48	He I	14	978	798	771	764	901	842									
71.69	He I	14															
77.74	N II	21	—	—	—	—	24	—	—	13	26	12	15	—	—	—	—
77.88	O II	88															
79.89	Al III	8	38	28	—	25	32	31	54	37	46	51	46	19	—	16	18
79.97	Al III	8															
81.13	Mg II	4	195	174	142	147	197	171	175	180	142	165	164	231	—	216	223
81.33	Mg II	4															
4491.25	O II	86	—	—	—	—	—	—	—	7	—	—	12	—	—	12	—
4512.54	Al III	3	—	—	—	—	—	—	—	41	—	—	37	—	—	—	—
29.18	Al III	3	—	—	—	—	—	—	—	71	—	—	66	—	—	—	—

TABLE 3. EQUIVALENT WIDTHS OF LINES IN A-TYPE SPECTRA

λ	Atom	R.M.T.	γ GEMINORUM			θ LEONIS				68 TAURI				15 VULPECULAE				
			BL169a	BL169b	Mean	IIIL$_A$	BL169	Palomar	Mean	BL169a	BL169b	BL496	Mean	IIIL$_A$	BL169	MtW 71B	Palomar	Mean
3902.95	Fe I	45	—	—	—	—	—	80	—	—	—	—	—	—	192	—	210	200
03.90	Fe I	429	—	—	—	—	—	—	—	—	—	43	—	—	87	—	83	87
05.53	Si I	3	—	—	—	—	—	105	—	—	—	133	—	—	192	—	215	205
05.64	Cr II	167																
05.88	Cr II	128	—	—	—	—	—	—	—	—	—	40	—	—	50	—	36	43
05.89	Nd II	—																
06.48	Fe I	4	—	—	—	—	—	—	—	—	—	58	—	—	151	—	160	156
07.10	Eu II	5	—	—	—	—	—	—	—	—	—	6	—	—	45	—	28	36
07.94	Fe I	280	—	—	—	—	—	—	—	—	—	17	—	—	57	—	56	61
09.66	Fe I	565	—	—	—	—	—	—	—	—	19	20	20	—	69	—	36	52
10.84	Fe I	284	—	—	—	—	—	—	—	—	12	8	10	—	38	—	28	33
12.32	Ti II	97	—	—	—	—	—	—	—	—	11	6	8	—	41	—	31	36
12.42	Ce II	60																
13.46	Ti II	34	126	—	—	—	128	127	128	—	153	169	161	—	250	—	270	260
15.94	Zr II	17	—	—	—	—	—	—	—	—	34	39	36	—	99	—	98	98
16.42	V II	10	31	—	35	—	39	35	37	—	64	66	65	—	107	—	109	108
16.73	Fe I	606	23	—	—	—	—	—	—	—	37	37	37	—	73	—	65	73
17.18	Fe I	20	17	—	—	—	—	—	—	—	33	36	34	—	89	—	86	88
18.32	Fe I	124	32	—	—	—	—	—	—	—	35	39	37	—	96	—	100	98
18.51	Fe II	191	26	—	—	—	40	40	40	—	58	64	61	—	84	—	98	91
19.07	Fe I	430	17	—	—	—	10	7	8	—	34	37	36	—	75	—	70	72
19.16	Cr I	23																
20.26	Fe I	4	50	—	54	—	48	51	50	—	90	92	91	—	192	—	180	192
20.65	Fe I	153	24	—	—	—	11	18	14	—	27	26	26	—	20	—	8	14
21.02	Zr II	42	10	—	—	—	—	—	—	—	20	17	18	—	51	—	37	44
22.08	Fe I	153	—	—	—	—	5	—	—	—	5	6	6	—	4	—	3	4
22.91	Fe I	4	57	57	58	—	58	64	61	—	105	102	104	—	230	—	205	220
25.20	Fe I	567	—	—	—	—	—	—	—	—	9	13	11	—	22	—	17	20
25.65	Fe I	364	—	—	—	—	14	18	16	—	30	27	28	—	59	—	42	50
25.95	Fe I	364	30	19	23	—	19	17	18	—	46	47	46	—	95	—	94	94
26.00	Fe I	562																
26.50	V II	11	—	—	—	—	—	—	—	—	18	13	16	—	14	—	6	10
27.92	Fe I	4	73	63	68	—	76	75	76	—	133	132	132	—	235	—	210	225
29.15	Ti II	97	—	—	—	—	13	—	—	—	31	29	30	—	91	—	69	80
29.73	V II	10	—	14	12	—	15	—	—	—	28	25	26	—	35	—	13	24
30.30	Fe I	4	84	66	76	—	88	75	82	—	136	123	130	—	265	—	230	250
32.01	Ti II	34	50	—	65	—	49	38	44	—	54	78	66	—	105	—	75	90

TABLE 3. EQUIVALENT WIDTHS OF LINES IN A-TYPE SPECTRA (Continued)

λ	Atom	R.M.T.	γ GEMINORUM			θ LEONIS				68 TAURI				15 VULPECULAE				
			BL169a	BL169b	Mean	IIIL_A	BL169	Palomar	Mean	BL169a	BL169b	BL496	Mean	IIIL_A	BL169	MtW 71B	Palomar	Mean
3933.66	Ca II	1	1395	1325	1285	—	1210	1170	1190	—	1485	1375	1430	—	3790	—	3810	3800
35.94	Fe II	173	43	—	60	—	55	59	57	—	96	90	93	—	134	—	98	116
37.33	Fe I	278	6	—	—	—	—	—	—	—	17	17	17	—	34	—	20	29
38.29	Fe II	3	62	60	65	—	68	60	64	—	87	91	89	—	165	—	148	156
38.97	Fe II	190	30	27	29	—	34	30	32	—	46	44	45	—	41	—	33	37
40.88	Fe I	20	—	—	—	—	—	—	—	—	12	12	12	—	64	—	—	—
41.28	Fe I	562	9	—	—	—	—	—	—	—	17	20	18	—	47	—	—	49
41.51	Nd II	27	—	—	—	—	—	—	—	—	9	8	8	—	25	—	—	—
42.44	Fe I	364	13	—	—	—	—	—	—	—	35	34	34	—	78	—	64	72
44.01	Al I	1	86	71	79	—	110	88	99	—	153	147	150	—	235	—	205	225
44.75	Fe I	361	9	—	—	—	20	23	22	—	24	16	20	—	75	—	56	66
44.89	Fe I	430	—	—	—	—	—	—	—	—	16	14	15	—	36	—	—	—
45.12	Fe I	280	46	—	—	—	18	22	20	—	56	62	59	—	137	—	—	—
45.21	Fe II	3																
47.00	Fe I	561	19	—	—	—	18	—	—	—	29	26	28	—	62	—	62	60
47.53	Fe I	361,426	46	—	40	—	15	—	—	—	35	35	35	—	66	—	47	56
48.11	Fe I	562	31	—	44	—	16	—	—	—	42	48	45	—	88	—	69	81
95.20	Fe I	604	12	—	—	—	9	4	6	28	31	31	30	—	—	—	—	—
96.00	Fe I	279	8	—	—	—	—	—	—	16	12	17	15	—	—	31	—	—
97.13	V II	9	29	—	—	—	24	16	20	35	43	50	43	—	—	64	—	—
97.39	Fe I	278	34	—	30	—	22	26	24	74	61	63	66	—	—	133	—	—
97.43	Y II	24																
98.05	Fe I	276	32	26	31	—	16	9	12	36	43	42	40	—	131	96	—	113
98.64	Ti I	12	—	—	—	—	5	—	—	13	8	11	11	—	—	27	—	—
3998.98	Zr II	16	14	—	—	—	32	31	32	38	40	49	42	—	122	107	—	118
4000.47	Fe I	426	9	—	—	—	12	6	9	15	18	24	19	—	78	64	—	71
01.67	Fe I	72	—	—	—	—	—	—	—	12	16	11	13	—	54	38	—	46
02.07	Fe II	29	35	29	31	17	25	18	20	36	38	44	39	—	69	43	—	56
02.48	Cr II	166	41	—	—	31	25	17	24	40	35	42	39	—	48	27	—	38
02.55	Fe II	190				—	12	—	—									
02.94	V II	9	13	—	—	—	—	—	—	33	32	37	34	—	73	48	—	61
03.33	Cr II	194	22	—	—	15	12	10	12	14	21	24	20	—	22	10	—	16
03.76	Fe I	728	—	—	—	—	—	—	—	4	12	10	9	—	52	27	—	39
03.77	Ce II	188	—	—	—	—	—	—	—	—	—	—	—	—				
04.83	Fe I	601	7	—	—	—	14	—	—	24	29	33	29	—	75	43	—	59
05.25	Fe I	43	64	56	59	57	77	58	64	105	108	101	105	215	215	215	—	215

4005.71	V II	32	47	47	47	64	62	50	59	99	90	87	92	108	131	123	—	121
06.31	Fe I	603	—	—	—	10	11	—	10	14	19	14	16	31	52	25	—	39
06.63	Fe I	488	14	—	—	15	7	—	11	12	14	15	14	43	68	47	—	53
06.77	Fe I	320								14	21	16	17					
07.28	Fe I	277	6	—	—	—	9	—	—	12	18	17	16	44	68	46	—	53
08.17	V II	32	—	—	—	—	4	—	—	9	12	7	9	13	18	9	—	13
08.91	Gd II	—	—	—	—	—	—	—	—	6	10	10	9	30	27	26	—	28
09.71	Fe I	72	25	18	21	18	20	16	18	34	40	40	38	87	98	85	—	90
10.41	—	—	—	—	—	—	—	—	—	6	5	7	6	—	7	10	—	8
10.58	—	—	6	—	—	—	—	—	—	5	16	6	9	19	22	14	—	18
12.37	Ti II	11	93	—	—	71	108	84	88	122	130	133	128	245	210	215	—	225
12.39	Ce II	206																
13.80	Fe I	485	—	—	—	10	—	—	—	10	17	16	14	43	40	43	—	42
13.82	Fe I	486																
14.49	Sc II	8	27	—	—	14	27	17	19	34	45	51	43	104	103	96	—	101
14.53	Fe I	802																
15.20	Fe II	142	—	—	—	—	—	—	—	76	62	68	69	—	—	—	—	—
15.50	Ni II	12	32	29	28	35	58	42	45					97	108	120	—	108
16.43	Fe I	560	6	9	8	—	—	—	—	6	7	9	7	19	20	19	—	19
16.82	V II	202	—	—	—	—	14	—	—	—	9	5	7	—	6	13	—	10
17.16	Fe I	527	15	14	13	13	14	9	12	27	32	21	27	66	79	77	—	74
17.29	V II	216																
17.60	Ce II	163	—	—	—	—	—	—	—	12	18	18	16	39	47	41	—	42
18.10	Mn I	5	8	—	—	—	17	7	12	16	22	17	18	81	51	42	—	45
18.28	Fe I	560	12	—	—	—				18	25	19	21		40	47	—	42
19.05	Fe I	219	—	—	—	—	—	—	—	—	4	4	4	16	20	8	—	15
20.87	Nd II	19	7	—	—	—	—	—	—	10	9	5	8	19	9	7	—	12
21.87	Fe I	278	25	17	23	12	30	15	19	45	60	51	52	102	112	98	—	104
22.45	Fe I	173	—	—	—	—	—	—	—	4	8	7	6	18	—	5	—	12
22.74	Fe I	556,654	4	—	—	—	—	—	—	7	7	6	7	12	—	14	—	13
23.39	V II	32	45	40	40	44	49	44	46	72	76	72	73	102	98	98	—	99
24.11	Fe I	277	—	—	—	—	10	—	—	8	12	7	9	15	24	12	—	17
24.45	Zr II	54	49	47	62	57	72	52	60	87	98	94	93	131	125	129	—	128
24.55	Fe II	127																
25.14	Ti II	11	58	51	51	36	49	39	41	64	67	58	63	119	125	103	—	116
25.87	La II	42	—	—	—	—	—	—	—	14	7	7	9	13	19	17	—	16
26.19	He I	18	59	18	45	23	54	28	35	—	—	—	—	—	—	—	—	—
27.68	Dy II	—	—	—	—	—	—	—	—	7	12	8	9	14	26	17	—	19
28.33	Ti II	87	72	64	66	65	75	63	68	90	90	81	87	146	149	137	—	143
28.41	Ce II	47	—	—	—	—	—	—	—									
29.64	Fe I	556,563	9	—	—	14	19	—	17	38	42	44	41	96	105	87	—	96
29.68	Zr II	41																
30.19	Fe I	72	13	—	—	—	13	18	16	13	15	9	12	19	18	17	—	18
30.50	Fe I	560	—	—	—	—	—	—	—	57	45	54	52	—	76	44	—	60
30.76	Mn I	2	47	29	38	49	42	43	45	90	86	87	88	177	178	189	—	181
31.46	Fe II	151	8	—	—	10	12	7	10	20	14	11	15	22	35	17	—	25

TABLE 3. EQUIVALENT WIDTHS OF LINES IN A-TYPE SPECTRA (Continued)

λ	Atom	R.M.T.	γ GEMINORUM			θ LEONIS				68 TAURI				15 VULPECULAE				
			BL169a	BL169b	Mean	IIIL$_A$	BL169	Palomar	Mean	BL169a	BL169b	BL496	Mean	IIIL$_A$	BL169	MtW 71B	Palomar	Mean
4031.68	La II	40	—	—	—	—	—	—	—	16	17	13	15	—	64	38	—	51
31.97	Fe I	655	6	—	—	—	11	6	9	22	20	11	18	—	40	45	—	42
32.46	Fe I	320	—	—	—	—	—	6	—	16	12	12	13	59	25	10	—	17
32.64	Fe I	44	6	—	—	—	14	—	—	20	25	25	23		50	42	—	45
33.07	Mn I	2	48	—	52	54	47	45	49	103	100	89	97	174	179	163	—	171
34.10	Zr II	42	—	—	—	—	—	—	—	13	7	8	9	20	25	23	—	23
34.49	Mn I	2	14	19	17	—	17	8	12	48	46	46	47	122	126	106	—	115
35.63	V II	32	41	42	42	45	45	42	44	90	86	87	88	137	141	126	—	132
35.73	Mn I	5																
36.78	V II	9	11	10	11	7	9	6	7	20	23	27	23	28	36	31	—	32
37.33	Gd II	49	—	—	—	—	—	—	—	3	—	4	4	20	23	8	—	17
38.03	Cr II	194	18	17	18	16	11	9	12	37	29	31	32	31	26	21	—	26
38.62	Fe I	600,728	—	—	—	—	—	—	—	5	—	3	4	17	7	—	—	6
38.79	—	—	—	—	—	—	—	—	—	6	6	3	5		17	10	—	11
39.12	Fe III	45	—	—	—	—	—	—	—	6	4	6	5	—	—	6	—	—
39.57	V II	32	—	—	—	—	—	—	—	8	10	5	8	16	23	9	—	16
40.24	Zr II	54	6	—	—	11	11	5	9	11	10	13	11	25	37	18	6	27
40.76	Ce II	138	—	—	—	—	9	—	—	20	19	19	19	73	86	75	61	77
40.80	Nd II	30																
41.29	Fe I	603,654	14	10	15	18	14	10	14	37	41	39	39	106	109	97	78	103
41.36	Mn I	5																
41.64	Fe II	172	—	—	—	—	—	—	—	5	6	—	5	—	—	17	6	—
41.79	Cr I	36	8	—	—	—	—	—	—	—	4	6	5	6	7	8	5	7
42.58	Ce II	140	—	—	—	—	—	—	—	—	—	—	—	18	30	18	11	22
42.91	La II	66	—	—	—	—	8	—	—	6	10	5	7	47	54	41	42	47
43.90	Fe I	276,557	—	—	—	—	—	—	—	36	38	40	38	78	86	62	55	75
44.01	Fe II	172	29	24	25	26	27	18	24									
44.61	Fe I	359	10	9	9	14	22	8	15	20	24	19	21	68	70	57	60	63
45.14	Fe I	425	6	—	—	10	13	7	10	13	15	10	13	22	17	19	12	19
45.82	Fe I	43	134	112	116	155	161	116	144	200	196	205	200	435	425	350	435	400
46.27	V II	177	—	—	—	—	9	—	—	12	16	11	13	—	—	—	—	—
48.68	Zr II	43	—	—	—	—	—	—	—	78	80	80	79	151	142	148	109	147
48.76	Mn I	5																
48.83	Fe II	172	37	—	—	55	62	46	54	—	—	—	—	—	—	—	—	—
49.14	Cr II	193	12	—	—	—	—	—	—	15	20	16	17	10	12	10	—	11
50.32	Zr II	43	—	—	—	13	13	7	11	12	22	17	17	44	57	47	32	48
50.69	Fe I	—	—	—	—	16	—	—	—	—	10	6	8	10	15	15	7	13

4051.06	V II	32	6	—	—	11	16	7	11	9	6	5	7	21	27	21	12	23
51.34	V II	215	5	—	—	—	—	—	—	5	11	10	9	—	10	10	—	10
51.92	Fe I	700	39	30	36	27	30	23	27	46	52	49	49	70	74	74	47	73
51.97	Cr II	19																
52.31	Fe I	700,852	—	—	—	—	—	—	—	—	12	8	10	—	6	13	—	10
52.47	Fe I	563	—	—	—	—	—	—	—	10	—	12	11	23	22	27	—	24
53.27	Fe I	—	8	—	—	—	—	—	—	8	15	6	10	10	29	19	6	19
53.45	Cr II	19	—	—	—	—	20	5	12	8	11	—	10	15	18	25	6	19
53.51	Ce II	36																
53.81	Ti II	87	65	—	—	69	80	66	72	76	80	68	75	149	141	137	102	142
53.82	Fe I	485																
54.11	Cr II	19	24	—	—	—	19	—	—	31	28	29	29	12	25	25	13	21
54.18	Fe I	557																
54.83	Fe I	698	12	—	—	—	13	5	9	27	32	21	27	73	88	77	81	79
54.88	Fe I	698																
55.05	Fe I	218	—	—	—	—	—	—	—	6	12	12	10	12	9	20	—	14
55.54	Mn I	5	6	9	11	—	24	4	14	13	16	13	14	46	58	45	44	50
55.98	Fe I	914	—	—	—	20	—	—	—	6	10	9	8	16	7	12	8	12
56.07	Cr II	182																
56.21	Ti II	11	16	—	—	—	—	—	—	8	8	9	8	23	22	25	21	23
56.27	V II	14																
57.46	Fe II	212	49	46	48	34	38	27	33	60	56	49	55	116	112	102	94	112
57.51	Mg I	16	—	—	—	—	—	—	—									
58.23	Fe I	558	9	—	—	8	13	5	9	13	15	9	12	37	48	43	26	43
58.77	Fe I	120	—	—	—	—	—	—	—	6	13	8	9	—	—	—	10	—
58.91	Ca I	40	7	—	—	10	13	8	10	8	8	7	8	45	54	43	24	47
58.93	Mn I	5												—	—	—		
59.73	Fe I	767	6	—	—	—	—	—	—	9	12	5	9	27	29	23	21	26
61.09	Nd II	10	—	—	—	—	—	—	—	12	13	14	13	48	54	49	35	50
61.79	Fe II	189	8	—	—	15	14	7	12	21	13	13	16	—	7	—	7	—
61.96	Fe I	—	—	—	—					—	10	—	—	19	26	20	—	22
62.45	Fe I	359	12	15	15	12	20	15	16	39	38	33	37	80	88	92	71	86
63.60	Fe I	43	109	90	95	109	129	99	112	169	160	149	159	305	295	295	270	305
64.46	Fe I	44	12	—	—	—	—	—	—	13	12	7	11	27	32	29	20	29
64.58	Sm II	24,33	—	—	—	—	—	—	—	8	—	4	6					
65.07	V II	215	—	—	—	10	11	8	10	13	12	10	12	16	24	22	16	21
65.40	Fe I	698	—	—	—	—	—	7	—	6	7	7	7	30	32	30	15	31
66.60	Fe I	424	—	—	—	—	—	—	—	—	14	10	12	20	26	29	16	25
66.98	Fe I	358	71	—	—	82	109	82	91	134	123	117	125	188	177	196	153	187
67.03	V II	9																
67.05	Ni II	11																
67.98	Fe I	559	26	21	24	19	32	18	23	59	49	44	51	97	94	99	81	95
69.88	Fe II	188	6	—	—	—	20	10	15	21	13	13	16	17	19	19	9	18
70.03	Fe II	22																
70.77	Fe I	558	29	—	—	31	34	22	29	58	51	44	51	76	73	63	62	73
71.74	Fe I	43	92	78	83	94	113	78	95	142	136	116	131	215	235	220	215	225

TABLE 3. EQUIVALENT WIDTHS OF LINES IN A-TYPE SPECTRA (Continued)

λ	Atom	R.M.T.	γ GEMINORUM			θ LEONIS				68 TAURI				15 VULPECULAE				
			BL169a	BL169b	Mean	IIIL$_{A}$	BL169	Palomar	Mean	BL169a	BL169b	BL496	Mean	IIIL$_{A}$	BL169	MtW 71B	Palomar	Mean
4072.52	Fe I	698	23	—	—	17	20	10	16	25	31	25	27	36	46	33	27	38
72.56	Cr II	26																
73.48	Ce II	4	—	—	—	—	—	—	—	7	6	6	6	20	22	16	16	19
73.76	Fe I	558	13	—	15	12	13	11	12	25	28	23	25	72	78	68	56	72
74.79	Fe I	524	8	—	—	11	7	6	8	20	23	13	19	60	66	56	42	61
76.64	Fe I	558	34	—	38	29	24	30	23	61	53	40	51	130	128	113	94	124
76.87	Cr II	19	32	—	—	14	22		17	—	—	—	—					
4077.71	Sr II	1	92	—	87	126	154	112	131	230	190	175	198	410	365	405	385	400
4101.74	Hδ	1	—	—	—	12310	—	13270	12790	15880	—	—	—	13000	—	15100	—	13000
18.55	Fe I	801	—	—	—	58	—	45	52	92	—	—	—	185	—	136	137	160
21.32	Co I	28	—	—	—	17	—	—	—	26	—	—	—	63	—	44	46	51
22.64	Fe II	28	—	—	—	55	—	54	54	84	—	—	—	146	—	111	109	123
24.79	Fe II	22	—	—	—	11	—	19	15	17	—	—	—	89	—	69	63	79
24.91	Y II	14																
26.19	Fe I	695	—	—	—	14	—	8	11	21	—	—	—	48	—	34	30	40
27.57	Y II	15	—	—	—	—	—	—	—	45	—	—	—	—	—	87	87	87
27.61	Fe I	357																
28.05	Si II	3	—	—	90:	123	—	99	111	128	—	—	—	97	—	114	113	106
28.74	Fe II	27	—	—	27:	41	—	30	36	57	—	—	—	89	—	67	61	76
30.88	Si II	3	—	—	114	150	—	106	128	169	—	—	—	128	—	97	72	113
32.06	Fe I	43	—	—	67	72	—	55	64	218	—	—	—	245	—	240	205	235
32.90	Fe I	357	—	—	37:	18	—	—	—	38	—	—	—	99	—	103	109	103
33.87	Fe I	698	—	—	—	—	—	—	—	12	—	—	—	85	—	90	47	80
34.68	Fe I	357	—	—	53	28	—	25	26	52	—	—	—	136	—	129	128	125
37.00	Fe I	726	—	—	—	17	—	12	14	39	—	—	—	86	—	91	55	82
37.65	Ce II	2	—	—	—	—	—	—	—	—	—	—	—	62	—	63	33	62
38.40	Fe II	39	—	—	—	10	—	7	8	16	—	—	—	47	—	32	16	40
41.86	Fe I	422	—	—	—	—	—	—	—	11	—	—	—	23	—	31	13	27
43.42	Fe I	523	—	—	40	25	—	—	—	78	—	—	—	151	—	143	108	148
43.87	Fe I	43	—	—	68	75	—	71	73	121	—	—	—	225	—	199	190	205
45.77	Cr II	162	—	—	—	32	—	22	27	44	—	—	—	45	—	52	28	45
47.67	Fe I	42	—	—	—	—	—	—	—	22	—	—	—	73	—	87	40	80
49.22	Zr II	41	—	—	—	65	—	54	60	92	—	75	84	200	—	205	150	205
49.37	Fe I	694																
50.26	Fe I	695	—	—	—	16	—	—	—	25	—	12	18	22	—	36	20	29

4151.00	Cr II	163	—	—	—	18	—	12	15	26	—	25	26	82	—	89	35	74
52.17	Fe I	18	—	—	—	11	—	—	—	40	—	27	34	106	—	98	66	100
53.91	Fe I	695	—	—	—	—	—	18	—	59	—	39	49	109	108	129	80	115
54.50	Fe I	355	—	—	—	—	—	—	—	44	—	53	48	82	89	115	82	95
54.81	Fe I	694	—	—	—	—	—	29	—	52	—	46	49	115	81	119	105	105
56.24	Zr II	29	—	—	—	23	—	14	18	40	—	42	41	125	108	140	92	121
56.80	Fe I	354	—	—	—	16	—	13	14	45	—	46	46	113	101	119	78	111
57.79	Fe I	695	—	—	25:	17	—	13	15	42	—	53	48	93	71	101	92	87
58.80	Fe I	695	—	—	—	—	—	—	—	34	—	27	30	52	55	77	37	58
59.18	—	—	—	—	—	—	—	10	—	25	—	31	28	67	57	74	55	66
60.56	Fe I	419	—	—	—	8	27	10	15	29	—	37	33	24	—	22	—	23
61.08	Fe I	689	—	—	—	23	27	18	23	50	41	49	47	113	99	75	78	96
61.18	Ce II	22																
61.20	Zr II	42																
61.52	Ti II	21	—	—	—	43	37	30	37	—	—	—	—	—	—	—	—	—
61.80	Sr II	3	—	—	—	—	—	—	—	26	33	31	30	108	87	103	83	99
63.64	Ti II	105	89	71	79	93	115	79	96	123	106	112	114	190	169	175	144	175
63.68	Fe I	274,699																
65.61	Ce II	10	15	—	—	—	—	—	—	16	—	15	16	50	45	41	28	45
66.00	Ba II	4	—	—	—	6	—	—	—	11	8	—	10	15	28	28	19	24
67.27	Mg I	15	76	58	61	35	41	28	35	73	56	65	65	107	115	104	90	108
67.86	Fe I	599	—	—	—	10	—	—	—	—	—	—	—	28	28	22	11	28
70.86	Cr II	181	22	—	—	21	20	18	20	52	50	51	51	116	114	103	94	111
70.91	Fe I	482																
71.90	Ti II	105	76	65	76	91	100	77	80	124	108	—	116	230	235	210	183	225
71.90	Fe I	650																
71.92	Cr II	18																
72.64	Fe I	689	20	—	—	11	—	—	—	42	38	32	37	66	80	68	48	71
72.75	Fe I	19	—	—	—													
73.45	Fe II	27	114	91	109	119	129	106	118	159	146	148	151	230	230	235	235	235
73.54	Ti II	21																
74.09	Ti II	105	21	—	—	—	14	16	15	24	26	19	23	45	55	47	36	49
74.42	Fe I	799	—	—	—	—	—	—	—	11	6	12	10	9	25	10	9	14
74.92	Fe I	19	—	—	—	—	—	—	—	8	12	9	10	48	50	24	21	40
75.64	Fe I	354	23	19	22	16	13	10	13	44	45	55	48	99	112	94	75	100
76.44	Fe II	149	23	—	—	16	11	10	12	40	37	48	42	82	98	86	71	86
76.57	Fe I	689	—	—	—													
77.54	Y II	14	—	—	—	—	—	—	—	143	128	135	135	275	255	265	230	270
77.60	Fe I	18	—	—	—	97	100	76	91									
77.70	Fe II	21	71	—	—													
78.39	V II	25	12	—	—	—	—	—	—	14	17	19	17	20	31	11	—	21
78.86	Fe II	28	103	83	90	100	111	98	103	149	124	126	133	200	220	210	176	210
79.43	Cr II	26	49	—	—	17	33	29	26	80	72	63	72	93	111	105	80	103
79.81	Zr II	99	16	—	—	—	—	—	—	14	10	15	13	19	28	23	18	26
81.76	Fe I	354	49	—	—	48	44	38	43	87	78	80	82	177	160	157	132	167
82.38	Fe I	476a	12	—	—	—	—	—	—	20	17	16	18	38	49	50	24	44

TABLE 3. EQUIVALENT WIDTHS OF LINES IN A-TYPE SPECTRA (Continued)

λ	Atom	R.M.T.	γ GEMINORUM			θ LEONIS				68 TAURI				15 VULPECULAE				
			BL169a	BL169b	Mean	IIIL$_A$	BL169	Palomar	Mean	BL169a	BL169b	BL496	Mean	IIIL$_A$	BL169	MtW 71B	Palomar	Mean
4183.44	V II	37	24	18	21	19	14	17	17	41	39	40	40	46	66	53	30	53
84.00	Ce II	—	14	—	—	8	—	—	—	32	29	26	29	37	53	52	51	47
84.33	Ti II	21	28	—	—	31	21	18	23	41	37	28	35	86	81	71	47	79
84.90	Fe I	355	26	20	20	18	14	10	14	35	31	36	34	82	91	71	63	81
86.69	Fe II	—	15	—	—	—	10	—	—	20	19	15	18	54	75	54	46	61
86.70	Zr II	97																
87.04	Fe I	152	54	45	44	54	40	32	42	84	75	73	77	132	144	137	112	138
87.80	Fe I	152	70	58	64	82	59	59	67	120	106	104	110	153	167	171	138	164
88.72	Fe I	—	30	—	—	12	18	11	14	37	35	33	35	81	100	71	59	84
90.29	Ti II	21	16	—	—	13	—	—	—	—	—	—	—	—	22	17	—	20
90.40	V II	25								9	5	10	8	16	26	16	9	19
91.44	Fe I	152	35	—	34	44	36	32	37	76	75	73	75	148	158	150	134	152
92.07	Ni II	10	20	17	17	14	13	13	13	38	29	30	32	47	54	40	18	47
95.34	Fe I	693	40	—	35	36	26	23	28	70	52	69	64	116	114	89	87	106
95.41	Cr II	161	—	—	—	—	—	—	—	—	—	—	—					
96.22	Fe I	693	21	—	—	19	16	11	15	34	28	32	31	74	77	59	56	68
96.33	Ce II	123				—	—	—	—									
96.53	Fe I	418	—	—	—	—	—	—	—	4	6	10	7	29	46	43	23	39
98.31	Fe I	152	60	—	—	38	59	49	49	92	97	99	96	193	186	190	161	199
98.64	Fe I	693	—	—	—	—	—	—	—	26	25	22	24	—	66	63	—	64
99.10	Fe I	522	65	50	57	56	71	51	59	99	90	90	93	166	177	152	140	166
4199.97	Fe I	3	—	—	—	—	—	—	—	—	—	5	—	10	31	16	11	18
4200.40	Ti II	96	—	—	—	10	13	10	11	10	—	11	10	16	28	9	4	18
00.93	Fe I	689	12	—	—	11	14	10	12	35	19	20	25	36	63	53	27	48
02.03	Fe I	42	65	—	—	74	93	69	79	123	107	94	108	230	225	210	235	230
02.35	V II	25	—	—	—	—	—	—	—	35	21	27	28	—	46	30	19	38
02.94	Ce II	186	4	—	—	7	—	—	—	13	3	6	7	24	34	22	16	27
03.95	Fe I	850	23	—	—	17	24	17	19	48	35	42	42	91	108	—	68	95
03.99	Fe I	355	—	—	—	—	—	—	—									
05.05	Eu II	1	28	—	—	29	40	34	34	59	45	53	52	120	114	—	94	117
05.08	V II	37																
05.48	Fe II	22	18	—	—	7	11	—	9	16	25	27	23	33	55	—	28	44
05.55	Fe I	689	—	—	—	—	—	—	—									
06.38	Mn II	7	9	8	8	—	16	10	13	13	11	18	14	15	20	—	9	18
06.70	Fe I	3	8	—	—	—	—	—	—	—	—	3	—	20	44	—	12	32
07.13	Fe I	352	11	—	—	6	6	—	6	—	—	14	—	38	56	—	23	47

4207.35	Cr II	26	—	—	—	32	21	12	22	20	18	13	17	—	—	—	—	—
08.61	Fe I	689,696	10	—	—	—	8	6	7	22	13	18	18	43	51	—	31	47
08.99	Zn II	41	13	—	—	19	35	30	28	49	43	46	46	95	108	—	73	98
10.22	La II	—	25	—	—	19	30	23	24	—	—	—	—	—	—	—	—	—
10.35	Fe I	152		19	22					60	51	63	58	119	115	—	96	109
11.88	Zn II	15	9	—	—	18	22	14	18	37	26	29	31	99	89	—	60	92
13.65	Fe I	355	8	—	—	8	4	5	6	22	17	23	21	56	60	—	28	54
15.52	Sr II	1	84	65	72	126	134	118	126	193	183	179	185	330	330	—	325	330
16.19	Fe I	3	11	—	—	—	—	—	—	20	12	13	15	55	56	—	34	57
17.07	Cr II	18	—	—	—	—	—	—	—	11	10	10	10	10	20	—	—	15
17.34	Ti II	96	18	—	—	—	20	15	18	—	—	—	—	—	—	—	—	—
15.55	Fe I	693	—	—	—	—	—	—	—	45	37	40	41	87	86	—	52	86
19.36	Fe I	800	33	—	—	22	35	29	29	71	67	71	70	129	122	—	80	121
20.05	V II	25	7	—	—	—	—	—	—	20	17	9	15	6	7	—	16	6
20.35	Fe I	482	4	—	—	—	12	14	13	14	10	11	12	46	51	—	25	48
22.22	Fe I	152	25	15	23	22	30	19	24	58	48	53	53	101	107	—	79	103
24.18	Fe I	689	20	13	23	15	15	—	15	50	51	46	49	104	100	—	90	98
24.51	Fe I	689	—	—	—	—	—	—	—	18	19	18	18	23	34	—	25	28
24.85	Cr II	162	27	—	—	—	20	17	18	44	38	33	38	—	31	—	15	—
25.23	V II	37	7	—	—	16	25	20	20	19	21	19	20	—	18	—	—	—
25.46	Fe I	693	25	18	20	8	15	14	12	47	45	44	45	101	100	—	89	103
26.73	Ca I	2	95	75	84	108	109	83	100	137	135	127	133	260	270	—	270	275
27.43	Fe I	693	67	—	63	56	74	47	59	120	107	104	110	215	185	—	189	197
29.76	Fe I	41	5	—	—	—	—	—	—	6	6	8	7	29	25	—	18	27
32.06	V II	225	5	—	—	—	7	5	6	7	4	8	6	25	18	—	19	22
33.17	Fe II	27	137	126	128	156	185	170	170	193	189	176	186	270	235	—	215	260
33.61	Fe I	152	45	38	37	20	33	19	24	74	70	66	70	99	124	—	97	118
35.29	Mn I	23	12	—	—	6	13	—	10	16	14	11	14	34	36	—	28	35
35.94	Fe I	152	60	48	55	68	70	50	63	106	92	100	99	210	192	—	160	200
37.16	Fe I	—	—	—	—	—	11	5	8	3	5	5	4	15	19	—	7	17
38.03	Fe I	689,696	17	13	15	6	13	8	9	23	23	21	22	69	51	—	32	57
38.38	La II	41	—	—	—	—	—	—	—	—	—	—	—	36	41	—	25	39
38.82	Fe I	693	43	27	38	26	40	25	30	65	57	61	61	105	103	—	87	109
39.74	Fe I	416	8	—	—	5	13	11	10	23	27	30	27	98	75	—	66	86
39.85	Fe I	18,273																
40.37	Fe I	764	—	—	—	—	10	—	—	12	7	15	11	19	25	—	14	22
42.38	Cr II	31	61	62	67	76	81	67	75	118	95	104	106	131	111	—	92	121
44.80	Ni II	9	13	8	13	11	17	10	13	24	17	23	21	28	27	—	17	30
45.26	Fe I	352	16	12	15	6	—	—	—	30	22	23	25	62	63	—	41	61
46.09	Fe I	906	8	—	—	7	—	—	—	13	4	15	11	48	37	—	20	43
46.83	Sc II	7	90	73	82	104	110	86	100	43	32	40	38	215	191	—	185	205
47.43	Fe I	693	40	32	35	18	30	20	23	63	51	74	63	110	113	—	95	116
48.23	Fe I	482	15	—	11	—	—	—	—	11	4	16	10	46	29	—	—	40
50.12	Fe I	152	44	44	47	55	64	40	53	91	80	84	85	163	146	—	149	158
50.79	Fe I	42	65	52	58	62	72	52	62	113	104	111	109	178	179	—	177	190
51.73	Gd II	15	—	—	—	9	11	6	9	21	12	13	15	30	24	—	20	32

TABLE 3. EQUIVALENT WIDTHS OF LINES IN A-TYPE SPECTRA (Continued)

λ	Atom	R.M.T.	γ GEMINORUM			θ LEONIS				68 TAURI				15 VULPECULAE				
			BL169a	BL169b	Mean	IIIL$_A$	BL169	Palomar	Mean	BL169a	BL169b	BL496	Mean	IIIL$_A$	BL169	MtW 71B	Palomar	Mean
4252.62	Cr II	31	41	30	35	41	33	25	33	58	48	54	53	69	51	—	43	62
54.35	Cr I	1	60	51	59	54	63	41	53	103	103	107	104	178	146	—	148	167
58.16	Fe II	28	57	53	58	69	78	52	66	90	76	81	82	154	125	—	121	140
59.20	Mn II	7	11	—	—	—	6	4	5	14	10	15	13	—	—	—	—	—
59.99	Fe I	689	—	—	—	—	—	—	—	16	18	16	17	45	55	—	34	50
60.48	Fe I	152	83	63	75	89	95	63	82	135	117	124	125	245	205	—	200	230
61.92	Cr II	31	69	56	61	61	71	44	59	90	89	98	92	113	94	—	87	102
63.90	Fe II	—	18	—	—	13	18	8	13	14	12	17	14	17	18	—	—	18
66.97	Fe I	273	11	—	—	6	5	6	6	12	13	8	11	26	21	—	15	27
67.83	Fe I	482	9	—	—	—	12	6	9	20	18	15	18	38	48	—	28	45
68.74	Fe I	649	9	—	—	5	13	6	8	15	9	17	14	24	23	—	19	24
69.28	Cr II	31	33	25	33	21	27	20	23	40	43	47	43	64	39	—	—	52
71.16	Fe I	152	54	43	48	33	50	38	40	88	86	89	88	153	144	146	140	152
71.76	Fe I	42	96	78	88	108	110	97	105	153	151	147	150	220	230	220	230	225
73.32	Fe II	27	55	41	50	51	67	46	55	77	75	82	78	131	112	122	88	122
74.80	Cr I	1	50	37	41	42	40	29	37	75	82	89	82	144	130	130	133	136
75.57	Cr II	31	51	42	49	46	55	39	47	78	74	86	79	79	71	81	63	78
76.68	Fe I	976	—	—	—	—	6	—	—	3	4	6	4	16	15	18	9	16
77.37	Zr II	40	6	—	—	—	—	5	—	6	9	9	8	12	16	10	8	13
78.13	Fe II	32	33	—	—	22	34	21	26	43	40	48	44	55	62	62	47	60
78.23	Fe I	691																
79.02	Mo II	3	5	—	—	—	—	—	—	11	11	16	13	4	10	6	—	7
79.30	Y II	70	6	—	—	12	18	8	13	—	—	—	—	—	16	—	5	—
81.10	Mn I	23	5	—	—	—	12	5	8	9	—	13	11	12	16	22	5	17
82.41	Fe I	71	46	35	42	42	45	37	41	70	72	74	72	137	128	126	127	137
83.01	Ca I	5	16	13	15	8	14	7	10	19	14	21	18	72	90	85	65	82
84.21	Cr II	31	46	37	41	40	42	32	38	59	59	61	60	62	65	52	47	60
85.44	Fe I	597	15	—	—	7	11	9	9	26	16	19	20	39	43	59	28	49
86.13	V II	23	17	—	—	14	14	7	12	—	—	—	—	8	8	15	—	10
86.31	Fe II	—								16	11	16	14	—	9	12	—	10
86.98	Fe I	976	8	—	—	—	—	—	—	6	5	10	7	35	31	60	—	41
87.89	Ti II	20	58	45	49	65	63	41	56	76	71	75	74	144	143	166	126	151
89.36	Ca I	5	11	—	—	10	13	12	12	17	16	19	17	98	86	116	66	100
89.72	Cr I	1	39	—	30	30	40	22	31	64	75	76	72	—	127	146	127	136
90.22	Ti II	41	108	91	99	132	125	103	120	138	133	144	138	240	220	250	240	235
90.38	Fe I	416	—	—	—	—	—	—	—									
90.87	Fe I	351	6	—	—	—	—	—	—	—	—	—	—	14	31	30	12	25

4291.47	Fe I	3,41	—	—	—	—	4	—	—	3	—	6	4	12	22	25	8	20
92.25	Mn II	6	6	8	11	—	—	—	—	9	8	14	10	12	14	28	10	18
93.14	Zr II	110	5	—	—	—	—	—	—	11	6	8	8	13	15	28	10	18
94.10	Ti II	20	105	—	—	114	122	95	110	138	134	147	140	215	205	220	210	215
94.13	Fe I	41	—	—	—													
94.77	Sc II	15	—	—	—	—	—	—	—	—	—	—	—	18	25	35	13	27
96.05	La II	53	4	—	—	—	5	—	—	9	7	17	11	44	37	59	18	47
96.57	Fe II	28	69	57	68	85	91	74	83	106	103	112	107	171	148	152	129	164
96.68	Ce II	2																
98.04	Fe I	520	—	—	—	—	5	—	—	10	11	7	9	34	31	37	19	34
4299.24	Fe I	152	46	39	47	41	52	42	45	80	79	89	83	210	172	197	188	193
4300.05	Ti II	41	121	103	116	150	146	118	138	157	155	140	151	265	240	250	230	255
01.13	V II	225	—	—	—	—	—	—	—	—	—	—	—	31	21	27	10	26
01.93	Ti II	41	71	63	74	98	98	75	90	102	107	114	108	194	174	193	164	182
02.53	Ca I	5	32	25	29	—	22	18	20	40	36	40	39	106	124	128	102	118
02.58	Cr II	—																
03.17	Fe II	27	92	76	87	124	114	95	111	121	126	138	128	197	182	174	166	186
03.57	Nd II	10	—	—	—	—	—	—	—	—	5	5	5	14	22	23	18	25
05.46	Fe I	476	19	—	—	49	37	28	38	51	47	60	53	158	96	125	95	110
05.72	Sc II	15	—	—	—	6	—	—	—	11	9	11	10		36	35		36
06.72	Ce II	1	11	—	—	14	13	3	10	—	—	—	—	14	12	12	8	13
07.90	Ti II	41	120	—	—	160	143	130	144	163	174	178	172	280	265	275	285	275
07.91	Fe I	42																
09.04	Fe I	849	3	—	—	—	—	—	—	11	12	18	14	45	33	32	6	37
09.62	Y II	5	12	—	—	11	14	6	10	52	56	68	59	145	123	149	129	148
09.74	Ce II	126	—	—	—	22	30	20	24									
12.86	Ti II	41	85	—	83	108	108	85	100	—	117	104	110	185	173	197	166	189
14.08	Sc II	15	47	—	—	97	96	81	91	—	16	17	16	—	—	128	160	—
14.29	Fe II	32	23	—	—					—	56	64	60	—	—	124		
14.98	Ti II	41	101	—	—	100	125	100	108	—	142	152	147	225	215	235	—	225
15.09	Fe I	71																
16.81	Ti II	94	13	—	—	26	21	20	22	—	32	36	34	65	52	51	44	58
18.65	Ca I	5	—	—	—	10	13	12	12	—	14	17	16	81	77	79	72	72
20.74	Sc II	15	45	—	—	27	28	30	28	—	—	—	—	—	—	—	175	—
20.96	Ti II	41	26	—	—													
25.01	Sc II	15	43	—	—	27	28	30	28	—	12	34	23	106	104	96	104	102
25.76	Fe I	42	100	—	—	112	124	103	113	—	187	151	169	245	235	245	250	250
30.26	Ti II	94	18	—	—	21	26	18	22	—	34	37	36	65	59	44	37	56
30.71	Ti II	41	14	—	—	16	35	20	24	—	41	42	42	63	65	54	95	61
33.76	La II	24	—	—	—	—	—	—	—	—	—	—	—	53	48	44	44	48
37.92	Ti II	20	35	—	—	55	37	60	51	—	72	73	72	214	148	140	205	167
40.47	Hγ	1	12650	—	—	13975	14050	14140	14050	—	12400	14200	13300	12575	12060	10500	14730	11525
50.83	Ti II	94	21	—	—	13	19	14	15	—	27	17	22	45	48	34	32	42
51.76	Fe II	27	132	—	—	156	169	114	146	—	165	179	172	315	275	245	280	280
52.74	Fe I	71	—	—	—	13	16	9	12	—	43	35	39	70	82	58	71	70
58.73	Y II	5	—	—	—	18	18	16	17	—	21	23	22	82	84	60	61	75

TABLE 3. EQUIVALENT WIDTHS OF LINES IN A-TYPE SPECTRA (Continued)

λ	Atom	R.M.T.	γ GEMINORUM			θ LEONIS				68 TAURI				15 VULPECULAE				
			BL169a	BL169b	Mean	IIIL$_A$	BL169	Palomar	Mean	BL169a	BL169b	BL496	Mean	IIIL$_A$	BL169	MtW 71B	Palomar	Mean
4359.58	Ni I	86	—	—	—	30	37	30	32	—	36	42	39	81	90	69	68	80
62.04	Sm II	45	22	—	21	37	52	37	42	—	37	48	42	38	54	41	30	44
62.10	Ni II	9																
67.58	Fe I	414	—	—	—	40	56	37	44	—	71	71	71	141	112	112	57	122
67.66	Ti II	104	44	48	46													
68.26	Fe II	—	35	—	—	7	18	10	12	—	21	21	21	18	31	28	6	26
69.40	Fe II	28	43	32	38	49	43	35	42	—	50	59	54	77	77	68	19	75
69.77	Gd II	15	15	—	—	18	15	11	15	—	26	32	29	55	76	58	24	65
69.77	Fe I	518																
70.96	Zp II	79	12	—	—	8	13	12	11	—	19	24	22	52	46	37	14	45
71.33	C I	14	13	—	—	6	10	8	8	—	12	15	14	55	58	52	15	55
73.56	Fe I	214,413	5	—	—	—	—	—	—	—	6	10	8	17	13	8	6	13
74.46	Sc II	14	52	39	46	38	46	26	37	—	8	7	8	80	107	85	54	91
74.50	Fe I	648	—	—	—	—	—	—	—	—	—	—	—					
74.82	Ti II	93	56	45	52	95	89	77	87	—	123	133	128	220	220	235	148	230
74.94	Y II	13																
75.93	Fe I	2	14	—	—	10	13	9	11	—	24	19	22	76	70	60	30	75
79.78	Zr II	88	13	—	—	14	21	19	18	—	31	34	32	60	63	59	27	62
82.78	Fe I	799a	10	—	—	11	9	7	9	—	7	10	8	27	19	25	7	24
83.55	Fe I	41	106	88	102	151	150	106	136	160	162	185	169	285	245	250	186	265
84.33	Fe II	32	50	—	—	—	57	45	49	60	67	64	64	83	64	74	35	74
84.64	Mg II	10	58	43	49	87	55	42	47	56	54	53	54	66	49	57	23	57
84.68	Fe I	474																
84.81	Sc II	14	—	—	—					10	13	16	13					
85.26	Fe I	415	87	66	80	118	106	91	105	120	127	131	126	200	168	180	110	190
85.38	Fe II	27																
86.86	Ti II	104	50	39	41	45	47	42	45	52	48	56	52	95	86	94	66	96
87.90	Fe I	476	—	9	—	—	9	9	9	11	8	6	8	28	38	34	9	33
87.93	He I	51	33	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
88.41	Fe I	830	19	—	—	—	10	12	11	26	24	27	26	63	58	66	32	61
90.46	Fe I	413	—	—	—	—	—	—	—	68	68	63	66	39	40	34	13	38
90.58	Mg II	10	67	57	71	59	73	60	64									
90.95	Fe I	414	31	—	—	—	16	18	17	35	30	36	34	102	88	87	38	92
90.98	Ti II	61																
91.66	Ce II	81	5	—	—	—	—	—	—	9	8	5	7	35	29	22	8	29
94.06	Ti II	51	43	34	43	30	50	35	38	57	59	62	59	114	110	120	59	122
95.03	Ti II	19	111	95	111	124	146	112	127	146	157	158	154	270	230	250	280	255

4395.85	Ti II	61	38	27	34	30	39	28	32	45	47	47	46	84	84	90	36	92
98.02	Y II	5	—	—	—	—	15	18	16	34	40	35	36	143	105	121	50	126
98.31	Ti II	61	6	—	—	—	—	—	—	6	6	16	9	14	18	22	5	18
4399.77	Ti II	51	80	61	75	94	91	65	83	106	110	99	105	205	176	196	108	192
4400.36	Sc II	14	27	28	31	20	32	22	25	5	4	10	6	112	94	108	46	105
01.45	Fe I	350	17	—	—	22	20	19	20	58	62	61	60	127	98	125	60	117
02.88	Fe II	—	16	—	—	19	10	12	14	17	13	14	15	14	12	14	—	13
03.35	Zr II	79	—	—	—	6	8	—	7	13	12	8	11	50	30	50	—	43
03.36	Sm II	22																
04.75	Fe I	41	90	72	85	96	116	86	99	149	138	144	144	245	225	255	178	245
07.68	Ti II	51	16	11	16	13	18	8	13	35	31	27	31	71	60	69	30	67
07.71	Fe I	68																
08.42	Fe I	68	11	—	17	8	13	7	9	38	23	22	28	73	66	71	26	70
09.22	Ti II	61	6	8	11	8	13	8	10	6	10	12	9	30	32	34	9	32
09.52	Ti II	61	14	—	—	—	15	12	14	20	16	20	19	52	42	49	15	48
10.52	Ni I	88	—	—	—	—	6	—	—	8	8	10	9	24	35	25	6	28
10.64	Ce II	33																
11.08	Ti II	115	40	32	39	35	47	30	37	55	56	54	55	82	72	86	28	80
11.94	Ti II	61	8	8	12	—	16	8	12	10	12	19	14	—	29	51	18	40
13.60	Fe II	32	11	9	15	19	21	12	17	23	25	27	25	54	37	48	13	47
15.12	Fe I	41	68	55	62	71	83	67	74	112	112	113	112	225	210	230	136	225
15.56	Sc II	14	31	22	27	12	29	16	19	—	4	9	6	—	75	93	34	83
16.82	Fe II	27	89	72	79	85	115	85	95	134	124	126	128	190	185	195	104	190
17.72	Ti II	40	84	64	73	82	94	74	83	104	107	108	106	181	172	195	106	184
18.34	Ti II	51	35	30	33	15	34	19	23	39	40	35	38	69	81	85	34	78
18.60	Fe I	899	—	—	—	8	11	12	10	—	—	5	—	30	18	24	8	24
18.78	Ce II	2																
21.95	Ti II	93	26	21	24	21	23	18	21	35	31	29	32	65	58	66	26	63
22.57	Fe I	350	24	—	—	16	13	8	12	42	41	34	39	114	90	122	49	109
22.59	Y II	5																
23.22	Ti II	61	6	—	—	—	—	—	—	11	5	10	9	10	—	12	5	11
24.34	Sm II	45	3	—	—	5	4	—	4	8	—	9	8	—	—	—	—	—
25.44	Ca I	4	16	9	13	14	12	7	11	15	15	13	14	94	79	96	30	88
27.31	Fe I	2	20	16	17	6	13	11	10	24	26	32	27	96	90	103	44	95
27.90	Ti II	61	26	14	23	17	17	16	17	21	20	24	22	30	20	23	8	24
28.00	Mg II	9																
29.32	Fe I	972	—	—	—	—	—	—	—	3	4	3	3	26	27	29	5	27
30.20	Fe I	472	9	—	—	6	8	—	7	6	9	—	8	65	60	55	19	60
30.62	Fe I	68	14	—	—	—	8	6	7	32	22	24	26	59	63	82	27	68
31.37	Sc II	14	6	—	—	—	6	4	5	—	3	4	4	—	—	10	—	—
31.63	Fe II	222	12	—	—	—	10	—	—	12	11	9	11	11	17	11	2	13
32.09	Ti II	51	—	—	—	—	—	—	—	5	4	6	5	13	16	13	5	14
33.22	Fe I	830	12	—	—	—	5	6	6	20	20	17	19	53	53	57	19	54
33.79	Fe I	825	—	—	—	—	—	—	—	34	—	19	26	52	48	52	9	49
33.99	Mg II	9	45	36	41	33	36	23	31	25	43	23	30	—	—	—	—	—
34.96	Ca I	4	18	14	18	12	13	11	12	35	32	27	31	128	116	145	52	128

TABLE 3. EQUIVALENT WIDTHS OF LINES IN A-TYPE SPECTRA (Concluded)

λ	Atom	R.M.T.	γ GEMINORUM			θ LEONIS				68 TAURI				15 VULPECULAE				
			BL169a	BL169b	Mean	IIIL_A	BL169	Palomar	Mean	BL169a	BL169b	BL496	Mean	IIIL_A	BL169	MtW 71B	Palomar	Mean
4435.69	Ca I	4	17	14	15	—	10	9	10	8	12	16	12	90	90	112	47	100
36.48	Mg II	19	9	—	—	—	—	—	—	6	5	6	6	9	13	14	—	12
36.93	Fe I	516	6	—	—	—	—	—	—	9	7	10	9	31	27	35	8	31
39.13	Fe II	32	5	8	9	—	—	—	—	—	4	3	4	9	18	12	2	13
40.45	Zr II	79	6	—	—	—	—	—	—	12	10	17	13	30	38	41	7	36
40.48	Fe I	829																
40.84	Fe I	992	—	—	—	—	—	—	—	5	3	8	5	10	18	15	3	14
41.73	Ti II	40	31	24	25	11	18	15	15	33	23	25	27	57	63	75	28	65
42.34	Fe I	68	23	18	23	—	19	19	19	48	46	41	45	105	115	123	48	108
42.99	Zr II	88	22	—	—	15	13	17	15	27	28	30	28	—	50	—	—	—
43.20	Fe I	350	10	16	16	20	23	17	20	25	25	27	26	110	89	126	64	113
43.80	Ti II	19	109	89	103	128	135	110	124	164	142	136	147	245	220	255	163	240
44.56	Ti II	31	37	28	32	33	33	20	29	42	42	42	42	80	93	106	50	93
44.56	Fe II	201																
46.25	Fe II	187	12	—	—	—	—	—	—	10	9	10	10	17	17	10	7	15
46.39	Nd II	49												—	—	16	6	—
46.84	Fe I	828	7	—	—	—	—	—	—	—	8	10	9	20	16	16	5	17
47.13	Fe I	69	7	—	—	—	—	—	—	5	5	6	5	—	10	—	—	—
47.72	Fe I	68	18	18	22	17	19	14	17	38	39	33	37	95	85	104	43	94
49.34	Ce II	202	6	—	—	—	5	5	5	—	—	10	—	18	22	26	7	22
49.66	Fe II	222	10	8	10	—	3	5	4	8	9	6	8	16	18	20	6	18
50.49	Ti II	19	72	60	67	63	83	70	72	92	90	91	91	180	150	184	100	174
51.54	Fe II	—	30	21	29	31	26	23	27	48	50	46	48	60	63	66	21	63
52.62	Fe I	969	8	—	—	—	—	—	—	—	—	6	—	17	12	10	—	13
53.35	V II	199	6	8	8	—	—	—	—	11	5	9	8	—	11	12	—	12
54.38	Fe I	350	—	—	—	11	15	9	12	32	22	22	25	37	46	48	21	44
54.78	Ca I	4	42	35	37	25	28	32	28	63	54	53	57	185	156	176	99	174
54.80	Zr II	40																
55.26	Fe II	—	22	20	21	26	16	20	21	42	31	26	33	—	25	40	12	32
55.85	Fe II	140	12	13	13	—	—	—	—	8	9	15	11	62	70	70	31	71
55.89	Ca I	4																
56.33	Fe I	516	—	—	—	—	—	—	—	—	—	6	—	35	20	24	5	21
56.65	Ti II	115	12	—	—	—	—	—	—	13	10	13	12		17	22	7	18
57.42	Zr II	79	—	—	—	—	—	—	—	13	13	15	14	38	37	34	14	36
59.12	Fe I	68	35	—	—	32	27	28	29	79	70	71	73	161	132	150	92	148
61.37	Fe I	725	—	—	—	16	22	20	19	22	22	18	21	—	—	61	22	—
61.43	Fe II	26	7	—	—													

4461.65	Fe I	2	10	11	17	—	10	—	—	30	33	32	32	70	65	65	36	67
61.99	Fe I	471,825	—	—	—	17	17	18	17	25	17	22	21	33	33	48	22	40
62.41	Nd II	54	—	—	—	11	14	10	12	5	9	17	10					
62.46	Ni I	86													27	30	13	30
64.46	Ti II	40	50	—	—	44	52	47	48	77	65	57	66	164	110	124	110	133
66.55	Fe I	350	29	22	29	26	27	28	27	70	66	51	62	124	106	121	67	119
67.34	Sm II	53	—	—	—	—	—	—	—	—	3	—	—	25	17	24	8	24
68.49	Ti II	31	109	92	98	117	120	118	118	162	148	134	148	255	230	235	184	240
69.16	Ti II	18	35	—	—	26	22	25	24	—	—	10	—	—	—	—	—	—
69.38	Fe I	830	—	—	—	—	17	—	—	58	52	40	50	113	90	101	54	101
70.39	V II	30	15	—	—	—	7	7	7	23	26	22	24	55	47	42	21	48
70.86	Ti II	40	34	23	32	18	11	26	18	44	38	33	38	68	60	65	27	64
71.68	Fe I	2	38	16	27	12	8	16	12	8	3	7	6	—	8	—	—	—
71.69	He I	14	36	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
72.92	Fe II	37	51	40	43	41	24	37	34	77	66	55	66	99	85	99	44	94
76.02	Fe I	350	39	25	30	27	25	30	27	80	76	65	74	147	125	143	106	136
76.08	Fe I	830																
78.66	Sm II	—	20	—	—	—	—	—	—	15	11	—	13	32	32	33	12	32
79.61	Fe I	828,848	17	—	—	—	16	8	12	10	12	—	11	32	20	27	15	26
81.13	Mg II	4	390	405	405	460	470	430	450	530	520	450	500	435	415	420	360	425
81.33	Mg II	4																
82.17	Fe I	2	37	—	31	15	31	15	20	68	43	42	51	126	108	112	56	115
82.26	Fe I	68																
84.23	Fe I	828	20	—	—	—	12	12	12	33	20	22	25	59	47	46	28	49
84.93	Fe II	9	—	—	—	—	—	—	—	10	5	—	8	—	15	13	—	14
85.68	Fe I	830	12	—	—	—	17	8	12	19	11	—	15	37	46	36	9	36
86.91	Ce II	57	—	—	—	—	—	—	—	—	8	—	—	23	—	22	8	21
87.36	Fe I	824	7	—	—	12	19	8	13	19	12	—	16	—	—	—	—	—
88.14	Fe I	819	—	—	—	—	—	—	—	75	66	—	70	104	—	98	58	105
88.32	Ti II	115	55	44	50	46	55	40	47									
89.18	Fe II	37	83	57	69	81	79	68	76	112	104	—	108	168	—	154	99	161
90.77	Fe I	974	—	—	—	—	—	—	—	20	10	—	15	—	—	—	16	30
91.40	Fe II	37	81	55	72	98	86	83	89	114	106	—	110	176	—	167	98	165
93.53	Ti II	18	—	—	—	—	—	13	—	32	24	—	28	179	—	166	150	172
93.58	Fe II	222																
94.57	Fe I	68	38	—	38	—	—	23	—	62	55	—	58	—	—	—	68	129
96.96	Zr II	40	—	—	—	—	—	12	—	44	32	—	38	98	—	90	47	94
4496.99	Mn II	17																
4501.27	Ti II	31	—	—	108	—	—	105	—	153	140	—	146	285	—	230	178	250
08.28	Fe II	38	—	—	96	—	—	85	—	142	140	—	141	235	—	—	147	215
11.82	Cr II	191	—	—	—	—	—	—	—	12	15	—	14	—	—	—	4	—
11.83	Sm II	14																
15.34	Fe II	37	—	—	94	—	—	—	—	143	128	—	136	215	—	—	141	200
18.30	Ti II	18	—	—	—	—	—	—	—	14	—	—	—	56	—	—	21	—
20.22	Fe II	37	—	—	88	—	—	—	—	120	—	—	—	205	—	—	138	191

TABLE 4. EQUIVALENT WIDTHS OF LINES IN F-TYPE SPECTRA

λ	Atom	R.M.T.	σ BOOTIS							α CANIS MINORIS							110 HERCULIS				
			IIIL$_A$	BL169a	BL169b	BL496	Mt. Wilson	Palomar	Mean	IIIL$_A$	Wood	BL84	BL496	9663	Mt. Wilson	Mean	BL84	BL169a	BL169b	Mt. Wilson	Mean
3899.71	Fe I	4	—	117	—	142	—	146	135	—	—	—	215	198	143	185	—	—	—	—	—
3900.52	Fe I	565	—	139	—	152	—	177	156	—	—	—	205	220	173	199	—	—	—	—	—
00.55	Ti II	34																			
02.40	Gd II	—	—	8	—	11	—	14	11	—	—	—	—	—	—	—	—	—	—	—	—
02.92	Cr I	23	—	161	215	172	—	173	175	—	—	—	215	210	167	198	—	—	—	—	—
02.95	Fe I	45																			
03.27	V II	11	—	47	—	42	—	49	46	—	—	—	80	99	92	90	—	—	—	—	—
03.90	Fe I	429	—	114	149	115	—	147	129	—	—	—	156	174	161	164	—	—	—	—	—
04.78	Ti I	56	—	40	—	44	—	54	46	—	—	—	88	77	64	76	—	—	—	—	—
05.53	Si I	3	—	215	305	220	—	225	230	—	—	—	285	270	230	260	—	—	—	—	—
05.64	Cr II	167																			
06.48	Fe I	4	—	135	180	124	—	134	138	—	—	—	172	185	137	165	—	—	—	—	—
06.75	Fe I	664	—	41	—	45	—	48	45	—	—	—	68	82	66	72	—	—	—	—	—
06.75	V I	42,43																			
07.65	Ti II	—	—	29	—	32	—	30	30	—	—	—	72	—	53	62	—	—	—	—	—
07.78	Cr I	262																			
07.94	Fe I	280	—	63	78	68	—	68	68	—	—	—	99	114	84	99	—	—	—	—	—
08.76	Cr I	23	—	45	—	48	—	54	49	—	—	—	82	87	92	87	—	—	—	—	—
12.32	Ti II	97	—	21	—	20	—	20	20	—	—	—	48	53	45	49	—	—	—	—	—
13.46	Ti II	34	—	191	220	192	—	205	199	—	—	—	205	210	188	200	—	—	—	—	—
16.42	V II	10	—	69	68	66	—	74	69	—	—	—	103	114	92	103	—	—	—	—	—
16.73	Fe I	606	—	75	—	76	—	76	76	—	—	—	92	110	79	94	—	—	—	—	—
17.18	Fe I	20	—	98	105	96	—	91	96	—	—	—	129	123	104	119	—	—	—	—	—
18.64	Fe I	430	—	80	—	83	—	79	81	—	—	—	116	133	111	120	—	—	—	—	—
19.07	Fe I	430	—	108	108	105	—	106	107	—	—	—	140	160	125	142	—	—	—	—	—
19.16	Cr I	23																			
20.26	Fe I	4	—	136	175	144	—	143	146	—	—	—	175	205	148	176	—	—	—	—	—
22.91	Fe I	4	—	168	220	172	—	192	185	—	—	—	188	220	185	198	—	—	—	—	—
24.53	Ti I	13	—	22	—	21	—	15	19	—	—	—	47	51	46	48	—	—	—	—	—
25.20	Fe I	567	—	31	—	31	—	28	30	—	—	—	55	63	54	57	—	—	—	—	—
25.65	Fe I	364	—	72	—	65	—	60	66	—	—	—	79	104	96	93	—	—	—	—	—
27.92	Fe I	4	—	173	—	156	—	230	186	—	—	—	181	184	172	179	—	—	—	—	—
30.30	Fe I	4	—	134	—	115	—	162	137	—	—	—	124	136	106	122	—	—	—	—	—
33.66	Ca II	1	—	5920	—	5870	—	5610	5800	—	—	—	9330	9750	8800	9300	—	—	—	—	—
40.88	Fe I	20	—	62	—	63	—	62	62	—	—	—	81	108	79	89	—	—	—	—	—
41.28	Fe I	562	—	66	—	54	—	45	55	—	—	—	80	89	74	81	—	—	—	—	—
42.44	Fe I	364	—	78	—	75	—	65	73	—	—	—	100	116	88	101	—	—	—	—	—
44.01	Al I	1	—	190	220	194	—	198	198	—	—	—	235	250	220	235	—	—	—	—	—
45.97	Cr I	—	—	13	—	6	—	9	9	—	—	—	28	30	29	29	—	—	—	—	—
47.00	Fe I	561	—	63	—	64	—	64	64	—	—	—	90	90	73	84	—	—	—	—	—
48.10	Fe I	562	—	87	—	82	—	79	83	—	—	—	100	121	89	103	—	—	—	—	—
48.78	Fe I	604	—	125	—	105	—	114	115	—	—	—	151	182	142	158	—	—	—	—	—

3949.10	La II	41	—	64	—	57	—	64	62	—	—	—	85	94	87	89	—	—	—	—	—
49.14	Fe I	730																			
49.95	Fe I	72	—	87	—	83	—	82	84	—	—	—	112	129	101	114	—	—	—	—	—
50.35	Y II	6	—	65	—	56	—	55	59	—	—	—	94	106	80	93	—	—	—	—	—
51.10	Cr I	136	—	86	—	83	—	80	83	—	—	—	107	130	102	113	—	—	—	—	—
51.16	Fe I	661																			
51.97	V II	10	—	66	—	59	—	57	61	—	—	—	94	105	78	92	—	—	—	—	—
95.20	Fe I	604	—	84	—	80	71	69	77	—	—	—	122	143	121	129	—	153	135	76	130
95.31	Co I	31																			
96.00	Fe I	279	—	62	—	52	38	47	51	—	—	—	76	99	90	88	—	137	122	71	118
97.39	Fe I	278	—	130	—	108	97	97	110	—	—	—	150	180	146	159	190	194	166	110	173
97.48	Fe I	563																			
97.49	Fe I	556																			
97.90	Co I	32	—	113	—	96	77	94	98	—	—	—	136	161	126	141	176	191	167	113	169
98.05	Fe I	276																			
98.64	Ti I	12	—	83	70	75	63	58	71	—	—	—	108	119	96	108	125	111	128	69	114
3998.98	Zr II	16	—	47	—	40	29	32	38	—	—	—	72	82	63	72	60	90	72	63	72
4001.17	V II	202	—	17	—	14	17	16	16	45	—	—	40	38	38	40	50	35	39	26	39
01.67	Fe I	72	—	66	64	57	47	55	58	117	—	—	88	101	92	100	110	124	98	56	103
02.07	Fe II	29	—	29	16	28	24	22	25	69	—	—	53	61	56	60	49	57	49	33	49
02.94	V II	9	—	39	25	33	23	27	31	90	—	—	69	82	70	78	71	65	65	41	63
03.33	Cr II	194											11	16	10	12	7	12	13	7	10
03.76	Fe I	728	—	36	—	34	27	27	32	78	—	—	58	68	69	68	67	67	62	41	62
03.77	Ce II	188																			
03.79	Ti I	188																			
05.25	Fe I	43	192	184	220	176	153	144	175	265	—	—	220	260	215	240	355	360	315	225	325
05.71	V II	32	62	70	64	68	53	56	63	134	—	—	109	132	106	120	78	90	94	74	85
06.31	Fe I	603	62	83	—	54	47	49	60	108	—	—	77	102	88	94	118	104	94	67	97
07.23	Fe I	119	53	74	—	58	51	52	59	93	—	—	90	100	86	92	112	101	91	60	95
07.28	Fe I	277																			
08.93	Ti I	12	43	45	—	38	33	35	39	88	—	—	76	83	76	81	101	99	91	61	92
09.71	Fe I	72	84	92	97	90	81	78	87	147	—	—	124	147	118	134	155	147	128	102	137
10.59	——	—	25	32	16	30	25	26	27	—	—	—	58	64	60	61	73	75	64	32	65
11.42	Fe I	218	23	22	—	15	18	18	19	34	—	—	37	46	40	39	43	43	39	24	39
12.37	Ti II	11	126	130	—	126	101	113	121	215	—	—	158	183	188	186	205	210	184	133	190
12.39	Ce II	206																			
14.49	Sc II	8	94	99	—	92	90	85	92	155	—	—	140	169	129	148	158	147	143	117	145
14.53	Fe I	802																			
14.90	Ce II	157	—	10	—	5	—	10	8	17	—	—	13	13	14	14	—	—	—	—	—
15.38	Ti I	185	—	—	—	—	—	—	—	—	—	—	86	99	98	94	108	96	91	82	96
15.50	Ni II	12	48	53	—	47	40	45	47												
16.43	Fe I	560	38	34	—	26	27	26	30	58	—	—	59	67	60	61	58	57	56	33	53
16.54	Fe I	277																			
17.10	Fe I	279	100	90	86	83	70	74	83	138	—	—	123	150	116	132	157	133	141	103	138
17.16	Fe I	527																			
17.56	Ni I	171	41	50	44	37	29	37	40	89	—	—	79	101	94	91	84	89	87	65	84
18.10	Mn I	5	95	86	—	74	54	82	79	—	—	—	122	123	115	120	196	184	184	127	179
18.28	Fe I	560	—	—	—	—	—	—	—	—	—	—	—	—	—	—					
20.90	Co I	16	19	14	—	10	17	13	14	36	—	—	36	44	38	38	38	42	30	18	34
21.81	Ti I	185	—	—	—	—	—	—	—	144	—	—	126	145	123	134	161	152	156	93	147
21.87	Fe I	278	96	90	94	94	86	80	89												

TABLE 4. EQUIVALENT WIDTHS OF LINES IN F-TYPE SPECTRA (Continued)

λ	Atom	R.M.T.	σ BOOTIS							α CANIS MINORIS							110 HERCULIS				
			IIIL$_A$	BL169a	BL169b	BL496	Mt. Wilson	Palomar	Mean	IIIL$_A$	Wood	BL84	BL496	9663	Mt. Wilson	Mean	BL84	BL169a	BL169b	Mt. Wilson	Mean
4022.26	Cr I	268	10	11	—	7	—	10	9	23	—	—	27	28	30	27	31	24	30	18	27
22.74	Fe I	556,654	12	14	—	9	—	11	12	30	—	—	37	39	39	36	54	40	40	27	42
23.39	V II	32	56	53	53	50	50	43	50	88	—	—	88	99	86	90	92	85	86	64	84
24.11	Fe I	277	12	16	—	16	19	17	16	51	—	—	55	59	50	54	62	58	66	42	59
25.11	Ni I	240	69	76	77	76	72	68	73	123	—	—	115	138	116	123	140	128	126	111	128
25.14	Ti II	11																			
25.87	La II	42	25	18	—	15	20	18	18	42	—	—	44	46	47	45	47	39	51	38	45
27.68	——	—	8	14	—	8	10	9	10	24	—	—	27	33	31	29	32	22	34	27	29
28.33	Ti II	87	100	84	97	79	75	66	81	126	—	—	121	136	110	123	110	109	104	88	105
28.41	Ce II	47																			
28.76	——	—	—	11	—	6	8	4	7	18	—	—	27	33	22	25	18	20	25	17	20
29.64	Fe I	556,563	63	68	72	62	51	55	62	102	—	—	98	128	98	106	96	108	103	67	97
29.68	Zr II	41																			
30.76	Mn I	2	200	195	240	168	162	151	181	250	—	—	225	275	215	240	340	305	305	260	310
31.97	Fe I	655	53	60	—	50	40	41	49	—	—	—	78	100	81	86	109	102	98	67	98
33.07	Mn I	2	172	160	205	148	138	121	152	215	—	—	210	275	205	225	265	240	235	200	240
34.49	Mn I	2	139	124	156	118	120	95	121	158	—	—	164	205	144	165	193	188	180	170	185
35.63	V II	32	127	111	—	103	90	91	103	183	—	—	167	205	153	177	200	210	195	160	196
35.73	Mn I	5																			
36.78	V II	9	25	18	—	14	16	13	16	44	—	—	46	55	46	48	38	32	45	21	36
37.12	——	—	9	15	—	8	—	8	10	27	—	—	29	33	34	31	31	32	38	28	33
38.03	Cr II	194	11	9	—	4	—	4	6	11	—	—	12	11	16	12	9	13	14	19	13
38.62	Fe I	600,728	24	26	—	15	—	15	19	45	—	—	47	61	53	52	66	56	52	52	57
39.10	Cr I	251	8	10	—	6	—	—	8	20	—	—	29	31	28	27	27	22	34	26	27
39.57	V II	32	8	10	—	4	24	—	10	9	—	—	18	15	12	14	8	6	16	14	11
40.65	Fe I	655	66	66	58	55	46	46	56	87	—	—	91	93	92	91	118	111	115	87	111
41.29	Fe I	603,654	110	113	127	107	99	88	106	163	—	—	158	177	142	160	174	169	156	128	161
41.36	Mn I	5																			
41.64	Fe II	172	—	15	—	12	—	14	13	—	—	—	38	52	36	42	16	26	27	16	22
41.68	Sm II	22																			
42.58	Ce II	140	—	9	—	5	—	9	8	8	—	—	11	11	13	11	11	12	15	17	13
42.64	V I	96																			
42.91	La II	66	17	16	—	11	14	11	13	12	—	—	21	22	24	20	18	17	20	19	18
43.90	Fe I	276,557	76	84	—	77	68	53	78	132	—	—	123	155	144	138	143	152	138	118	141
44.01	Fe II	172						45													
44.61	Fe I	359	63	76	76	72	66	76	73	124	—	—	114	139	123	125	123	131	127	91	122
45.82	Fe I	43	350	345	385	305	360	295	330	480	—	—	420	575	420	475	550	550	530	510	540
47.32	Fe I	117,853	—	14	—	9	—	8	10	13	—	—	18	25	19	19	26	20	24	25	24
48.68	Zr II	43	78	83	—	74	70	58	72	144	—	—	138	153	125	140	138	157	140	112	140
48.76	Mn I	5																			
48.78	Cr I	251																			
49.34	Fe I	218	20	27	20	15	21	12	19	38	—	—	43	46	45	43	47	42	48	38	45
49.78	Cr I	251	—	11	—	4	—	—	8	8	—	—	16	14	17	14	20	15	19	13	17

4050.32	Zr II	43	7	12	—	8	11	10	10	28	—	—	27	33	24	28	22	24	31	27	26
50.69	Fe I	—	14	23	17	14	23	14	17	41	—	—	45	57	47	48	48	49	42	51	47
51.92	Fe I	700	47	60	—	44	46	36	47	85	—	—	87	103	92	92	90	92	92	68	88
51.97	Cr II	19																			
53.27	Fe I	—	28	32	22	21	26	18	24	57	—	—	55	63	50	56	59	68	64	61	63
53.81	Ti II	87	66	84	—	60	69	46	64	109	—	—	107	131	90	109	104	108	111	84	104
53.82	Fe I	485																			
54.11	Cr II	19	15	30	—	18	22	20	22	55	—	—	56	70	58	60	58	59	64	52	59
54.18	Fe I	557																			
55.54	Mn I	5	71	77	—	60	64	46	63	100	—	—	109	132	94	109	119	109	106	90	108
57.46	Fe II	212	166	146	182	147	118	136	147	—	—	—	185	200	230	205	260	275	245	190	250
57.51	Mg I	16																			
58.18	Co I	16	56	64	—	52	48	43	53	88	—	—	86	99	93	92	113	116	106	85	108
58.23	Fe I	558																			
59.39	Mn I	29	7	9	—	7	—	7	8	18	—	—	22	25	25	22	27	28	32	30	29
59.73	Fe I	767	34	41	31	30	36	25	37	59	—	—	65	71	58	63	76	85	77	42	74
60.26	Ti I	80	—	—	—	4	—	6	5	8	—	—	13	15	9	11	15	24	20	27	21
60.62	Cr I	156	—	—	—	—	—	4	—	—	—	—	11	11	8	10	20	26	24	24	23
60.75	—	—	—	—	—	—	—	—	—	12	—	—	14	15	14	14					
61.08	Nd II	10	32	36	32	29	29	25	30	43	—	—	54	70	58	56	60	53	56	46	55
61.96	Fe I	—	18	—	—	20	—	23	21	56	—	—	44	61	46	52	62	58	68	55	62
62.45	Fe I	359	67	82	88	71	80	62	74	109	—	—	107	125	115	114	123	112	115	90	113
63.60	Fe I	43	250	250	340	210	200	185	230	330	—	—	285	375	285	320	435	410	375	290	390
64.35	Ti II	106	14	32	—	20	22	23	23	63	—	—	58	61	69	63	85	73	82	75	79
64.37	Ni I	179																			
64.46	Fe I	44																			
65.07	V II	215	8	17	—	12	17	8	12	26	—	—	29	34	35	31	27	25	33	17	27
65.09	Ti I	80																			
65.40	Fe I	698	31	32	31	25	23	23	27	64	—	—	62	71	69	66	66	79	77	55	71
66.02	Fe I	695	—	—	—	—	—	—	—	30	—	—	31	30	28	30	36	45	44	—	42
66.16	Cr II	182	11	19	—	7	—	10	12												
66.60	Fe I	424	38	51	38	31	26	26	35	73	—	—	69	74	69	71	101	102	98	—	100
66.98	Fe I	358	82	105	—	82	77	68	84	132	—	—	123	155	127	134	155	134	140	—	143
67.03	V II	9																			
67.28	Fe I	217	54	79	—	59	70	53	63	100	—	—	91	120	90	100	109	112	117	—	113
67.98	Fe I	559	86	100	—	77	96	68	84	137	—	—	122	152	129	135	146	153	132	89	136
68.00	Mn I	5																			
68.98	Ti I	299	10	16	—	8	—	8	10	24	—	—	28	29	28	27	35	50	49	23	42
69.08	Fe I	557																			
69.60	—	—	10	16	—	6	18	7	11	20	—	—	21	21	23	21	14	30	37	25	27
70.28	Mn I	5	9	21	—	7	14	12	13	42	—	—	38	46	39	41	50	55	46	38	49
70.77	Fe I	558	62	77	—	57	66	48	62	103	—	—	98	125	99	106	105	126	121	85	113
71.74	Fe I	43	240	210	285	190	210	170	210	320	—	—	275	320	270	295	345	340	305	235	315
72.52	Fe I	698	30	41	—	36	29	27	33	77	—	—	69	82	71	75	83	90	84	63	82
72.56	Cr II	26																			
73.76	Fe I	558	59	68	62	58	62	46	59	93	—	—	89	112	92	96	92	109	102	73	97
74.79	Fe I	524	81	80	—	67	65	57	69	122	—	—	114	131	108	119	127	154	145	108	137
75.12	Nd II	62	—	17	—	7	15	16	14	—	—	—	43	34	32	36	—	—	—	—	—
75.92	Cr I	66	52	53	—	40	36	35	43	96	—	—	74	90	84	86	91	126	111	74	104
75.95	Fe II	21																			
76.23	Fe I	486	—	31	—	14	—	—	22	—	—	—	38	48	39	42	62	81	74	—	72
77.71	Sr II	1	230	235	340	195	235	210	230	355	—	—	320	390	300	340	370	385	350	200	345

TABLE 4. EQUIVALENT WIDTHS OF LINES IN F-TYPE SPECTRA (Continued)

λ	Atom	R.M.T.	σ BOOTIS							α CANIS MINORIS							110 HERCULIS				
			IIIL$_{\text{A}}$	BL169a	BL169b	BL496	Mt. Wilson	Palomar	Mean	IIIL$_{\text{A}}$	Wood	BL84	BL496	9663	Mt. Wilson	Mean	BL84	BL169a	BL169b	Mt. Wilson	Mean
4078.36	Fe I	217	80	75	—	59	66	55	66	147	—	—	106	133	106	123	123	135	121	88	121
79.85	Fe I	359	52	54	—	45	—	39	47	82	—	—	86	100	84	88	90	94	—	77	89
80.23	Fe I	558	21	45	—	36	—	32	35	82	—	—	74	87	73	79	67	80	—	45	68
80.89	Fe I	557	12	9	—	11	—	13	11	34	—	—	44	49	30	39	26	35	—	35	31
81.21	Ce II	4	12	14	—	16	—	15	15	34	—	—	36	37	41	37	28	37	—	40	34
82.12	Fe I	698	—	18	—	12	—	18	16	49	—	—	46	65	47	52	40	45	—	50	44
82.94	Mn I	5	—	44	—	—	—	32	38	92	—	—	75	96	70	83	63	59	—	61	61
84.50	Fe I	698	53	75	—	—	—	62	65	113	—	—	—	128	104	115	90	106	—	99	98
85.01	Fe I	358	51	60	—	—	—	39	50	—	—	—	—	103	75	89	53	—	—	—	—
85.31	Fe I	559	61	79	—	—	—	60	68	113	—	—	—	130	119	121	142	—	—	—	—
87.10	Fe I	694	26	28	—	—	—	31	29	62	—	—	—	78	58	66	72	75	—	66	72
91.56	Fe I	357	17	12	—	—	—	15	14	30	—	—	—	50	32	37	30	37	—	36	34
4094.93	Ca I	25	46	32	—	—	—	32	35	62	—	—	—	71	49	61	86	135	—	120	112
4101.74	Hδ	1	8370	7100	—	—	3190	4320	—	5700	—	—	—	7300	6280	6750	—	6050	—	4300	5200
07.49	Fe I	354	90	—	—	—	—	74	79	106	—	—	—	107	91	101	—	—	—	77	—
08.55	Ca I	39	21	—	—	—	—	18	19	38	—	—	—	41	36	38	—	—	—	54	—
10.53	Co I	29	19	—	—	—	—	10	13	39	—	—	—	45	38	41	—	—	—	44	—
11.78	V I	27	13	—	—	—	—	10	11	49	—	—	—	50	50	50	—	—	—	55	—
12.35	Fe I	695	8	—	—	—	—	12	11	38	—	—	—	35	36	36	—	—	—	40	—
12.97	Fe I	1103	37	—	—	—	—	38	38	92	—	—	—	94	73	86	—	—	—	56	—
14.45	Fe I	357	40	—	—	—	—	38	39	80	—	—	—	100	76	85	—	—	—	48	—
17.87	Fe I	700, 1103	15	—	—	—	—	13	14	41	—	—	—	48	37	42	—	—	—	20	—
18.55	Fe I	801	—	—	—	—	—	84	—	—	—	—	—	140	107	124	—	—	—	—	—
20.21	Fe I	423	50	—	—	—	—	38	42	80	—	—	—	105	76	87	—	—	—	61	—
21.32	Co I	28	67	—	—	—	—	38	48	106	—	—	—	—	92	99	—	—	—	59	—
23.23	La II	41	29	—	—	—	—	22	24	60	—	—	—	—	44	52	—	—	—	47	—
26.19	Fe I	695	73	—	—	—	—	45	54	—	—	—	—	—	84	—	—	—	—	73	—
26.52	Cr I	35	13	—	—	—	—	6	8	—	—	—	—	—	20	—	—	—	—	37	—
28.05	Si II	3	66	—	—	—	—	41	49	117	—	—	—	—	96	106	—	—	—	83	—
28.07	V I	27																			
28.74	Fe II	27	44	—	—	—	—	30	35	78	—	—	—	—	68	73	—	—	—	45	—
30.64	Ba II	4	45	—	—	—	—	21	29	—	—	—	—	—	50	—	—	—	—	56	—
32.06	Fe I	43	160	—	—	—	132	120	133	245	—	—	—	—	210	230	—	—	—	189	—
32.90	Fe I	357	78	—	—	—	70	56	65	147	—	—	—	—	106	126	—	—	—	89	—
33.87	Fe I	698	64	—	—	—	49	38	47	112	—	—	—	—	92	102	—	—	—	71	—
34.68	Fe I	357	128	—	—	—	84	78	92	—	—	—	—	—	120	—	—	—	—	122	—
36.51	Fe I	694	22	—	—	—	—	16	18	53	—	—	—	—	48	50	—	—	—	—	—
37.00	Fe I	726	71	—	—	—	59	53	59	110	—	—	—	—	95	102	—	—	—	71	—
37.42	Fe I	1103	—	—	—	—	—	13	—	—	—	—	—	—	44	—	—	—	—	50	—
37.65	Ce II	2	27	—	—	—	—	14	18	—	—	—	—	—	28	—	—	—	—	28	—
39.93	Fe I	18	20	—	—	—	—	20	20	60	—	—	—	52	48	53	—	—	—	—	—

4141.86	Fe I	422	24	—	—	—	—	19	21	50	—	—	—	41	45	45	—	—	—	50	—
43.42	Fe I	523	102	—	—	—	86	86	90	174	—	—	—	152	140	155	—	—	—	104	—
43.87	Fe I	43	134	—	—	—	129	115	123	235	—	—	—	210	200	215	—	—	—	184	—
46.07	Fe I	422	31	—	—	—	—	21	24	75	—	—	—	56	54	62	—	—	—	—	—
47.67	Fe I	42	74	—	—	—	55	58	61	139	—	—	—	117	105	120	—	—	—	86	—
50.26	Fe I	695	40	—	—	—	—	29	33	90	—	—	—	79	65	78	—	—	—	46	—
53.91	Fe I	695	94	88	—	—	73	78	83	—	—	—	—	138	131	136	—	—	—	106	—
54.50	Fe I	355	81	74	—	—	58	51	65	—	—	—	—	130	107	118	—	—	—	—	—
54.81	Fe I	694	64	88	—	—	66	62	72	136	—	—	—	124	113	124	—	—	—	—	—
56.24	Zr II	29	66	71	—	—	41	47	57	—	—	—	—	114	110	112	—	—	—	96	—
56.80	Fe I	354	106	97	—	—	80	78	89	—	—	—	—	147	134	140	—	—	—	130	—
57.79	Fe I	695	84	96	—	—	61	63	77	131	—	—	—	134	110	125	—	—	—	88	—
58.80	Fe I	695	58	64	—	—	44	48	54	96	—	—	—	108	90	98	—	—	—	57	—
59.19	——	—	54	58	—	—	40	42	49	105	—	—	—	106	97	103	—	—	—	66	—
60.28	Fe II	149	28	40	—	—	32	20	30	—	—	—	—	54	48	51	—	—	—	44	—
61.49	Fe I	422	62	66	—	—	—	46	57	—	—	—	—	122	100	111	—	—	—	90	—
61.52	Ti II	21																			
63.64	Ti II	105	102	100	—	—	73	73	87	150	—	—	—	143	128	140	—	146	—	81	124
63.68	Fe I	274, 699																			
67.27	Mg I	15	124	135	—	—	102	112	120	180	—	—	—	168	169	172	—	195	—	149	180
68.62	Fe I	689	14	—	—	—	—	12	13	27	—	—	—	37	34	33	—	40	—	26	35
68.94	Fe I	694	19	—	—	—	—	14	16	38	—	—	—	41	44	41	—	35	—	24	31
69.78	Fe I	693	26	—	—	—	—	16	19	55	—	—	—	42	49	49	—	53	—	31	46
72.64	Fe I	689	102	103	—	87	71	72	87	141	—	—	—	178	176	165	—	220	195	142	194
72.75	Fe I	19	—	—	—	—	—	—	—												
73.45	Fe II	27	176	170	—	137	116	109	140	—	220	—	—	197	210	210	—	255	210	151	220
73.54	Ti II	21																			
73.93	Fe I	19	50	44	—	42	31	30	39	—	113	—	—	79	77	90	—	—	—	—	—
74.09	Ti II	105																			
74.92	Fe I	19	64	73	58	65	50	35	58	115	121	—	110	121	103	114	—	117	92	74	98
75.64	Fe I	354	92	85	68	80	71	54	74	126	115	—	121	123	94	116	—	132	97	86	109
76.57	Fe I	695	82	87	91	71	61	52	73	122	115	—	113	122	103	115	—	108	94	76	96
77.54	Y II	14	132	137	—	128	89	103	120	245	235	—	194	210	179	215	—	245	230	157	220
77.60	Fe I	18																			
78.02	Sm II	16, 50	16	16	—	22	18	20	19	51	48	—	53	60	56	54	—	63	50	34	52
78.39	V II	25	—	—	—	8	—	6	7	20	—	—	30	24	24	24	—	—	15	28	19
78.86	Fe II	28	94	96	91	88	78	68	85	138	124	—	131	144	124	132	—	141	94	90	112
79.42	V I	25	81	78	—	72	49	56	68	128	126	—	114	130	132	126	—	171	133	98	141
79.43	Cr II	26																			
79.81	Zr II	99	—	—	—	4	4	5	4	8	10	—	14	14	13	12	—	6	—	—	—
80.41	Fe I	274	—	—	—	—	—	—	—	16	13	—	13	18	15	15	—	9	15	18	13
81.76	Fe I	354	146	122	—	112	65	102	110	186	180	—	144	160	148	164	—	190	179	147	177
82.38	Fe I	476a	52	58	50	53	39	40	49	93	92	—	92	118	84	96	—	79	70	62	72
82.79	Fe I	694	15	21	—	19	19	14	18	—	52	—	42	40	40	44	—	36	20	36	30
83.02	Fe I	697	—	—	—	—	—	—	—	—	—	—	22	13	17	17	—	18	34	32	27
83.44	V II	37	22	28	28	26	22	20	24	70	63	—	64	68	66	66	—	58	53	43	53
84.00	——	—	85	81	—	66	44	55	67	120	118	—	105	119	116	116	—	137	126	97	125
84.33	Ti II	21	32	42	—	33	29	32	34	—	76	—	79	80	89	81	—	48	63	53	55
84.90	Fe I	355	73	79	83	70	66	59	71	109	98	—	106	120	103	107	—	87	96	60	85
84.90	Cr I	155																			
86.12	Ti I	129	9	9	—	10	—	5	8	22	22	—	18	20	15	19	—	12	12	17	13

TABLE 4. EQUIVALENT WIDTHS OF LINES IN F-TYPE SPECTRA (Continued)

λ	Atom	R.M.T.	σ BOOTIS							α CANIS MINORIS							110 HERCULIS				
			IIIL$_A$	BL169a	BL169b	BL496	Mt. Wilson	Palomar	Mean	IIIL$_A$	Wood	BL84	BL496	9663	Mt. Wilson	Mean	BL84	BL169a	BL169b	Mt. Wilson	Mean
4186.60	Ce II	1	19	30	22	22	22	22	47	46	46	—	40	46	46	45	—	51	62	35	52
86.70	Zr II	97																			
87.04	Fe I	152	116	132	129	116	89	80	110	200	161	—	154	160	138	163	—	172	169	113	159
87.80	Fe I	152	142	156	146	120	105	119	131	196	205	—	175	190	170	187	—	192	205	151	189
88.72	——	—	76	92	—	76	57	59	73	122	110	—	109	121	98	112	—	120	123	98	117
89.56	Fe I	940	19	21	—	21	15	14	18	41	43	—	48	48	40	44	—	40	52	27	42
91.44	Fe I	152	136	132	134	116	89	82	113	181	172	—	152	167	146	164	—	197	200	143	188
91.68	Fe I	355	—	50	—	44	36	29	40	—	—	—	81	92	83	85	—	51	58	—	54
92.07	Ni II	10	5	14	—	10	—	—	10	18	18	—	26	24	26	22	—	19	20	12	18
92.10	Cr I	273																			
93.86	CN	—	13	16	—	11	12	8	12	—	12	—	20	17	20	17	—	7	24	22	17
95.34	Fe I	693	98	96	—	87	67	67	83	—	143	—	123	121	102	122	—	124	124	112	122
95.41	Cr II	161																			
95.61	Fe I	478	—	42	—	40	30	30	36	—	—	—	75	80	75	77	—	65	73	—	69
96.22	Fe I	693	67	80	74	68	51	52	66	110	107	—	105	103	105	106	—	99	113	83	101
96.53	Fe I	418	18	30	33	22	22	19	24	—	60	—	49	54	50	53	—	60	56	43	55
96.55	La II	41																			
98.31	Fe I	152	176	164	171	147	119	138	152	—	235	—	200	210	196	210	—	270	305	185	260
98.64	Fe I	693	59	84	74	69	47	52	66	—	115	—	105	104	97	195	—	106	94	66	93
99.10	Fe I	522	133	132	129	114	94	85	113	176	164	—	158	166	139	161	—	164	175	115	159
4199.97	Fe I	3	23	26	—	25	14	14	21	63	63	—	50	47	56	56	—	56	72	45	60
4200.40	Ti II	96	14	17	—	10	5	7	11	—	23	—	26	24	21	24	—	34	39	24	34
00.46	Ni I	89																			
00.93	Fe I	689	61	70	68	57	39	42	56	116	109	—	98	99	97	104	—	115	96	69	98
02.03	Fe I	42	174	157	160	142	125	127	146	265	220	—	205	210	180	215	205	250	235	175	220
02.76	Fe I	476a,521	21	22	—	22	—	14	20	53	51	—	43	44	49	48	32	47	44	42	41
03.57	Fe I	19	13	16	—	12	—	8	12	—	36	—	34	29	33	33	18	25	34	13	24
03.59	Cr I	35																			
03.95	Fe I	850	106	105	110	96	—	78	97	159	138	—	137	142	120	139	115	138	143	95	127
03.99	Fe I	355																			
04.69	Y II	1	32	22	—	18	—	11	19	—	49	—	41	46	38	44	—	50	58	38	51
04.75	CH	—																			
05.05	Eu II	1	50	46	45	45	—	30	42	—	96	—	86	82	84	87	74	102	102	72	90
05.05	V II	25																			
06.38	Mn II	7	12	8	—	6	—	4	7	—	22	—	18	12	11	16	—	12	16	—	14
06.70	Fe I	3	62	62	65	53	—	36	54	106	98	—	97	104	98	101	78	93	103	72	89
07.13	Fe I	352	59	59	50	53	—	38	51	105	80	—	83	82	85	87	80	96	74	57	80
07.35	Cr II	26	—	4	—	—	—	5	4	—	22	—	28	35	22	27	22	31	20	20	24
07.43	CN	—	—	—	—	—	—	—	—	—											
08.61	Fe I	689, 696	69	61	54	62	—	41	56	100	94	101	92	102	86	96	81	102	90	51	85
08.99	Zr II	41	37	40	36	33	—	23	33	57	58	73	62	66	62	63	57	58	50	39	53
09.37	Cr I	248	—	7	—	9	—	—	8	—	20	22	18	16	14	18	13	18	20	—	17
10.35	Fe I	152	137	112	108	117	—	84	109	157	161	159	149	166	130	154	132	155	143	91	136

4210.96	CH	—	—	11	—	10	—	9	10	33	28	26	26	32	25	28	32	30	26	12	27
11.80	Fe II	21	50	34	28	32	—	19	31	79	60	65	61	60	66	65	60	51	53	44	53
11.88	Zr II	15																			
12.66	CH	—	—	4	—	—	—	6	5	32	29	18	24	26	24	26	23	17	16	15	18
13.65	Fe I	355	64	66	80	61	—	43	60	108	99	95	98	101	82	97	90	77	90	70	83
15.52	Sr II	1	210	215	250	215	—	167	205	325	315	270	285	315	250	295	280	300	320	200	285
16.19	Fe I	3	90	89	—	83	—	66	81	149	141	132	128	125	112	131	123	132	132	100	125
17.55	Fe I	693	80	87	—	86	—	60	78	131	136	115	123	119	102	121	103	106	126	80	110
17.56	La II	78																			
18.18	Ti II	33	20	21	—	13	—	9	15	32	21	29	34	32	35	30	28	25	29	24	27
18.21	Fe I	172																			
19.36	Fe I	800	91	116	124	114	—	83	105	162	160	153	145	147	146	152	125	138	143	105	131
20.05	V II	25	16	19	—	16	—	11	15	—	33	40	39	41	38	38	26	26	24	13	24
20.05	Fe I	994																			
20.35	Fe I	482	49	52	43	46	—	39	46	91	96	95	91	81	72	88	74	96	92	49	82
22.22	Fe I	152	100	100	108	98	—	73	94	144	155	129	133	147	118	138	111	138	137	89	123
22.60	Ce II	36	14	18	—	13	—	12	14	—	18	24	23	24	17	21	14	15	26	26	19
24.18	Fe I	689	90	86	92	89	—	59	82	143	143	125	123	133	118	131	116	141	132	95	126
24.51	Fe I	689	42	63	68	57	—	34	52	99	95	108	100	89	83	96	—	103	83	76	90
24.51	V II	25																			
24.85	CH	—	28	25	—	18	—	14	20	—	40	51	46	48	37	44	38	31	56	34	41
24.85	Cr II	162																			
25.46	Fe I	693	112	98	—	88	—	71	89	151	151	131	120	117	116	131	141	167	154	93	145
25.96	Fe I	521	58	58	—	51	—	33	49	99	90	96	93	89	73	90	83	92	90	84	88
26.73	Ca I	2	260	300	—	275	—	260	275	435	430	425	375	400	335	400	480	510	495	365	475
27.43	Fe I	693	174	162	164	142	—	109	146	275	215	205	195	200	180	210	215	220	215	155	210
28.34	—	—	14	18	—	15	—	10	14	—	23	20	24	26	28	24	6	19	15	8	13
28.71	Fe I	690	9	11	—	—	—	7	9	—	15	9	12	12	10	12	7	9	12	15	10
29.52	Fe I	416,649	32	27	19	28	—	20	25	72	68	69	61	61	58	65	59	67	81	44	65
29.76	Fe I	41	24	32	42	22	—	12	25	—	63	72	58	57	62	62	66	77	76	39	68
31.00	CH	—	16	20	—	16	—	12	16	52	37	44	39	38	40	42	26	24	43	28	31
31.04	Ni I	136																			
31.95	—	—	—	12	—	6	—	11	10	36	38	34	32	30	28	33	27	30	34	28	30
32.72	Fe I	3	12	10	—	7	—	8	9	—	27	26	26	24	22	25	12	12	21	18	15
33.17	Fe II	27	163	154	144	136	—	103	137	205	215	200	188	194	182	198	190	205	210	144	193
33.61	Fe I	152	129	128	126	116	—	85	114	169	142	174	148	170	136	156	142	169	171	104	153
35.14	Mn I	23	45	52	48	48	—	37	46	—	100	95	86	81	88	90	97	101	123	61	100
35.29	Mn I	23																			
35.94	Fe I	152	165	150	160	142	—	106	140	235	215	205	195	186	200	205	220	270	240	137	230
36.76	Fe I	906	10	8	—	—	—	8	8	—	16	17	22	24	19	20	20	26	35	22	26
37.08	Fe I	19	39	38	—	36	—	29	35	86	80	83	75	78	78	80	84	96	96	70	89
37.16	Fe I	—																			
38.03	Fe I	689,696	60	70	68	55	—	53	60	109	99	110	105	102	94	103	92	98	111	76	97
38.38	La II	41	—	16	—	11	—	10	12	—	17	20	24	25	21	21	30	23	24	25	26
38.82	Fe I	693	98	102	105	96	—	72	93	162	157	151	132	148	135	148	128	158	154	100	140
39.36	Fe I	907	—	17	—	15	—	12	15	38	37	46	44	47	32	41	34	32	49	37	38
40.37	Fe I	764	46	52	—	44	—	36	44	94	98	97	91	98	89	95	97	108	99	63	96
40.46	Ca I	38																			
40.70	Cr I	105,178	—	14	—	11	—	8	11	—	23	35	30	26	25	28	21	34	32	23	28
41.11	Fe I	351	5	6	—	—	—	10	7	17	—	32	24	26	22	24	18	11	26	15	18
42.38	Cr II	31	70	76	72	70	—	49	66	140	124	123	107	117	106	120	118	126	126	95	119
43.79	Fe I	994	14	18	—	12	—	7	13	41	37	45	34	36	34	38	38	30	29	27	31

TABLE 4. EQUIVALENT WIDTHS OF LINES IN F-TYPE SPECTRA (Continued)

λ	Atom	R.M.T.	σ BOOTIS							α CANIS MINORIS							110 HERCULIS				
			IIIL$_A$	BL169a	BL169b	BL496	Mt. Wilson	Palomar	Mean	IIIL$_A$	Wood	BL84	BL496	9663	Mt. Wilson	Mean	BL84	BL169a	BL169b	Mt Wilson	Mean
4244.80	Ni II	9	—	4	—	4	—	6	5	—	14	13	17	14	12	14	4	7	11	4	7
45.26	Fe I	352	70	92	86	88	—	69	82	130	157	153	146	137	124	141	121	138	137	94	127
45.36	Fe I	691																			
46.09	Fe I	906	34	52	50	47	—	34	44	—	83	83	85	80	80	82	78	90	99	54	84
46.83	Sc II	7	146	160	170	146	123	105	140	205	230	205	205	210	170	205	177	192	196	127	180
47.43	Fe I	693	98	125	113	115	91	76	104	174	178	164	146	145	152	160	150	167	164	100	152
48.23	Fe I	482	52	56	50	52	48	39	49	102	103	109	99	84	92	98	101	111	115	69	103
50.12	Fe I	152	121	142	142	127	115	92	122	185	184	189	168	167	160	176	174	190	196	104	175
50.79	Fe I	42	145	165	169	155	119	111	144	220	245	225	195	215	166	210	194	205	215	133	194
52.05	Ti II	95	—	—	—	11	—	—	—	—	13	11	13	8	10	11	7	9	10	10	9
52.11	Ni I	136																			
52.62	Cr II	31	24	36	35	30	22	16	27	64	63	64	59	55	58	60	56	70	60	47	60
53.93	Fe I	905	7	10	—	10	12	7	9	20	14	26	22	—	18	20	19	15	15	9	15
54.35	Cr I	1	134	150	140	135	122	101	130	189	220	205	178	194	170	193	181	200	190	161	186
54.94	Fe I	419,477	16	12	—	11	—	8	11	37	37	45	35	32	32	36	26	27	38	38	31
54.98	CH	—	—	—	—	—	—	—	—												
55.50	Fe I	416	24	20	—	17	—	9	17	47	52	52	40	40	38	45	57	48	50	51	52
55.50	Cr I	105																			
56.79	Fe I	1102	—	10	—	—	—	4	7	18	18	22	22	18	16	19	10	15	13	12	13
57.66	Mn I	23	—	13	17	10	—	8	11	34	35	35	30	35	28	33	25	27	20	23	24
58.05	Zr II	15	84	72	—	63	43	52	63	—	—	—	104	105	101	103	137	154	132	95	134
58.16	Fe II	28																			
58.62	Fe I	351	16	25	30	21	—	12	20	—	48	54	47	50	46	49	47	54	58	32	50
58.96	Fe I	419	20	24	—	20	—	10	18	—	38	48	36	37	35	39	38	44	47	39	42
60.48	Fe I	152	193	186	187	177	149	125	167	295	240	250	215	220	200	235	275	290	280	210	270
61.92	Cr II	31	60	64	52	64	52	39	55	109	120	112	102	104	102	108	95	115	113	71	102
62.38	Cr I	154	—	4	—	6	—	—	5	17	14	15	15	13	11	14	4	15	18	21	14
62.68	Sm II	37	—	4	—	—	—	—	—	—	11	12	13	12	10	12	3	6	4	14	6
63.13	Ti I	162	11	13	—	16	14	9	13	—	40	46	42	34	34	39	29	23	34	29	29
63.14	Cr I	247																			
63.59	La II	84	8	6	—	6	—	—	6	—	12	12	14	10	10	12	3	7	9	6	6
63.90	Fe II	—	8	4	—	9	—	—	7	—	18	10	8	11	8	11	8	12	15	17	12
64.21	Fe I	692	26	34	26	32	25	17	27	57	66	70	57	62	56	61	55	67	70	54	63
64.74	Fe I	993	12	18	22	16	—	8	15	37	39	46	36	34	29	37	23	28	43	37	32
65.26	Fe I	993,994	16	25	22	22	27	12	20	42	61	53	48	48	40	49	32	38	48	34	39
65.92	Mn I	23	11	14	—	17	18	10	14	36	42	46	39	44	38	41	24	32	34	23	29
66.97	Fe I	273	42	51	44	42	41	30	41	83	80	87	82	82	66	80	64	67	77	54	67
67.83	Fe I	482	57	74	66	68	54	43	61	125	122	118	106	106	92	112	106	126	128	83	115
68.74	Fe I	649	32	40	44	40	31	20	34	—	82	83	74	67	66	74	69	72	88	55	73
68.79	Cr I	271																			
69.28	Cr II	31	20	26	—	27	—	17	23	69	57	65	48	52	46	56	56	58	59	46	56
71.16	Fe I	152	135	152	131	138	117	102	130	198	215	205	192	200	163	196	188	192	200	128	184
71.76	Fe I	42	188	215	200	205	180	155	191	320	320	300	275	295	260	295	310	360	340	205	320

4272.53	——	—	—	18	—	13	—	6	12	20	24	20	23	20	21	21	18	22	25	15	21
72.91	Cr I	96	—	7	—	9	—	4	7	20	25	22	20	18	17	20	12	15	20	9	15
73.32	Fe II	27	48	66	62	65	53	35	55	114	112	112	106	104	100	108	99	102	118	71	101
73.87	Fe I	478	16	26	—	25	—	15	21	67	69	69	59	62	54	63	62	75	91	58	73
74.17	CH	—	—	6	—	4	—	—	5	13	8	13	19	16	12	14	14	21	24	15	19
74.80	Cr I	1	138	146	142	137	118	96	128	210	215	200	191	191	168	196	179	200	191	130	182
75.57	Cr I	31	51	56	52	48	43	32	46	117	113	95	101	100	99	104	104	108	114	81	105
76.68	Fe I	976	18	26	26	21	23	12	21	50	47	48	43	44	37	45	37	33	47	30	38
76.96	V I	88	—	7	—	6	—	—	6	—	5	15	12	9	10	10	9	17	21	6	14
78.13	Fe II	32	35	46	—	45	37	26	40	95	97	96	92	92	81	92	72	76	90	54	76
78.23	Fe I	691																			
79.48	Fe I	993	21	25	22	16	23	13	19	—	52	45	39	42	37	43	58	49	59	46	54
81.10	Mn I	23	22	28	—	28	21	11	22	59	57	65	54	58	54	58	64	79	60	49	65
81.96	CH	—	—	8	—	5	—	5	6	21	25	27	22	26	22	24	9	17	22	24	17
82.41	Fe I	71	110	126	112	116	102	79	107	166	182	171	148	149	125	157	140	166	154	91	144
83.01	Ca I	5	90	114	110	102	103	70	97	161	167	159	142	142	121	140	138	159	141	93	138
84.08	Mn I	23	44	44	—	43	34	25	38	97	95	83	75	80	83	86	76	82	85	57	78
84.21	Cr II	31																			
84.98	CH	—	16	16	20	15	18	10	15	—	41	38	28	33	26	33	38	47	37	29	39
84.99	Ti I	148																			
85.44	Fe I	597	51	61	58	66	52	36	54	106	117	111	104	106	96	107	97	112	109	65	100
86.01	Ti I	44	25	30	28	28	27	17	26	—	69	70	59	60	56	63	85	87	81	56	80
86.44	Fe I	414	11	22	—	24	24	11	20	66	66	59	52	57	46	58	52	64	60	41	56
86.51	Zr II	69																			
86.97	La II	75	39	44	42	40	31	30	38	—	85	86	75	86	79	82	92	101	85	52	87
86.98	Fe I	976																			
87.40	Ti I	44	12	17	17	20	18	10	16	34	34	40	43	41	34	38	32	20	32	21	27
87.89	Ti II	20	124	102	—	106	77	66	94	194	169	174	138	153	142	162	175	188	188	121	175
88.00	Ni I	178																			
88.96	Fe I	214	33	41	38	38	33	22	34	—	78	87	75	71	60	74	88	93	90	37	83
89.07	Ti I	44																			
89.36	Ca I	5	90	104	108	100	87	68	92	—	160	151	134	145	108	140	123	132	154	80	128
89.72	Cr I	1	142	144	134	134	119	100	128	205	205	200	160	185	151	185	205	192	196	133	189
90.22	Ti II	41	150	150	124	144	120	100	131	235	220	215	190	183	192	205	210	225	225	149	210
90.38	Fe I	416																			
91.47	Fe I	3,41	32	46	40	43	45	27	39	91	98	84	82	81	76	85	85	95	77	67	83
93.14	Zr II	110	14	23	—	34	18	16	22	—	72	62	58	59	58	62	59	68	53	42	57
94.10	Ti II	20	150	172	182	161	—	117	154	220	235	225	205	210	180	215	196	210	192	123	189
94.13	Fe I	41																			
94.77	Sc II	15	30	44	43	42	—	24	37	—	91	83	82	81	72	82	73	85	79	60	76
95.75	Ti I	44	14	26	—	31	—	25	25	—	66	62	53	58	46	57	63	65	56	32	57
95.76	Cr I	64																			
96.57	Fe II	28	104	90	94	87	66	62	82	153	153	137	121	122	130	136	143	161	154	94	144
96.68	Ce II	2																			
98.03	V I	120	39	57	—	56	42	38	48	116	112	98	99	100	97	104	108	108	98	76	101
98.04	Fe I	520																			
98.99	Ca I	5		90	—	89	98	67	84	—	—	166	148	159	136	152	—	—	—	—	—
99.23	Ti I	148	230	154	—	140	123	109	133	—	220	220	189	185	196	200	265	275	265	205	255
4299.24	Fe I	152																			
4300.05	Ti II	41	177	170	169	155	137	106	149	270	260	230	215	210	210	230	250	285	275	193	260
00.57	Ti I	44	47	55	62	53	44	34	49	—	124	107	96	89	88	101	120	104	107	100	109
00.58	CH	—																			

TABLE 4. EQUIVALENT WIDTHS OF LINES IN F-TYPE SPECTRA (Continued)

λ	Atom	R.M.T.	σ BOOTIS							α CANIS MINORIS							110 HERCULIS				
			IIIL$_A$	BL169a	BL169b	BL496	Mt. Wilson	Palomar	Mean	IIIL$_A$	Wood	BL84	BL496	9663	Mt. Wilson	Mean	BL84	BL169a	BL169b	Mt. Wilson	Mean
4301.93	Ti II	41	127	128	110	116	108	86	112	195	196	175	172	161	149	175	179	198	188	124	179
02.53	Ca I	5	134	148	131	133	118	98	127	220	205	188	172	183	152	187	215	230	220	147	210
03.17	Fe II	27	111	110	102	100	82	66	94	164	173	161	134	140	130	150	151	164	159	101	150
04.55	Fe I	414	28	33	34	22	33	18	27	98	82	65	67	49	49	72	87	87	81	61	82
04.57	CH	—																			
05.45	Sr II	3	68	78	—	81	64	55	70	—	152	146	118	121	109	129	162	148	121	102	135
05.45	Cr I	96																			
05.46	Cr II	476																			
05.91	Ti I	44	94	84	—	82	—	62	79	—	—	—	117	121	117	118	171	162	132	130	151
07.90	Ti II	41	285	245	305	265	—	225	255	435	365	330	320	345	340	355	435	425	440	310	415
07.91	Fe I	42																			
09.04	Fe I	849	38	50	48	52	46	37	46	—	122	110	100	97	108	107	136	113	90	99	111
09.38	Fe I	414	71	82	—	81	77	61	74	—	140	—	120	127	120	127	—	—	—	—	—
09.46	Fe I	478																			
12.86	Ti II	41	116	105	116	110	109	84	104	205	195	175	167	187	154	181	174	194	188	132	178
14.08	Sc II	15	145	120	118	116	—	106	118	220	200	178	167	172	158	183	193	174	184	158	180
14.29	Fe II	32	—	46	—	41	—	—	44	—	—	—	94	94	84	91					
14.98	Ti II	41	205	190	200	180	—	150	181	—	310	245	230	265	230	255	245	235	255	200	240
15.09	Fe I	71																			
16.81	Ti II	94	42	36	34	39	—	45	40	88	97	70	71	70	68	77	63	73	60	52	63
18.65	Ca I	5	108	102	—	99	—	80	96	151	155	136	131	160	126	143	118	128	121	104	120
25.01	Sc II	15	100	110	—	101	—	86	99	200	182	165	167	165	158	173	181	198	184	117	178
25.76	Fe I	42	199	205	—	210	—	180	200	—	330	315	255	330	290	305	320	320	335	250	315
30.26	Ti II	94	25	33	—	43	—	25	32	61	74	65	60	62	57	63	51	48	45	37	46
30.71	Ti II	41	66	54	—	57	—	44	54	99	100	86	90	82	91	91	85	70	83	65	77
33.76	La II	24	26	30	—	24	—	23	26	40	46	37	34	36	42	39	33	42	54	32	41
37.05	Fe I	41	101	78	—	86	—	79	84	135	128	118	112	114	100	118	135	136	130	93	128
37.92	Ti II	20	115	102	—	92	—	97	100	142	150	158	141	135	134	143	149	140	156	120	144
40.47	Hγ	1	5560	5470	—	5200	—	5840	5500	5990	6650	6160	6230	7115	6160	6400	5415	4660	4770	4100	4850
52.74	Fe I	71	77	90	—	85	—	67	80	148	145	121	122	117	121	129	115	128	126	94	119
54.61	Sc II	14	27	37	—	23	—	18	26	73	72	63	66	56	70	67	63	65	67	51	63
55.10	Ca I	37	46	44	—	32	—	32	37	78	76	66	74	64	70	71	72	73	66	58	69
58.50	Fe I	412	37	44	—	39	—	30	38	—	82	64	73	61	68	68	86	76	81	71	80
59.63	Cr I	22	63	60	—	55	—	41	54	110	112	94	109	90	104	103	115	128	116	120	120
65.90	Fe I	415	11	12	—	9	—	8	10	33	33	29	30	35	35	32	22	22	16	35	22
67.58	Fe I	414	111	94	106	100	—	75	94	180	172	140	148	142	142	154	140	148	141	147	144
67.66	Ti II	104																			
67.91	Fe I	41	32	38	37	38	—	22	33	—	80	74	72	62	66	71	83	71	59	48	68
69.40	Fe II	28	23	30	31	32	—	19	27	—	76	62	66	62	63	66	61	53	47	44	52
69.77	Fe I	518	66	76	78	80	—	58	72	150	138	112	112	107	105	121	110	129	106	102	113

4371.28	Cr I	22	47	44	33	45	43	32	41	118	114	93	93	95	99	102	87	109	90	63	91
71.33	C I	14																			
73.25	Cr I	22	—	6	—	6	—	4	5	—	13	20	14	14	18	16	24	19	13	24	19
73.56	Fe I	214,413	11	23	21	29	24	16	21	59	53	53	55	55	50	54	56	60	51	46	54
74.46	Sc II	14	102	104	98	99	89	68	92	177	166	146	131	142	130	149	131	171	143	122	145
74.50	Fe I	648																			
74.82	Ti II	93	91	110	111	102	87	81	97	—	200	179	175	185	153	179	168	186	171	130	169
74.94	Y II	13																			
75.93	Fe I	2	87	100	102	99	90	67	90	151	158	133	123	139	126	138	112	143	121	104	122
76.78	Fe I	471,904	13	11	—	3	—	8	8	—	34	32	34	38	34	34	24	28	18	33	25
76.80	Cr I	304																			
79.24	V I	22	27	29	30	30	22	15	25	84	76	62	70	68	66	71	58	62	53	59	58
79.78	Zr II	88	15	6	—	9	13	8	9	31	42	38	34	32	32	35	27	33	24	33	29
79.78	Cr I	130																			
82.78	Fe I	799a	21	40	—	35	33	24	32	100	96	76	66	68	71	80	78	96	100	74	89
82.85	Cr I	64																			
83.55	Fe I	41	255	240	250	230	230	184	225	385	375	325	315	370	325	350	385	420	395	305	385
84.33	Fe II	32	41	46	41	45	42	27	40	—	100	84	85	80	84	87	101	101	80	68	90
85.26	Fe I	415	95	103	96	94	67	67	87	180	165	140	131	139	142	150	146	142	125	126	136
85.38	Fe II	27																			
86.86	Ti II	104	51	54	38	52	41	40	47	94	104	84	87	80	92	90	90	88	74	83	84
87.90	Fe I	476	44	41	39	39	35	25	36	74	86	65	69	69	77	73	57	77	60	61	64
88.41	Fe I	830	66	76	66	63	56	44	62	116	131	98	99	90	99	106	87	114	90	90	96
89.24	Fe I	2	16	18	—	13	19	12	15	51	54	46	46	43	46	48	40	41	41	33	40
89.97	V I	22	28	16	26	17	16	12	18	60	57	54	52	43	55	54	58	65	64	56	61
90.95	Fe I	414	82	79	73	77	65	57	72	141	154	125	121	127	130	133	121	132	121	105	122
90.98	Ti II	61																			
92.58	Fe I	973	4	14	—	8	—	4	8	—	33	24	26	15	22	24	18	26	13	18	19
94.06	Ti II	51	67	78	81	78	65	51	70	119	130	112	114	108	115	116	92	107	89	76	93
95.03	Ti II	19	166	158	174	158	144	109	148	240	255	225	205	210	205	225	220	245	220	181	225
95.85	Ti II	61	53	53	55	57	43	34	49	104	114	95	98	91	92	99	81	97	87	79	87
98.02	Y II	5	25	37	33	35	26	21	30	90	84	67	72	67	67	74	60	66	56	47	59
98.31	Ti II	61	—	14	22	13	15	10	14	—	52	44	48	37	40	44	21	41	34	37	33
99.20	Ce II	81	—	—	—	—	—	—	—	—	5	4	10	5	6	6	11	17	8	16	13
99.77	Ti II	51	103	110	118	108	90	75	100	162	181	151	153	146	140	156	132	152	155	118	142
4399.82	Cr I	129																			
4400.36	Sc II	14	93	96	102	97	76	66	88	149	170	148	143	136	143	148	127	135	140	93	128
04.10	Fe I	987	7	13	—	8	—	5	8	—	17	16	17	15	12	15	20	18	24	24	21
04.75	Fe I	41	192	210	210	199	190	152	190	305	320	280	260	280	255	285	300	340	325	215	305
07.68	Ti II	51	74	82	68	79	65	48	69	131	143	112	119	111	118	122	121	127	123	85	118
07.71	Fe I	68																			
08.42	Fe I	68	79	84	81	78	56	54	73	—	142	118	137	125	125	129	139	159	158	96	144
08.51	V I	22																			
09.12	Fe I	645	20	29	28	27	16	15	23	—	66	54	50	49	54	55	55	71	61	48	60
09.22	Ti II	61																			
09.52	Ti II	61	22	31	28	19	29	13	23	—	69	56	56	56	55	58	50	55	60	37	52
10.52	Ni I	88	9	15	13	9	15	8	12	22	39	30	35	29	36	32	20	40	31	31	30
11.08	Ti II	115	36	50	41	40	39	30	40	86	94	74	81	75	82	82	58	73	70	42	63
11.09	Cr I	129																			
11.88	Mn I	—	24	28	24	26	20	16	23	63	74	50	61	56	62	61	37	52	48	32	44
11.94	Ti II	61																			

TABLE 4. EQUIVALENT WIDTHS OF LINES IN F-TYPE SPECTRA (Continued)

λ	Atom	R.M.T.	σ BOOTIS							α CANIS MINORIS							110 HERCULIS				
			$\mathrm{IIIL_A}$	BL169a	BL169b	BL496	Mt. Wilson	Palomar	Mean	$\mathrm{IIIL_A}$	Wood	BL84	BL496	9663	Mt. Wilson	Mean	BL84	BL169a	BL169b	Mt. Wilson	Mean
4412.25	Cr I	22	—	6	—	8	—	—	7	—	13	14	15	9	12	12	20	29	14	17	20
13.60	Fe II	32	21	20	22	18	24	11	18	56	50	39	46	43	46	47	32	38	41	30	36
15.12	Fe I	41	170	157	174	152	135	116	148	245	255	210	193	215	200	220	240	320	265	194	260
15.56	Sc II	14	75	92	93	88	69	58	79	—	151	129	128	126	114	130	117	109	104	76	105
16.82	Fe II	27	96	98	101	88	73	60	85	125	150	118	122	132	124	128	104	125	113	72	108
17.72	Ti II	40	106	116	116	105	93	76	101	153	178	138	151	141	142	150	124	154	133	98	131
18.34	Ti II	51	46	56	60	58	46	41	51	98	126	91	102	96	99	102	92	101	90	61	90
18.43	Fe I	412																			
18.78	Ce II	2	—	—	—	—	—	—	—	—	21	15	15	11	11	15	22	27	15	10	20
20.30	——	—	8	10	—	7	6	5	7	19	28	12	23	19	18	20	14	20	18	18	17
20.66	Sc II	14	—	5	—	7	—	4	5	23	20	16	22	18	21	20	16	24	16	9	17
20.75	Fe II	9																			
21.95	Ti II	93	51	49	32	38	34	26	38	82	93	69	71	60	80	76	72	84	81	55	76
22.57	Fe I	350	83	86	—	80	58	53	72	137	150	110	112	111	120	123	116	130	116	86	116
22.59	Y II	5																			
23.14	Fe I	412	11	18	22	13	13	8	14	—	45	47	45	48	47	46	50	55	40	30	46
23.22	Ti II	61																			
23.86	Fe I	830	13	20	22	14	16	10	15	43	46	39	38	37	38	40	33	53	39	38	41
25.44	Ca I	4	99	105	104	97	79	67	91	134	172	125	127	137	112	134	136	167	138	95	140
27.31	Fe I	2	107	114	118	105	92	74	100	141	178	150	139	144	133	148	156	175	167	111	158
27.90	Ti II	61	4	11	—	5	7	6	7	16	23	14	16	11	16	16	9	30	16	22	19
28.00	Mg II	9	—	3	—	3	—	4	3								—	—	—	—	—
28.50	Cr I	129	6	10	—	7	—	8	—	20	28	19	18	15	16	19	20	19	23	24	21
28.52	V I	21																			
28.57	Fe I	973																			
29.90	La II	38	9	15	21	14	20	12	15	—	37	33	22	24	27	29	38	41	33	32	37
30.20	Fe I	472	—	22	24	15	18	13	18	72	72	51	52	49	53	58	62	89	67	60	71
30.62	Fe I	68	85	79	78	72	57	58	71	129	144	113	111	118	124	123	139	144	135	82	131
31.37	Sc II	14	11	16	24	9	7	8	12	—	48	33	40	32	37	38	32	44	36	23	35
31.92	Mn I	40	—	—	—	—	—	—	—	—	43	23	26	23	23	28	26	30	29	22	27
32.09	Ti II	51	10	16	21	11	9	7	12	—	38	32	36	34	32	34	34	44	36	28	37
32.18	Cr I	81																			
32.57	Fe I	797	10	14	21	12	12	8	12	31	47	32	38	33	34	36	26	30	27	21	27
33.22	Fe I	830	58	66	54	56	50	36	53	98	122	82	88	84	84	93	92	110	89	70	93
33.79	Fe I	825	42	42	33	41	30	22	35	62	86	62	63	65	68	68	80	82	66	36	70
34.96	Ca I	4	134	135	128	122	94	83	115	172	192	174	150	149	156	166	184	220	175	133	184
35.15	Fe I	2								—	—	—	—	—	—	—					
35.69	Ca I	4	95	94	96	92	80	58	84	117	161	125	122	136	122	130	106	161	121	95	124
36.35	Mn I	22	10	22	21	14	17	9	15	39	57	40	44	36	42	43	38	44	43	33	40
36.36	Zr II	—																			
36.93	Fe I	516	22	22	22	17	14	13	18	53	53	50	50	48	48	50	34	47	42	44	41
36.98	Ni I	86																			
37.57	Ni I	168	10	3	—	4	—	—	5	—	20	17	20	11	15	17	9	18	11	5	12

4438.35	Fe I	828	5	10	—	12	14	9	10	36	43	29	38	31	34	35	24	34	29	27	29
39.88	Fe I	116	6	8	—	—	—	6	7	24	28	26	26	29	25	26	18	26	20	9	20
40.45	Zr II	79	10	10	—	9	—	6	9	34	42	32	35	27	32	34	26	45	28	41	34
40.48	Fe I	829																			
40.84	Fe I	992	6	10	—	11	16	8	10	—	34	26	28	20	25	27	24	47	36	30	35
41.68	V I	21	—	—	—	—	—	—	—	82	110	81	82	79	82	86	67	81	77	53	72
41.73	Ti II	40	33	52	36	38	41	26	38												
42.34	Fe I	68	86	100	100	94	90	66	88	147	179	136	138	138	132	145	116	149	125	90	124
43.20	Fe I	350	81	78	66	68	72	58	70	125	132	117	110	104	104	115	118	163	125	87	128
43.80	Ti II	19	138	135	158	134	128	101	129	183	210	184	176	182	172	185	151	200	180	122	169
44.56	Ti II	31	49	46	42	48	40	41	45	88	121	92	86	89	91	94	76	87	84	69	80
44.56	Fe II	201																			
46.25	Fe II	187	—	—	—	6	—	4	5	—	11	11	11	8	8	10	11	11	12	10	11
46.84	Fe I	828	18	24	21	25	18	17	21	—	66	47	52	58	52	55	55	54	47	32	49
47.13	Fe I	69	8	21	22	23	13	14	18	—	62	54	43	48	47	51	37	38	45	24	38
47.72	Fe I	68	95	97	96	87	82	68	86	149	168	132	125	142	125	140	118	149	120	102	125
49.14	Ti I	160	—	18	21	13	13	8	14	46	52	37	40	35	36	41	—	27	29	32	29
50.32	Fe I	476	107	104	103	87	82	77	92	161	180	165	134	146	146	155	—	154	141	89	136
50.48	Ti II	19																			
51.54	Fe II	—	50	46	54	45	56	32	45	85	95	92	85	81	82	87	—	83	77	48	74
51.57	Nd II	50																			
51.59	Mn I	22																			
52.62	Fe I	969	6	10	—	3	—	—	6	20	19	19	20	13	17	18	—	20	18	26	20
53.00	Mn I	22	6	6	—	8	—	6	7	—	41	38	31	30	28	34	—	31	27	17	27
53.31	Ti I	113	11	10	—	11	20	8	11	—	50	51	40	37	40	44	—	34	33	14	30
53.35	V II	199																			
53.71	Ti I	160	3	8	—	8	—	6	7	—	18	29	22	20	20	22	—	12	17	8	13
54.38	Fe I	350	42	56	60	54	58	44	52	—	115	91	98	89	95	98	—	77	101	60	83
54.78	Ca I	4	164	133	136	127	111	100	126	—	210	198	172	167	162	182	—	230	245	176	225
54.80	Zr II	40																			
55.82	Mn I	28	88	94	93	85	72	59	81	132	151	147	125	145	129	138	—	143	132	88	128
55.89	Ca I	4																			
56.33	Fe I	516	—	13	—	12	17	10	12	—	48	44	33	38	38	40	—	32	37	31	34
56.61	Ca I	4	23	17	—	27	28	19	23	61	68	70	58	62	62	64	—	62	67	35	59
56.65	Ti II	115																			
59.04	Ni I	86	—	—	—	—	—	—	—	190	210	185	160	164	166	180	—	215	205	128	194
59.12	Fe I	68	132	112	—	108	99	88	106												
61.65	Fe I	2	90	80	—	78	—	62	76	—	153	140	122	127	116	131	—	—	145	105	132
61.99	Fe I	471,825	52	52	—	53	—	43	50	—	125	114	99	98	100	107	—	—	93	89	92
62.02	Mn I	28																			
62.46	Ni I	86	16	10	—	14	—	12	13	—	79	67	56	58	56	63	—	—	61	48	57
64.46	Ti II	40	109	—	—	71	—	61	75	—	140	118	108	106	107	116	—	—	116	87	106
64.77	Fe I	472	—	—	—	25	—	28	26	—	90	101	69	78	84	84	—	—	65	54	61
65.81	Ti I	146	—	—	—	—	—	—	—	15	29	17	16	25	15	20	—	—	18	8	15
66.55	Fe I	350	115	—	—	91	—	69	87	163	176	152	123	127	135	146	—	—	123	103	116
67.34	Sm II	53	—	—	—	—	—	—	—	—	—	20	17	15	12	16	—	—	14	12	13
67.45	Fe I	1048	6	—	—	7	—	—	7	—	16	7	10	7	9	10	—	—	7	6	7
67.56	Cr I	127																			
68.49	Ti II	31	133	—	—	124	—	102	117	195	230	205	175	184	174	194	—	—	167	115	150
69.16	Ti II	18	—	—	—	36	—	16	26	—	73	69	61	67	62	66	—	—	—	—	—
69.38	Fe I	830	84	—	—	70	—	64	70	—	140	130	106	106	111	119	—	—	133	104	123
70.14	Mn I	22	10	—	—	6	—	7	7	—	43	34	29	25	27	32	—	—	18	14	17

TABLE 4. EQUIVALENT WIDTHS OF LINES IN F-TYPE SPECTRA (Concluded)

λ	Atom	R.M.T.	σ BOOTIS							α CANIS MINORIS							110 HERCULIS				
			IIIL$_\mathrm{A}$	BL169a	BL169b	BL496	Mt. Wilson	Palomar	Mean	IIIL$_\mathrm{A}$	Wood	BL84	BL496	9663	Mt. Wilson	Mean	BL84	BL169a	BL169b	Mt. Wilson	Mean
4470.48	Ni I	86	33	—	—	36	—	23	30	—	76	72	61	68	68	69	—	—	57	47	54
70.86	Ti II	40	38	—	—	41	—	33	37	89	106	92	83	89	82	90	—	—	80	55	72
71.24	Ti I	146	—	—	—	9	—	8	8	16	34	31	26	22	25	26	—	—	23	—	—
71.24	Ce II	8																			
71.68	Fe I	2	—	—	—	—	—	—	—	—	18	11	12	11	10	12	—	—	—	20	—
72.92	Fe II	37	58	—	—	41	—	34	42	—	113	87	83	79	78	88	—	—	—	66	—
74.71	V I	101	—	—	—	—	—	—	—	—	12	7	12	3	10	9	—	—	—	17	—
74.85	Ti I	113, 184	7	—	—	9	—	4	7	—	19	17	10	15	12	15	—	—	—	17	—
76.02	Fe I	350	130	—	—	108	—	89	105	167	185	165	155	159	146	163	—	—	—	111	—
76.08	Fe I	830																			
77.45	Y I	14	—	—	—	—	—	—	—	19	24	15	14	14	13	16	—	—	—	12	—
79.61	Fe I	828, 848	29	—	—	16	—	18	19	63	78	59	50	60	52	60	—	—	—	59	—
79.97	Fe I	974	21	—	—	15	—	13	14	—	32	43	38	33	28	35	—	—	—	—	—
80.14	Fe I	515		—	—	10	—	12	11	70	78	60	53	56	62	63	—	—	—	60	—
81.13	Mg II	4	260	—	—	196	—	156	192	335	400	325	265	143	265	315	—	—	—	195	
81.33	Mg II	4												143							
82.17	Fe I	2	124	—	—	131	—	95	115	170	195	189	154	184	164	176	—	—	—	115	—
82.26	Fe I	68																			
82.69	Ti I	113	25	—	—	17	—	21	20	63	67	60	52	56	59	60	—	—	—	37	—
82.75	Fe I	828																			
84.23	Fe I	828	56	—	—	46	—	43	47	94	116	90	80	87	90	93	—	—	—	54	—
85.68	Fe I	830	40	—	—	34	—	27	32	76	79	69	59	68	67	70	—	—	—	47	—
86.91	Ce II	57	—	—	—	—	—	—	—	14	24	22	17	17	14	18	—	—	—	12	—
88.14	Fe I	819	—	—	—	15	—	—	—	—	38	39	36	39	30	36	—	—	—	26	—
88.32	Ti II	115	55	—	—	43	—	42	45	—	110	105	76	89	86	93	—	—	—	63	—
89.09	Ti I	146	—	—	—	—	—	—	—	126	146	120	104	116	108	120	—	—	—	98	—
89.18	Fe II	37	75	—	—	58	—	58	61												
89.74	Fe I	2	29	—	—	32	—	28	30	—	101	83	68	79	70	80	—	—	—	46	—
90.08	Mn I	22	28	—	—	32	—	25	28	—	68	73	59	70	68	68	—	—	—	55	—
90.08	Fe I	469																			
90.77	Fe I	974	14	—	—	27	—	23	23	—	77	71	57	70	64	68	—	—	—	41	—
91.40	Fe II	37	50	—	—	58	—	60	57	125	135	124	102	106	108	117	—	—	—	66	—
92.31	Cr I	197	—	—	—	6	—	—	—	—	14	12	13	8	13	12	—	—	—	22	—
92.69	Fe I	969	—	—	—	11	—	5	8	18	21	22	15	18	20	19	—	—	—	10	—
93.53	Ti II	18	11	—	—	18	—	11	14	42	58	47	44	33	45	45	—	—	—	19	—
93.58	Fe II	222																			
94.05	Fe I	973	6	—	—	10	—	—	9	—	45	32	32	19	26	31	—	—	—	29	—
94.57	Fe I	68	92	—	—	70	—	76	77	150	163	144	125	135	134	142	—	—	—	97	—
96.86	Cr I	10	—	—	—	—	—	—	—	100	130	109	99	98	101	106	—	—	—	71	—
4496.96	Zr II	40	58	—	—	39	—	42	44												
4501.27	Ti II	31	115	—	—	—	—	103	107	197	190	205	—	183	163	188	—	—	—	132	—
04.84	Fe I	555	14	—	—	—	—	7	9	24	37	29	—	23	28	28	—	—	—	22	—
08.28	Fe II	38	82	—	—	—	—	75	77	159	173	150	—	132	119	147	—	—	—	90	—

4509.75	——	—	—	—	—	—	—	6	—	—	34	29	—	23	32	30	—	—	—	—	—
12.72	V II	212	14	—	—	—	—	10	11	37	48	36	—	32	32	37	—	—	—	30	—
12.73	Ti I	42																			
14.19	Fe I	514	20	—	—	—	—	9	13	—	—	40	—	35	40	38	—	—	—	40	—
14.37	Cr I	287	—	—	—	—	—	—	—	—	—	46	—	30	29	35	—	—	—		
15.34	Fe II	37	83	—	—	—	—	68	73	147	150	136	—	129	130	138	—	—	—	96	—
17.53	Fe I	472	28	—	—	—	—	13	18	88	62	50	—	48	60	62	—	—	—	32	—
17.60	Fe I	992																			
18.02	Ti I	42	47	—	—	—	—	13	15	43	48	44	—	36	39	42	—	—	—	—	—
18.30	Ti II	18						19	22	74	68	67	—	70	60	68	—	—	—	54	—
20.22	Fe II	37	76	—	—	—	—	70	72	118	152	133	—	218	110	128	—	—	—	80	—
20.24	Fe I	471																			

TABLE 5. EQUIVALENT WIDTHS OF LINES IN G-TYPE SPECTRA

λ	Atom	R.M.T.	λ SERPENTIS					μ HERCULIS			
			BL169a	BL169b	BL169c	Mt. Wilson	Mean	BL169a	BL169b	Mt. Wilson	Mean
3995.31	Co I	31	—	—	—	—	—	210	—	—	—
95.74	La II	27	—	—	—	—	—	60	—	—	—
97.90	Co I	32	—	—	—	120	—	250	—	187	220
98.05	Fe I	276									
3998.64	Ti I	12	—	—	—	140	—	205	—	194	200
4001.67	Fe I	72	113	—	115	122	118	160	—	130	145
02.94	V II	79	78	—	77	70	74	89	—	78	84
03.76	Fe I	728	93	—	85	91	90	104	—	84	94
05.25	Fe I	43	455	495	485	475	475	640	—	635	635
07.23	Fe I	119	109	107	107	92	101	148	—	114	131
07.28	Fe I	277									
08.93	Ti I	12	144	133	130	136	136	184	—	135	160
09.71	Fe I	72	—	—	—	—	—	250	—	192	220
10.18	Fe I	915	50	42	42	40	43	68	—	51	60
11.42	Fe I	218	83	72	75	65	72	104	—	81	92
11.71	Fe I	153	64	61	61	62	62	94	—	81	88
14.53	Fe I	802	139	146	141	145	143	198	—	164	181
15.61	⊙	—	118	102	109	91	102	130	—	106	118
16.04	—	—	—	—	—	—	—	18	—	16	17
16.43	Fe I	560	88	89	89	78	84	122	—	98	110
17.10	Fe I	279	—	—	—	136	—	197	—	194	196
17.16	Fe I	527									
20.90	Co I	16	102	91	106	78	91	117	—	111	114
21.33	Nd II	36	—	—	—	—	—	22	—	19	20
22.26	Cr I	268	—	—	—	49	—	90	—	77	84
22.74	Fe I	556 ,654	67	61	69	54	61	81	—	75	78
23.39	V II	32	94	75	83	80	82	94	—	84	89
23.40	Co I	59									
23.69	Sc I	7	60	61	64	43	54	88	—	79	84
25.83	—	—	73	61	85	56	66	84	—	78	81
26.17	Cr I	37	60	44	51	—	52	65	—	73	69
27.64	⊙	—	56	50	63	46	52	75	—	59	67
27.94	⊙	—	33	22	36	—	30	52	—	45	48
28.33	Ti II	87	108	102	113	103	106	135	—	106	120
28.41	Ce II	47									
28.78	Fe I	—	54	37	53	37	44	63	—	56	60
29.64	Fe I	556, 563	122	118	130	101	114	139	—	109	124
29.68	Zr II	41									
30.76	Mn I	2	315	325	385	—	340	480	—	420	450
33.07	Mn I	2	305	300	290	270	285	375	—	360	370
34.49	Mn I	2	240	240	255	220	235	355	—	305	330
36.37	Fe I	279	34	28	41	29	32	63	—	63	63
36.78	V II	9	55	58	71	44	55	81	—	67	74
37.72	Fe I	118	33	36	49	27	34	56	—	57	56
39.10	Cr I	251	45	44	68	44	49	81	—	66	74
41.29	Fe I	603, 654	210	192	190	175	188	205	—	175	190
41.36	Mn I	5									
45.82	Fe I	43	975	1025	1090	980	1010	1835	—	1745	1790
48.76	Mn I	5	165	156	174	147	158	170	—	141	156
48.78	Cr I	251									
50.32	Zr II	43	41	36	40	23	33	23	—	29	26
50.69	Fe I	—	76	70	82	67	73	85	—	79	82
52.91	Co I	—	—	—	—	—	—	64	—	43	54
52.93	Ti I	208									

TABLE 5. EQUIVALENT WIDTHS OF LINES IN G-TYPE SPECTRA (*Continued*)

λ	Atom	R.M.T.	λ SERPENTIS					μ HERCULIS			
			BL169a	BL169b	BL169c	Mt. Wilson	Mean	BL169a	BL169b	Mt. Wilson	Mean
4053.27	Fe I	—	98	87	89	76	85	—	—	83	—
53.81	Ti II	87	102	94	98	89	94	107	—	82	94
53.82	Fe I	485									
55.54	Mn I	5	154	149	149	136	145	192	—	160	176
58.18	Co I	16	141	132	154	119	133	187	—	137	162
58.23	Fe I	558									
59.39	Mn I	29	75	79	89	—	81	151	—	141	146
59.73	Fe I	767	90	94	108	76	89	134	—	96	115
60.26	Ti I	80	52	52	67	35	48	91	—	66	78
61.08	Nd II	10	85	74	80	60	72	94	—	84	89
63.60	Fe I	43	735	740	820	680	730	1165	—	1080	1120
65.40	Fe I	698	95	81	100	71	84	85	—	84	84
67.28	Fe I	217	124	120	128	102	115	156	—	120	138
67.98	Fe I	559	160	170	175	163	166	230	—	220	225
68.00	Mn I	5									
68.54	Co I	58	37	34	50	36	39	76	—	69	72
69.61	⊙	—	42	43	51	30	39	61	—	61	61
70.28	Mn I	5	70	75	94	70	76	96	—	82	89
71.74	Fe I	43	495	595	680	595	595	950	—	955	950
73.76	Fe I	558	102	100	111	93	100	145	—	128	136
75.11	Nd II	62	75	78	71	65	71	—	—	91	—
77.71	Sr II	1	315	300	375	340	345	415	—	450	435
79.85	Fe I	359	94	98	104	94	97	133	—	120	126
80.23	Fe I	558	94	87	98	86	90	111	—	93	102
80.89	Fe I	557	60	60	83	52	61	78	—	73	76
82.12	Fe I	698	87	70	75	68	74	87	—	90	88
82.94	Mn I	5	99	87	99	89	93	102	—	108	105
85.01	Fe I	358	130	108	93	90	102	131	—	126	128
85.31	Fe I	559	163	137	143	—	148	186	—	200	193
86.72	La II	10	68	37	55	49	52	64	—	67	66
87.10	Fe I	694	85	64	73	80	76	114	—	104	109
88.57	Fe I	906	68	—	63	65	65	—	—	79	—
89.22	Fe I	422	71	—	69	57	64	—	—	76	—
90.95	Ce II	174	70	—	54	53	58	—	—	80	—
90.98	Fe I	695									
91.56	Fe I	357	73	—	59	58	62	—	—	78	—
94.93	Ca I	25	108	—	94	—	101	—	—	121	—
98.18	Fe I	558	—	—	—	105	—	—	—	129	—
4098.53	Ca I	25	—	—	—	109	—	—	—	124	—
4101.74	Hδ	1	—	—	—	—	—	—	—	3180	—
04.13	Fe I	356, 558	—	—	—	113	—	—	—	122	—
07.49	V I	52	—	—	—	92	—	—	—	139	—
07.49	Fe I	354									
10.53	Co I	29	—	—	—	—	—	—	—	122	—
11.36	Cr I	97	—	—	—	—	—	—	—	66	—
11.78	V I	27	—	—	—	100	—	—	—	150	—
14.45	Fe I	357	—	—	—	98	—	—	—	123	—
17.87	Fe I	700, 1103	—	—	—	68	—	—	—	109	—
20.21	Fe I	423	—	—	—	92	—	—	—	102	—
21.32	Co I	28	—	—	—	123	—	—	—	157	—
21.81	Fe I	356	—	—	—	89	—	—	—	128	—
26.19	Fe I	695	—	—	—	97	—	—	—	99	—
28.74	Fe II	27	—	—	—	55	—	—	—	69	—
32.06	Fe I	43	—	—	—	315	—	—	—	515	—

TABLE 5. EQUIVALENT WIDTHS OF LINES IN G-TYPE SPECTRA (*Continued*)

λ	Atom	R.M.T.	λ SERPENTIS					μ HERCULIS			
			BL169a	BL169b	BL169c	Mt. Wilson	Mean	BL169a	BL169b	Mt. Wilson	Mean
4132.90	Fe I	357	—	—	—	128	—	—	—	149	—
36.51	Fe I	694	—	—	—	69	—	—	—	109	—
37.00	Fe I	726	—	—	—	102	—	—	—	145	—
39.93	Fe I	18	—	—	—	74	—	—	—	97	—
43.87	Fe I	43	—	—	—	390	—	—	—	625	—
47.67	Fe I	42	—	—	—	137	—	—	—	192	—
54.50	Fe I	355	148	—	—	156	152	—	—	220	—
54.81	Fe I	694	—	—	—	136	—	—	—	186	—
57.79	Fe I	695	121	—	—	132	126	—	—	177	—
58.80	Fe I	695	109	—	—	97	103	—	—	126	—
59.19	CN	—	129	—	—	121	125	—	—	143	—
66.31	Ti I, CN	163	22	—	—	17	20	—	—	53	—
67.27	Mg I	15	190	—	—	235	214	390	—	350	370
68.12	Cb I	1	65	47	—	47	54	—	—	—	—
68.62	Fe I	689	—	—	—	—	—	120	—	84	102
68.94	Fe I	694	78	58	—	53	60	96	—	72	84
74.92	Fe I	19	156	159	141	139	147	230	205	200	210
75.64	Fe I	354	146	111	110	116	120	194	168	146	164
76.57	Fe I	695	149	117	113	136	130	215	210	197	205
78.86	Fe II, CN	28	111	108	81	110	102	149	133	125	133
79.81	Zr II	99	30	20	10	20	20	—	—	37	—
80.41	Fe I, CN	274	56	50	43	50	50	152	155	126	140
81.76	Fe I	354	200	173	170	203	190	340	240	255	270
82.38	Fe I	476a	115	109	107	101	107	186	177	158	170
82.79	Fe I	694	89	75	77	68	75	145	135	108	124
84.08	CN	—	138	124	114	—	125	205	194	175	188
84.90	Cr I, CN	155	141	109	111	118	119	174	167	158	164
84.90	Fe I	355									
86.12	Ti I	129	55	44	44	39	44	100	84	75	84
87.04	Fe I	152	215	210	192	192	200	330	280	285	295
88.69	Ti I	220	143	124	128	—	132	225	185	170	188
89.56	Fe I, CN	940	89	80	72	58	71	130	132	107	119
89.84	V I	24	28	—	—	14	21	—	—	—	—
90.71	Co I, CN	1	—	—	—	—	—	167	172	148	159
92.55	CN	—	68	61	61	56	60	119	134	102	114
92.57	CH	—									
96.22	Fe I, CN	693	145	113	121	114	121	210	198	149	177
99.10	Fe I	522	193	194	187	192	192	290	240	230	245
4199.97	Fe I	3	—	—	—	—	—	240	220	195	210
4202.03	Fe I	42	295	330	305	335	320	610	650	595	615
03.57	Fe I	19	70	72	66	61	66	144	141	118	130
03.59	Cr I	35									
05.05	Eu II	1	129	127	136	105	120	200	195	155	176
06.70	Fe I	3	183	145	148	149	155	255	242	208	228
07.13	Fe I	352	94	89	86	91	90	133	150	119	130
07.82	⊙	—	27	30	19	17	22	63	70	43	55
08.61	Fe I	689, 696	—	—	—	—	—	172	167	126	148
08.99	Zr II	41	70	57	52	53	57	93	92	65	79
10.35	Fe I	152	180	192	166	164	173	280	265	200	235
10.35	Sm II	8									
10.98	CH	—	99	98	80	83	89	161	131	124	135
11.35	Cr I	133	30	24	18	—	24	92	89	—	90
11.88	Zr II	15	77	76	74	73	75	—	—	—	—
12.70	CN, CH	—	90	84	78	82	83	162	162	124	143

TABLE 5. EQUIVALENT WIDTHS OF LINES IN G-TYPE SPECTRA (*Continued*)

λ	Atom	R.M.T.	λ SERPENTIS					μ HERCULIS			
			BL169a	BL169b	BL169c	Mt. Wilson	Mean	BL169a	BL169b	Mt. Wilson	Mean
4213.65	Fe I, CN	355	131	131	121	125	127	192	—	160	176
15.52	Sr II, CN	1	275	340	325	325	320	650	675	435	550
16.19	Fe I	3	184	160	150	- -	165	- -	- -	210	—
16.60	⊙	- -	47	53	39	39	43	87	83	61	73
17.55	Fe I	693	136	130	128	129	130	200	171	147	166
18.72	CH	- -	72	77	74	70	73	117	109	87	100
19.36	Fe I	800	183	179	200	205	194	250	230	191	215
20.05	Fe I	991	56	51	51	52	52	118	102	71	90
20.05	V II	25									
20.35	Fe I	482	104	91	90	93	95	153	149	116	134
22.22	Fe I	152	166	170	162	200	180	235	240	200	220
26.73	Ca I	2	1140	1050	1030	1110	1090	2225	1720	1630	1805
31.04	Ni I, CH	136	109	104	85	88	95	139	127	99	116
31.64	Zr II	99	73	62	70	—	68	112	105	75	92
31.96	⊙	—	48	53	52	—	51	98	101	65	82
32.72	Fe I	3	80	92	89	69	80	143	151	102	124
33.17	Fe II	27	170	170	166	149	161	225	215	176	190
33.61	Fe I	152	227	205	205	173	197	290	280	225	255
34.52	V I	6	21	25	28	—	26	66	72	44	56
34.57	Sm II	42									
35.94	Fe I	152	330	355	370	360	355	540	565	460	505
37.16	Fe I, CH	- -	- -	—	—	- -	- - -	250	245	210	230
38.03	Fe I	689, 696	116	138	120	118	122	196	192	161	178
38.82	Fe I	693	170	186	181	185	181	285	260	215	245
39.31	Zr I	45	70	72	69	60	66	126	124	99	112
39.36	Fe I	907									
41.11	Fe I	351	53	55	44	44	48	91	93	69	80
43.79	Fe I	994	68	60	63	57	61	100	103	71	86
45.26	Fe I	352	166	170	183	- -	173	205	235	178	198
46.09	Fe I	906	125	109	111	101	109	165	174	128	149
46.83	Sc II	7	179	187	193	188	187	230	225	185	205
47.43	Fe I	693	205	215	195	205	205	290	285	225	260
50.12	Fe I	152	275	245	230	240	245	435	395	335	375
50.79	Fe I	42	305	305	275	285	290	485	540	440	475
53.01	⊙	—	37	34	28	—	33	—	—	51	—
53.21	⊙	- -	34	36	22	- -	31	—	—	49	- -
54.35	Cr I	1	300	265	245	270	270	465	480	430	450
54.94	Fe I, CH	419, 477	107	104	104	107	106	—	—	—	—
55.25	CH	—	68	65	64	71	68	—	—	93	—
56.62	Cr I	131	22	17	15	13	16	—	—	31	—
56.79	Fe I	1102	40	37	40	33	37	68	75	45	58
57.66	Mn I	23	64	60	59	57	59	97	106	75	88
60.48	Fe I	152	435	470	485	435	450	765	770	550	660
61.92	Cr II, CH	31	134	138	147	132	137	190	169	162	171
62.38	Cr I	154	38	34	31	24	30	72	80	53	64
63.13	Ti I	162	—	—	—	—	- -	104	101	91	97
63.14	Cr I	247									
63.59	La II	84	—	—	—	—	—	66	66	48	57
64.21	Fe I	692	102	105	104	87	97	162	148	118	136
64.74	Fe I	993	100	88	102	77	89	134	133	122	128
65.26	Fe I	993, 994	82	76	78	73	76	112	115	84	99
65.92	Mn I	23	67	61	63	54	60	100	104	75	88
66.97	Fe I	273	109	107	109	102	106	160	151	105	130

TABLE 5. EQUIVALENT WIDTHS OF LINES IN G-TYPE SPECTRA (*Continued*)

λ	Atom	R.M.T.	λ SERPENTIS					μ HERCULIS			
			BL169a	BL169b	BL169c	Mt. Wilson	Mean	BL169a	BL169b	Mt. Wilson	Mean
4267.38	CH	—	72	70	76	68	71	120	117	85	102
67.83	Fe I, CH	482	167	162	185	184	176	—	—	200	—
68.74	Fe I	649	117	119	123	115	118	177	173	148	162
71.76	Fe I	42	725	595	705	735	700	1075	1175	1090	1105
74.80	Cr I	1	290	330	330	305	310	495	470	410	445
76.68	Fe I	976	75	75	77	66	72	115	124	97	108
78.13	Fe II	32	99	102	109	94	100	151	147	113	131
78.23	Fe I	691									
78.83	Ti I	252	61	52	53	40	49	—	—	—	—
81.37	Ti I	44	—	—	—	—	—	56	59	48	53
81.97	CH	—	83	93	89	69	81	115	125	92	106
82.41	Fe I	71	179	182	183	162	174	240	230	200	215
83.01	Ca I	5	179	175	172	153	166	220	235	182	205
85.44	Fe I	597	188	173	181	146	167	215	230	181	200
86.44	Fe I, CH	414	123	132	132	126	128	176	185	144	162
87.40	Ti I	44	75	89	86	64	76	115	125	92	106
88.78	V II, CH	17	98	104	109	78	93	—	—	111	—
91.47	Fe I	3, 41	107	115	113	89	103	159	154	122	139
93.14	Zr II, CH	110	154	155	162	134	148	199	186	177	185
94.10	Ti II	20	265	265	255	250	255	310	360	340	340
4294.13	Fe I	41									
4301.09	Ti I, CH	44	—	—	—	—	—	300	290	300	300
13.63	CH	—	98	94	88	73	85	155	151	122	138
18.63	Ti I	235	170	149	166	145	155	215	195	184	195
18.65	Ca I	5									
25.76	Fe I	42	665	650	735	665	675	1135	1135	1230	1180
27.10	Fe I	761	127	120	115	108	116	—	—	—	—
27.92	Fe I	597	109	103	92	97	100	159	174	166	166
30.02	V I	5	37	42	39	39	39	102	99	87	94
31.64	Ni I	52	100	89	84	83	88	117	128	92	107
32.82	V I	5	—	—	—	—	—	124	107	107	111
32.88	Fe II	33									
33.76	La II	24	75	78	60	—	71	105	99	76	89
37.57	Cr I	22	118	106	109	72	95	160	175	180	174
37.92	Ti II	20	131	136	139	137	136	168	157	205	184
40.47	H γ	1	2900	3280	2890	—	3025	3235	2775	3115	3060
47.24	Fe I	2	57	46	36	35	42	87	96	81	86
48.34	CH	—	53	56	46	37	46	88	82	73	79
48.94	Fe I	414	70	72	66	50	62	98	96	73	85
55.10	Ca I	37	133	134	115	106	119	174	146	166	163
57.52	Cr I	198	34	37	28	—	33	78	58	60	64
59.58	Ni I	86	225	215	220	220	220	280	270	255	265
59.63	Cr I	22									
60.81	Fe I	903	65	71	39	47	54	115	92	73	88
65.54	⊙	—	17	32	21	16	20	50	47	32	40
65.90	Fe I	415	57	66	50	46	53	89	74	59	70
68.63	Nd II	11	21	21	20	16	19	48	39	25	34
69.77	Fe I	518	192	183	181	158	174	220	220	180	200
71.80	⊙	—	11	16	7	—	11	40	37	20	30
73.25	Cr I	22	38	55	38	47	45	102	83	68	80
73.56	Fe I	214, 413	92	107	83	81	89	136	126	94	112
75.93	Fe I	2	200	185	154	141	164	240	240	180	210
76.78	Fe I	471, 904	58	70	56	59	61	97	76	60	74

TABLE 5. EQUIVALENT WIDTHS OF LINES IN G-TYPE SPECTRA (*Continued*)

λ	Atom	R M.T.	λ SERPENTIS					μ HERCULIS			
			BL169a	BL169b	BL169c	Mt. Wilson	Mean	BL169a	BL169b	Mt. Wilson	Mean
4377.80	Fe I	645	34	41	32	38	37	68	63	53	59
79.24	V I	22	124	137	115	107	118	175	170	135	154
79.78	Zr II	88	28	43	28	23	29	42	42	35	39
79.78	Cr I	130									
80.06	Ce II, CH	155	66	83	72	58	67	107	99	85	94
83.55	Fe I	41	895	945	945	935	930	1900	1625	1625	1695
86.06	⊙	—	34	51	38	30	37	85	71	60	69
86.84	Ce II	57	81	101	85	87	88	—	96	90	93
86.86	Ti II	104									
87.08	CH	—	39	63	55	56	53	—	91	90	90
87.90	Fe I	476	93	114	92	89	95	123	120	103	112
88.41	Fe I	830	119	141	124	130	129	169	167	140	155
89.24	Fe I	2	85	104	83	87	89	127	127	106	116
90.95	Fe I	414	157	158	155	—	157	190	199	172	183
90.98	Ti II	61									
92.58	Fe I	973	40	39	39	39	39	91	85	70	79
94.06	Ti II	51	132	130	116	100	116	144	152	125	136
95.03	Ti II	19	230	265	255	—	250	235	220	220	225
95.85	Ti II	61	85	109	98	86	93	114	103	89	99
96.96	CH	—	36	58	49	35	45	91	80	64	75
98.02	Y II	5	60	72	66	67	66	89	80	69	77
99.77	Ti II	51	175	153	170	—	166	200	210	170	188
4399.82	Cr I	129									
4404.75	Fe I	41	680	680	720	820	745	1300	1165	1035	1135
06.64	V I	22	107	115	92	—	105	136	156	154	150
07.64	V I	22	—	—	—	—	—	245	230	200	220
07.68	Ti II	51									
07.71	Fe I	68									
09.52	Ti II	61	55	64	62	57	59	79	90	58	71
10.52	Ni I	88	58	70	60	64	63	92	79	71	78
11.88	Mn I	—	71	92	72	—	78	101	100	80	90
11.94	Ti II	61									
12.25	Cr I	22	29	28	26	—	28	79	70	65	70
13.12	⊙	—	11	22	7	—	13	17	14	13	14
13.60	Fe II	32	56	59	44	—	53	56	60	50	54
15.12	Fe I	41	425	445	400	375	405	715	685	695	700
16.47	V I	22	44	39	38	—	40	96	96	98	97
16.82	Fe II	27	112	116	116	87	104	127	119	124	123
17.72	Ti II	40	141	143	141	118	132	155	143	130	140
18.34	Ti II	51	100	105	116	89	100	147	129	131	134
18.43	Fe I	412									
19.94	V I	21	16	14	9	10	12	24	32	—	28
20.29	⊙	—	37	38	31	29	33	66	50	53	56
21.57	V I	22	38	46	38	—	41	99	93	69	82
22.57	Fe I	350	160	155	156	131	147	185	205	175	185
22.59	Y II	5									
23.86	Fe I	830	70	68	70	51	62	91	89	75	82
25.44	Ca I	4	166	187	175	151	166	210	210	175	192
26.00	V I	22	42	50	30	42	41	114	101	80	94
26.05	Ti I	161									
27.90	Ti II	61	23	22	16	10	16	36	34	20	28
27.92	Ce II	171									
28.50	Cr I	129	44	48	41	—	44	101	101	83	92
28.52	V I	21									

TABLE 5. EQUIVALENT WIDTHS OF LINES IN G-TYPE SPECTRA (*Continued*)

λ	Atom	R.M.T.	λ SERPENTIS					μ HERCULIS			
			BL169a	BL169b	BL169c	Mt. Wilson	Mean	BL169a	BL169b	Mt. Wilson	Mean
4430.62	Fe I	68	157	187	160	140	157	210	200	220	215
31.28	Ti I	218	57	56	50	45	51	89	86	67	77
31.37	Sc II	14									
31.85	⊙	--	37	54	42	40	43	77	73	60	68
32.57	Fe I	797	62	63	61	51	58	91	91	66	78
33.22	Fe I	830	130	130	124	103	118	168	172	160	165
35.69	Ca I	4	162	157	158	145	153	197	198	170	184
36.93	Fe I	516	93	87	100	74	86	122	132	102	114
36.98	Ni I	86									
38.35	Fe I	828	60	76	67	45	59	107	92	82	91
39.64	Fe I	515	14	20	16	11	14	36	35	35	35
39.88	Fe I	116	56	53	57	52	54	84	81	66	74
41.68	V I	21	102	116	103	87	99	154	148	125	138
41.73	Ti II	40									
42.34	Fe I	68	200	240	180	170	190	240	215	235	230
42.84	Fe I	69	82	89	92	91	89	124	119	91	104
43.20	Fe I	350	132	132	134	107	122	167	171	136	152
43.80	Ti II	19	179	161	169	140	158	190	205	175	186
44.21	V I	21	37	41	33	39	38	100	94	78	88
44.56	Ti II	31	89	99	92	68	83	105	104	96	100
45.48	Fe I	2	42	48	32	31	37	82	88	71	78
46.84	Fe I	828	92	89	86	77	84	127	119	106	114
47.13	Fe I	69	83	93	83	70	80	113	113	88	100
47.72	Fe I	68	176	166	158	160	164	230	215	225	225
49.14	Ti I	160	75	78	77	65	72	113	136	88	106
51.59	Mn I	22	113	119	107	106	110	125	133	110	120
51.98	Nd II	6	25	29	30	18	24	57	50	53	53
52.01	V I	87									
53.00	Mn I	22	75	64	59	56	62	113	95	81	92
53.31	Ti I	113	89	77	78	—	81	113	98	94	100
53.71	Ti I	160	62	50	46	44	49	100	84	69	80
54.38	Fe I	350	131	145	131	96	120	147	132	112	126
54.78	Ca I	4	255	305	260	215	250	300	275	290	290
54.80	Zr II	40									
55.32	Mn I	28	114	96	113	76	95	160	129	115	130
55.32	Ti I	113									
56.33	Fe I	516	72	81	77	62	71	117	103	99	104
56.61	Ca I	4	97	94	99	64	84	142	125	110	122
57.04	Mn I	28	48	45	51	38	44	90	79	68	76
58.52	Sm II	7	58	62	53	37	49	100	92	70	83
58.54	Cr I	127									
59.74	Cr I	127	63	55	63	46	55	119	104	95	103
59.76	V I	21									
60.77	Cr I	63	16	10	8	9	10	36	31	23	28
61.65	Fe I	2	151	—	—	123	137	215	200	170	190
61.99	Fe I	471, 825	129	—	—	120	124	210	184	177	187
62.02	Mn I	28									
62.36	V I	87	100	—	—	83	92	130	134	126	129
62.46	Ni I	86									
64.46	Ti II	40	108	—	—	85	96	—	—	108	--
65.81	Ti I	146	40	—	—	23	32	—	66	54	60
66.55	Fe I	350	162	—	—	153	158	—	210	230	220
66.57	Fe I	2									
66.94	Fe I	992	80	—	—	64	72	—	102	95	98

TABLE 5 EQUIVALENT WIDTHS OF LINES IN G-TYPE SPECTRA (*Concluded*)

λ	Atom	R.M.T.	λ SERPENTIS					μ HERCULIS			
			BL169a	BL169b	BL169c	Mt. Wilson	Mean	BL169a	BL169b	Mt. Wilson	Mean
4468.49	Ti II	31	176	—	—	152	164	—	187	184	186
70.14	Mn I	22	58	—	—	43	50	—	80	64	72
70.48	Ni I	86	99	—	—	78	88	—	114	100	107
70.86	Ti II	40	77	—	—	74	76	—	79	91	85
71.24	Ti I	146	43	—	—	35	39	—	69	72	70
71.24	Ce II	8									
75.34	Cr I	95	15	—	—	11	13	—	36	31	34
76.02	Fe I	350	170	—	—	161	166	—	198	210	205
76.08	Fe I	830									
77.02	Cr I	63	12	—	—	—	—	—	17	23	20
78.04	Fe I	69	16	—	—	24	20	—	36	49	42
79.61	Fe I	828, 848	93	—	—	—	—	—	120	125	122
81.13	Mg II	4	205	—	—	—	—	—	215	225	220
81.26	Ti I	146									
81.33	Mg II	4									
82.17	Fe I	2	215	—	—	210	215	—	275	245	260
84.23	Fe I	828	131	—	—	91	111	—	118	113	116
85.68	Fe I	830	132	—	—	78	105	—	118	104	111
85.97	Fe I	825	—	—	—	11	—	—	47	40	44
86.91	Ce II	57	—	—	—	19	—	—	53	44	48
87.28	Y I	14	—	—	—	15	—	—	56	38	47
87.74	Fe I	594	—	—	—	14	—	—	58	43	50
89.18	Fe II	37	—	—	—	108	—	—	—	152	—
89.74	Fe I	2	—	—	—	93	—	—	—	123	—
90.08	Mn I	22	—	—	—	78	—	—	—	108	—
90.08	Fe I	469									
90.77	Fe I	974, 974	—	—	—	100	—	—	—	124	—
91.40	Fe II	37	—	—	—	81	—	—	—	100	—
93.53	Ti II	18	—	—	—	37	—	—	—	73	—
94.57	Fe I	68	—	—	—	180	—	—	—	245	—
96.86	Cr I	10	—	—	—	129	—	—	—	164	—
4498.90	Mn I	22	—	—	—	—	—	—	—	87	—
4501.27	Ti II	31	—	—	—	119	—	—	—	210	—
02.22	Mn I	22	—	—	—	60	—	—	—	80	—
04.84	Fe I	555	—	—	—	—	—	—	—	84	—
08.28	Fe II	38	—	—	—	96	—	—	—	105	—
09.74	Ti I	—	—	—	—	38	—	—	—	64	—
12.73	Ti I	42	—	—	—	—	—	—	—	98	—
15.34	Fe II	37	—	—	—	103	—	—	—	124	—

TABLE 6a. EQUIVALENT WIDTHS MEASURED FROM MOUNT WILSON SPECTROPHOTOMETRIC SCANS

λ	Atom	R.M.T.	ρ LEONIS			γ PEGASI			ι HERCULIS		
			Greenstein Wright	No.	Photographic Mean	Oke	No.	Photographic Mean	Greenstein Wright	No.	Photographic Mean
4236.93	N II	48	107	1	112	—	—	—	—	—	—
37.05	N II	48									
41.79	N II	47, 48	165	3	159	—	—	—	—	—	—
53.59	S III	4	236	2	242	—	—	—	—	—	—
53.74	O II	101									
67.00	C II	6	216	2	223	—	—	—	—	—	—
67.26	C II	6									
76.71	O II	54, 67	82	2	84	—	—	—	—	—	—
77.40	O II	67, 68									
84.99	S III	4	64	2	106	—	—	—	—	—	—
86.16	Fe III	121	63	1	42	—	—	—	—	—	—
4317.14	O II	2	128	2	175	—	—	—	—	—	—
17.26	C II	28									
17.65	O II	53									
19.63	O II	2	143	2	194	—	—	—	—	—	—
25.77	O II	2	61	3	41	15	2	20	—	—	—
27.48	O II	41	—	—	—	12	2	13	—	—	—
31.13	O II	66, 75	—	—	—	17	2	—	—	—	—
40.47	H γ	1	2190	3	1810	5070	2	4380	—	—	—
45.56	O II	2	187	3	172	37	2	—	—	—	—
47.36	Fe III	16	118	2	100	24	2	—	—	—	—
47.42	O II	16									
48.11	A II	7	—	—	—	30	2	—	—	—	—
49.43	O II	2	352	2	355	73	2	54	—	—	—
51.27	O II	16	151	2	145	51	2	40	—	—	—
52.57	Fe III	4	—	—	—	7	2	13	—	—	—
54.56	S III	7	39	2	37	23	2	13	—	—	—
61.53	S III	4	—	—	—	20	2	17	—	—	—
66.90	O II	2	—	—	—	73	2	53	—	—	—
69.28	O II	26	—	—	—	8	2	13	—	—	—
71.34	Fe III	4	—	—	—	7	2	14	—	—	—
71.36	A II	1									

4372.31	Fe III	122	—	—	—	13	1	18	—	—	—
72.49	C I	45									
4447.03	N II	15	150	2	162	—	—	—	38	2	23
52.38	O II	5	83	2	65	—	—	—	26	2	9
69.92	[He I]	15	1175	3	840	—	—	—	1330	2	1240
71.48	He I	14									
71.69	He I	14									
79.83	Al III	8	—	—	—	—	—	—	42	2	18
79.97	Al II	8									
81.13	Mg II	4	330	2	171	—	—	—	245	2	225
81.33	Mg II	4									

TABLE 6b. EQUIVALENT WIDTHS MEASURED FROM MOUNT WILSON SPECTROPHOTOMETRIC SCANS

λ	Atom	R.M.T.	γ GEMINORUM				
			Oke	No.	Greenstein Wright	No.	Photographic Mean
4202.03	Fe I	42	—	—	81	1	65:
03.95	Fe I	850	—	—	16	1	23:
05.05	Eu II	1	—	—	12	2	28:
05.08	V II	37					
10.35	Fe I	152	—	—	14	2	22
15.52	Sr II	1	—	—	93	2	72
16.19	Fe I	3	—	—	6	2	11:
17.34	Ti II	96	—	—	17	2	18:
19.36	Fe I	800	—	—	40	2	33:
22.22	Fe I	152	—	—	29	2	23
24.18	Fe I	689	—	—	22	2	23
24.85	Cr II	162	—	—	31	2	27:
25.46	Fe I	693	—	—	26	2	20
26.73	Ca I	2	—	—	128	2	84
27.43	Fe I	693	—	—	57	2	63
33.17	Fe II	27	—	—	183	2	128
33.61	Fe I	152	—	—	19	1	37
35.94	Fe I	152	—	—	72	2	55
38.03	Fe I	689, 696	—	—	12	2	15
38.82	Fe I	693	—	—	26	2	38
42.38	Cr II	31	—	—	71	2	67
44.80	Ni II	9	—	—	10	2	13
45.26	Fe I	352	—	—	13	2	15
46.83	Sc II	7	—	—	85	2	82
47.43	Fe I	693	—	—	27	2	35
48.23	Fe I	482	—	—	10	2	11
50.12	Fe I	152	—	—	41	2	47
50.79	Fe I	42	—	—	50	2	58
52.62	Cr II	31	—	—	32	2	35
54.35	Cr I	1	—	—	56	2	59
56.79	Fe I	1102	—	—	10	1	14:
4312.86	Ti II	41	83	2	—	—	83
14.08	Sc II	15	129	1	87	1	70
14.29	Fe II	32					
14.98	Ti II	41	96	2	94	1	101:
15.09	Fe I	71					
16.81	Ti II	94	15	2	28	1	13:
18.65	Ca I	5	7	2	—	—	—
20.74	Sc II	15	63	2	—	—	71
20.95	Ti II	41					
25.01	Sc II	15	38	2	—	—	43
25.76	Fe I	42	100	2	—	—	100
40.48	Hγ	1	17650	2	12550	1	12630
50.83	Ti II	94	6	2	—	—	21:
51.76	Fe II	27	88	2	—	—	132:
69.40	Fe II	28	34	1	—	—	38
69.77	Gd II	15	26	1	—	—	15:
69.77	Fe I	518					
74.46	Sc II	14	13	1	—	—	46
74.82	Ti II	93	33	1	—	—	52
74.94	Y II	13					

TABLE 6b. EQUIVALENT WIDTHS MEASURED FROM MOUNT WILSON SPECTROPHOTOMETRIC SCANS (*Concluded*)

λ	Atom	R.M.T.	γ GEMINORUM				
			Oke	No.	Greenstein Wright	No.	Photographic Mean
4433.99	Mg II	9	—	—	32	3	41
34.96	Ca I	4	—	—	21	3	18
35.69	Ca I	4	—	—	24	3	15
36.48	Mg II	19	—	—	9	3	9:
39.13	Fe II	32	—	—	11	1	9
41.73	Ti II	40	—	—	7	2	25
42.34	Fe I	68	—	—	15	3	23
42.99	Zr II	88	—	—	10	3	22:
43.80	Ti II	19	—	—	106	3	103
44.56	Ti II	31	—	—	27	3	32
44.56	Fe II	201					
46.25	Fe II	187	—	—	9	3	12:
46.39	Nd II	49					
47.72	Fe I	68	—	—	11	3	22
49.66	Fe II	222	—	—	10	3	10
4150.49	Ti II	19	—	—	65	3	67
51.54	Fe II	—	—	—	24	3	29
53.35	V II	199	—	—	19	3	8
54.78	Ca I	4	—	—	22	3	37
54.80	Zr II	40					
55.26	Fe II	—	—	—	25	3	21
55.85	Fe II	140	—	—	6	3	13
55.89	Ca I	4					
56.65	Ti II	115	—	—	11	3	12:
59.12	Fe I	68	—	—	27	3	35:
61.65	Fe I	2	34	1	18	3	14
61.46	Ti II	40	56	3	24	3	50:
66.55	Fe I	350	31	3	24	3	29
68.49	Ti II	31	159	3	100	1	98
69.16	Ti II	18	21	3	24	3	35:
70.86	Ti II	40	29	3	24	3	32
71.68	Fe I	2	28	3	24	3	27
72.92	Fe II	37	42	3	38	3	43
76.02	Fe I	350	26	3	19	3	30
76.08	Fe I	830					
78.66	Sm II	—	4	3	18	3	20:
79.61	Fe I	828, 848	4	2	10	3	17:
81.13	Mg II	4	520	3	440	2	405
81.33	Mg II	4					
82.17	Fe I	2	8	1	17	2	31
82.26	Fe I	68					
84.23	Fe I	828	5	1	6	2	20:

V. COMPARISONS OF EQUIVALENT-WIDTH DATA FOR INDIVIDUAL STARS

Preliminary comparisons of equivalent-width data for some of these stars were presented in reports of the Sub-commission on Line Intensity Standards (Wright, 1957, 1960, 1962, 1962 a). However the large body of data included in Tables 2 to 5 enables considerably more detailed comparisons to be made. For each star the equivalent widths were grouped according to line strength for the regions 3900A-4100A., 4100A-4340A. and 4340A-4520A. In a preliminary analysis the percentage deviation from the mean for each spectrograph was obtained for each line for a few stars, but it was found that the result's were very little different when average deviations from the mean were obtained for each group of lines. In the final analysis, therefore, mean differences were obtained for each small range of equivalent widths, and these were then converted to percentage deviations. In some cases there may be real differences for different wave-length regions, as a result of uncertainties in drawing the continuum, but in general the differences are not large and are probably not very significant in the final analysis. Therefore the different wave-length regions have been combined and the results for each star, for each observer or spectrographic combination, for each intensity range are listed in Tables 7a to 7l. The average equivalent width for each group of lines is listed in column 1 of each table, and the number of lines in each group are listed beside each percentage deviation from the mean. The data for each star will be discussed separately.

In order to make some estimate of the differences in equivalent widths measured for different spectrographs and by different observers, average values for the data given in Tables 7a to 7l have been calculated and are given in Table 9. Since very weak lines are difficult to measure and are particularly sensitive to the adopted position of the continuum, lines of equivalent width < 25mA. have been given one-quarter weight in the calculations. For the B-type spectra, lines of equivalent width, $25 < W < 75$mA., have been given half weight, and all other lines have been given unit weight. For all other spectra, where the reliability of the measurements is usually greater, lines of equivalent width, $25 < W < 50$mA. have been given half weight, and all other lines have been given unit weight. It was noted that some very large differences have been found in equivalent widths of weak lines measured on low-dispersion spectra by some early observers.* These discordant values have been omitted from the mean. The average percentage differences from the mean equivalent widths listed in Tables 2 to 5 for each observer and for each spectrograph are listed in Table 9, and the best estimate of the systematic differences between observers and spectrographs is given in the final line of that table. The weights have been given in part according to the number of sets of observations of a given star, and in part according to the type of lines in the star—e.g. the B-type stars with their weak and broad lines have been given lower weight than those of later type.

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*For very weak lines almost all lower-dispersion work gives higher equivalent widths than does higher-dispersion work. One reason is that the background noise almost always adds in a positive sense to an equivalent width. If the mean of the grains adds up to an emission line, the observer may omit the measure, but if it appears as an absorption line it is given full weight.

TABLE 7. AVERAGE PERCENTAGE DEVIATIONS FROM MEAN EQUIVALENT WIDTHS

(*a*) ρ LEONIS

$\overline{W}$	IIIL$_A$		BL84		BL169		BL496		Mt. Wilson		Williams (1936)		Underhill (1948)		Huang and Struve (1953)		Wilson (1956)		Kopylov (1958)	
	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.
18	+18.7	6	−16.1	9	−12.3	10	−24.8	8	+33.5	10	—	—	—	—	—	—	—	—	—	—
39	+ 9.8	12	+ 1.6	14	− 7.2	12	+ 9.5	16	− 9.4	15	—	—	—	—	—	—	—	—	—	—
61	+ 8.5	9	− 8.6	11	+ 3.7	11	− 4.0	11	+ 2.1	13	+38	1	—	—	+120	1	—	—	+130	1
83	− 8.4	7	− 4.3	5	− 2.7	5	+ 8.5	7	+ 5.5	7	−17	6	—	—	+ 23	7	—	—	+ 87	5
121	− 2.0	7	+ 1.1	9	− 4.4	9	+ 3.2	9	+ 1.8	12	−28	3	—	—	+ 1	2	—	—	+ 70	3
173	+ 3.2	8	+ 0.1	7	− 5.7	7	− 1.8	7	+ 4.0	8	+ 1	6	—	—	+ 25	4	+45	1	+ 82	4
240	+ 3.2	8	+ 5.4	9	−11.2	8	− 1.8	8	+ 3.0	8	+ 2	7	—	—	− 10	5	+14	1	+ 47	4
350	− 7.6	2	− 9.1	2	− 5.6	2	+15.4	2	+ 0.3	2	−12	2	−21	1	—	—	+19	2	+ 17	2
460	—	—	− 2.1	1	—	—	—	—	—	—	+12	1	—	—	—	—	—	—	+ 22	2
550	—	—	—	—	—	—	—	—	—	—	+10	1	−25	1	—	—	+ 4	1	0	2
800	+ 7.6	7	− 2.1	4	− 4.5	4	− 5.1	5	0.0	6	+21	1	−13	1	—	—	−11	1	+ 20	2
1950	+ 1.4	1	+ 5.5	1	− 5.5	1	− 3.0	1	+ 1.4	1	− 6	2	0	2	—	—	+21	1	− 3	2
Mean	+ 0.4	45	− 1.1	52	− 5.6	48	+ 1.2	54	+ 2.4	60	− 5.4	30	− 6.5	5	+11.8	18	+15.7	6	+ 53	24

Although in some cases differences from the mean equivalent widths vary with line strength, the average results given in Table 9 are not unsatisfactory. Previous comparisons have indicated that most measurements made before 1950 should not be given high weight, and the results in Table 9 strengthen this conclusion.

ρ LEONIS

This star, having a spectrum classified as B1 Ib, was added to the list of stars suggested as line-intensity standards because the lines are relatively strong and well-defined for a B-type spectrum, and because it is in a suitable part of the sky. Equivalent-width data have been given by Williams (1936), who measured the strong and important lines in numerous B-type spectra observed at Mount Wilson Observatory with a dispersion of 39 A/mm at Hγ. Although Williams was among the first to make intensity measures his results have been found to be in fair agreement with more modern observations. Others who have made intensity measurements on the spectrum of *ρ Leonis* include Underhill (1948), Huang and Struve (1953), Wilson (1956), and Kopylov (1958). None of these observers made a complete study of the spectrum, even over the limited region covered in the present investigation; Wilson and Kopylov used dispersions that were too low to separate and measure all the features adequately. Therefore the adopted mean equivalent width given in Table 2 for each line is the simple mean of the measurements made on the plates listed in Table 1 for the five spectrographic combinations given there. The measures for weak lines are quite uncertain because the lines are broad and it is often difficult to be sure that the features are present on the high-magnification tracings even when several tracings are superposed. However the addition of the Mount Wilson data and direct comparisons between the Mount Wilson and Victoria tracings increased greatly the reliability of many of the measures. Since the lines are broad, the assumption that the profiles are triangular is not suitable and all areas were measured with the planimeter. Short stretches of the spectrum were recorded with the photoelectric spectral scanner at the coudé focus of the 100-inch telescope by Greenstein and Wright on Feb. 22, 1962. The intensities obtained from these scans are listed in Table 6a, but have not been included in the mean because the latter is intended to be as homogeneous as possible.

When lines of different strengths in the different regions of the spectrum were compared, a large scatter was found for the very weak lines (< 25mA.), but for stronger lines the measures were reasonably accordant. Although there are large differences for a few individual lines which cannot always be explained, the averages are well within the errors to be expected in spectrophotometry.

1963PDAO...12..173W

TABLE 7. AVERAGE PERCENTAGE DEVIATIONS FROM MEAN EQUIVALENT WIDTHS

(*b*) γ PEGASI

$\overline{W}$	IIILA		BL84		BL169 BL496		Mt. Wilson		Aller (1956) (1958)		Williams (1936)		Underhill (1948)		Miczaika (1948)		Butler and Seddon (1958)		Kopylov (1958)	
	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.
14	+20.2	47	+ 4.8	69	+ 2.8	71	−11.1	79	− 1.5	76	+100	3	—	—	—	—	—	—	—	—
34	+11.2	27	+ 4.7	24	− 2.5	30	− 4.3	35	− 2.7	35	− 5	7	− 13	1	—	—	—	—	+260	6
58	+ 7.7	7	+ 9.2	8	− 8.9	8	− 1.6	9	− 1.5	9	+ 26	4	—	—	—	—	—	—	+200	2
86	− 2.5	3	+ 8.0	5	− 3.6	6	− 0.4	6	− 5.3	5	+ 27	4	—	—	+ 80	5	—	—	+ 85	3
124	+ 9.9	1	+ 4.5	2	− 8.7	2	+ 5.8	2	+ 6.7	2	+ 12	2	—	—	+200	1	—	—	+ 62	2
164	+ 6.7	1	+ 9.8	1	−13.4	1	+ 0.6	1	− 2.4	1	+ 71	1	+ 5	1	—	—	+ 58	1	+ 80	2
250	+ 2.0	2	+ 4.8	1	− 2.4	1	− 5.2	2	+ 2.0	2	+ 39	2	—	—	+115	2	—	—	+ 18	3
640	−16.4	2	+ 2.5	2	− 3.7	2	− 0.7	3	+ 8.7	3	+ 15	3	− 7	2	− 20	3	—	—	+ 9	3
970	− 0.6	3	+ 4.7	3	+ 4.8	3	− 6.3	3	− 0.1	3	− 2	1	− 6	1	+ 10	1	− 6	1	+ 10	1
1300	+ 6.4	2	+ 6.4	2	− 7.8	2	+ 1.8	2	+ 0.2	2	+ 0	2	− 12	2	+ 16	2	+ 16	1	+ 8	2
4520	+ 1.5	2	+ 8.8	1	− 2.2	1	− 7.2	2	+ 2.4	2	− 1	2	+ 1	2	0	2	+ 14	1	− 7	2
Mean	+ 9.2	45	+ 5.6	50	− 1.6	55	− 5.3	63	− 0.4	45	+15.8	22	− 5.4	8	+ 60	14	+ 8	3	+ 35	18

γ PEGASI

This main sequence star has a sharp-lined B2 spectrum and has been studied almost as intensively as τ *Scorpii.* The latter has not been included in this study because it is too far south for extended observations from Victoria. The star has been found to be a short-period β *Canis Majoris* star by McNamara with a period of 0.1517 days (1953). However there seems to be no evidence that the line shapes or intensities vary, although a very precise study might show some effects. The lines are quite weak but are so sharp that lines having equivalent widths of 10mA. can be measured on high-dispersion spectra.

Aller and his collaborators have made several studies of the atmosphere of this star. Their most recent intensity measures have been published by Aller (1956) and by Aller and Jugaku (1958a); the Hγ profile has been published by Aller and Jugaku (1958b). These measures are considered quite reliable and are the combined results of observations obtained at several observatories; greatest weight has been given the Mount Wilson plates. Therefore Aller's measures have been given equal weight with the other sets of spectrograms listed in Table 1 in deriving the mean equivalent widths listed in Table 2. Tracings from the BL169 and BL496 spectrograms have been combined to form a single set of observations. No measures were made on tracings from the IIIL$_A$ plates of some of the weak lines.

Other equivalent widths derived from spectrograms of lower dispersion have been published by Williams (1936), Underhill (1948), Miczaika (1948), Butler and Seddon (1958) and by Kopylov (1958). Their results have been compared with the mean equivalent widths given in Table 2 in Table 7b. Even Williams' measures for very weak lines are 100 per cent larger than our values, although Williams' data are usually considered quite good. For the strong lines the equivalent widths obtained from low-dispersion spectra are less discrepant but, for the most part, are still larger than those measured here.

Böhm-Vitense and Struve (1956) compared profiles of lines arising from different atoms and found definite differences in the line shapes; however they did not publish their equivalent widths of these lines. For the stronger lines, which were studied by Böhm-Vitense and Struve, the planimeter was used to determine areas absorbed from the continuum on our plates, although standard profiles were used for the weaker lines for the Victoria plates, and the lines were assumed to be triangular in shape for the Mount Wilson plates.

Several runs over selected regions of the spectrum were made by Oke with the Mount Wilson photoelectric scanner on November 21, 1961. With his permission we have measured his tracings and the results are included in Table 6a.

TABLE 7. AVERAGE PERCENTAGE DEVIATIONS FROM MEAN EQUIVALENT WIDTHS

(c) ι HERCULIS

$\overline{W}$	$\mathrm{IIIL_A}$		BL169		9643		Williams (1936)		Aller (1949)		Kopylov (1958)		Butler and Seddon (1960)	
	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.
13	−11.2	73	+ 6.6	80	+ 7.6	88	−28	4	+40	14	+450	7	+56	8
31	−19.6	11	+16.6	11	− 2.7	13	−18	4	−12	9	+200	5	−74	1
58	+10.4	1	+ 9.5	2	−11.1	3	− 8	2	−14	2	+115	3	—	—
82	+11.6	2	− 3.2	3	− 0.7	4	+33	4	−28	4	+ 50	3	+12	1
111	—	—	− 9.0	1	+ 9.9	1	−24	1	—	—	—	—	—	—
158	− 9.5	1	+10.1	1	− 1.3	1	+38	3	−53	1	+ 20	1	—	—
215	+ 2.9	3	+ 6.2	1	− 4.9	3	+ 4	3	−27	2	+ 43	3	+27	2
635	− 8.4	1	− 2.4	2	+ 7.6	3	+18	1	−39	3	+ 4	1	—	—
770	−10.1	1	+ 2.6	1	+ 7.5	1	+ 8	2	−17	1	+ 20	1	+14	1
1300	− 7.8	2	− 3.3	1	+ 9.1	2	+ 0	2	−38	2	+ 8	3	+10	1
5575	− 8.2	2	− 8.7	1	+ 8.6	2	—	—	−40	2	+ 3	2	+ 6	1
Mean	− 9.2	37	+ 6.2	36	+ 4.0	47	+12	19	−28	20	+ 26	13	+16	6

ι Herculis

This sharp-lined B3 spectrum has been studied by Williams (1936), Aller (1949), Kopylov (1958) and Butler and Seddon (1960). Aller measured Mount Wilson plates, but the other intensities were obtained from low-dispersion spectrograms. Relatively few lines were measured and their results have not been included in our means. Aller has suggested that considerable scattered light is present in his Mount Wilson plates and considered that it might amount to 20 per cent. The comparisons in Table 7c do show that his equivalent widths are much lower than our adopted mean values; on the average for all lines his measures are 28 per cent lower than those listed here.

The mean equivalent widths listed in Table 2 are the average of the three sets of spectrograms listed in Table 1. The three plates taken with the 96-inch camera of the coudé spectrograph of the 48-inch telescope were obtained before the calibration system was in its final form; a narrower and more uniform slit later replaced the one that was used at that time. This might explain the differences in the Hγ profiles that will be discussed in Section VI. However these plates were all measured separately and gave comparable results. Therefore equal weight has been given each set of observations.

TABLE 7. AVERAGE PERCENTAGE DEVIATIONS FROM MEAN EQUIVALENT WIDTHS

(*d*) γ GEMINORUM

$\overline{W}$	Aller (1942)		Buscombe (1951)		BL169a Wright		BL169b Wehlau	
	%	No.	%	No.	%	No.	%	No.
16	− 3.1	21	− 5.4	43	+ 0.5	47	−15.9	45
37	− 0.2	37	− 0.9	46	+ 9.5	59	−11.6	49
62	− 9.5	23	+ 9.6	31	+ 4.1	33	−13.4	28
84	− 8.0	17	+ 5.0	18	+ 9.3	21	−11.1	18
110	− 9.9	6	+11.6	6	+ 5.6	6	−12.2	6
127	−22.6	1	+ 2.8	2	+ 3.5	3	− 1.6	1
405	+ 5.7	1	− 1.2	1	− 3.5	1	0.0	1
1285	−16.0	1	− 5.4	1	+ 8.5	1	+29.6	1
Mean	− 5.8	62	+ 4.1	93	+ 6.3	105	−12.2	89

γ Geminorum

The lines in the spectrum of this AO V star are quite sharp and are suitable for spectrophotometric measurement. The radial velocity is variable, as noted by Harper (1935); it is currently being followed by Beardsley (private communication), who is also studying plates taken at the Dominion Astrophysical Observatory. However no appreciable systematic differences in equivalent widths have been noted on plates taken at different times.

Aller (1942) published a good list of equivalent widths measured on spectrograms taken at the McDonald Observatory. On the average these intensities are comparable with other, more recent measures, but there is considerable scatter from line to line; therefore these data have been given half-weight in deriving the mean equivalent widths listed in Table 3. Buscombe (1951) made a detailed study of equivalent widths based on Mount Wilson plates. His observations seem to be as consistent as any other similar measures, and have been given unit weight in computing mean equivalent widths. Wehlau made duplicate copies of the Victoria tracings and obtained the equivalent widths independently. He drew standard profiles using the same methods as those discussed in Section III, but his profiles are usually somewhat broader and flatter at the core than those drawn by Wright. For this star the average difference between measures by Wehlau and by Wright is 18 per cent, which is larger than might be expected from measures made on the same plates.

In Figure 13 the individual measures of each line made by Aller, Buscombe, Wehlau and Wright are plotted as differences from the adopted mean equivalent width. The mean values for each intensity group are shown as starred circles.

Two sets of photoelectric scans have been made for this star, one by Oke on November 21, 1961 and the other by Greenstein and Wright on February 22, 1962. Both of these scans have been measured at Victoria and the results are included in Table 6b.

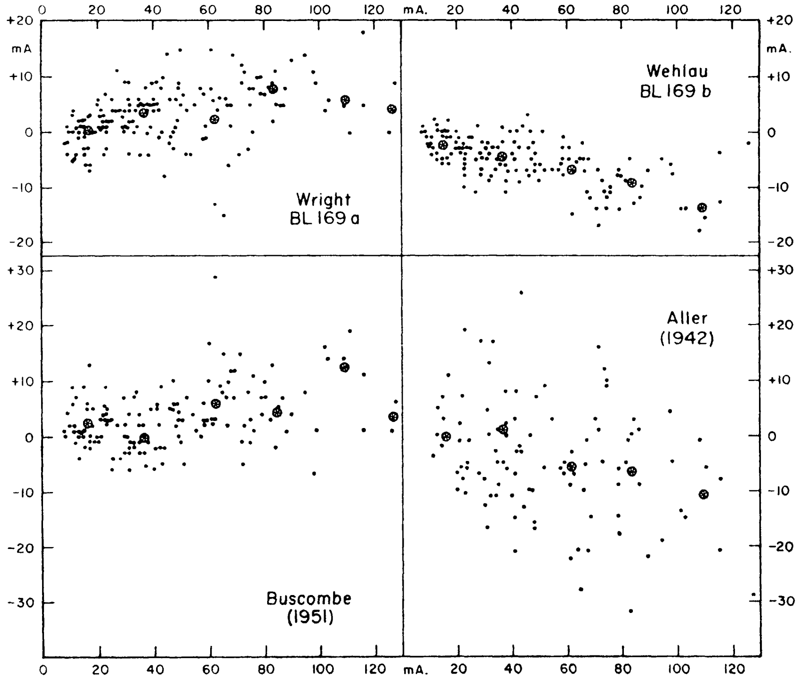


Figure 13

Deviations from the mean adopted equivalent width for individual lines in the spectrum of γ *Geminorum*, as measured by different observers. The starred circles represent mean values.

TABLE 7. AVERAGE PERCENTAGE DEVIATIONS FROM MEAN EQUIVALENT WIDTHS

(*e*) θ LEONIS

$\overline{W}$	IIIL$_A$		BL169		Palomar	
	%	No.	%	No.	%	No.
14	−1.2	129	+16.1	167	−14.8	159
36	−1.1	60	+11.9	62	−10.5	65
61	+1.8	26	+10.7	25	−10.8	30
87	+1.0	19	+11.6	22	−12.4	22
109	+3.8	15	+ 7.3	7	−10.7	15
134	+6.0	10	+ 9.2	10	−13.7	11
170	−8.2	1	+ 8.8	1	0.0	1
450	+2.2	1	+ 4.4	1	− 4.4	1
1190	—	—	+ 1.7	1	− 1.7	1
6990	−6.9	1	+ 0.3	1	+ 3.3	1
13420	−2.2	2	0.0	2	+ 2.2	2
Mean	+0.7	137	+12.1	144	−11.8	156

TABLE 7. AVERAGE PERCENTAGE DEVIATIONS FROM MEAN EQUIVALENT WIDTHS

(*f*) 68 TAURI

$\overline{W}$	BL169a		BL169b		BL496	
	%	No.	%	No.	%	No.
12	+0.1	171	−1.1	197	+ 6.8	196
36	+3.6	89	−1.9	100	− 2.6	109
61	+5.8	45	−3.4	53	− 1.2	51
87	+2.2	24	−1.5	26	− 1.7	27
108	+3.8	16	−1.9	18	− 1.0	15
135	+3.8	18	−2.1	22	− 1.1	19
166	+2.8	10	−0.1	14	− 2.0	14
200	0.0	1	−2.0	1	+ 2.5	1
500	+6.0	1	+4.0	1	−10.0	1
1430	—	—	+3.8	1	− 3.8	1
13300	—	—	−6.8	1	+ 6.8	1
Mean	+3.2	202	−1.9	237	+ 0.1	234

θ LEONIS

The lines in the spectrum of this A2 V star are definitely broader than those of the other A-type stars observed for this study. Two sets of Victoria observations, one taken with the $\mathrm{IIIL_A}$ spectrograph and the other with the BL169 Littrow spectrograph of the 72-inch telescope, and one set of Mount Palomar observations taken with the 200-inch telescope by Greenstein, were available for study. No other intensity measures for this star are known.

For the $\mathrm{IIIL_A}$ spectra the equivalent widths were obtained by assuming a triangular shape for all but the strongest lines. Standard profiles were derived and used as the basis for measurement of the BL169 plates. However the intensity differences from plate to plate were greater than for most other spectra studied here and, although the data have been averaged and mean equivalent widths computed, assuming equal weights for each of the three series of measurements, it seems possible that there may be a real variation in the line intensities in this spectrum. This suggestion finds some support in the fact that the Mount Palomar plates were taken on a single night and, though accordant among themselves, give intensities somewhat lower than mean values for the Victoria plates. This effect is shown in the average percentage deviations from the mean equivalent widths listed in Table 7e.

68 TAURI

This A2 V star is a member of the Taurus cluster. The lines are sharp and well-defined and the continuum also seems to be readily determined. Therefore this spectrum would appear to be an excellent choice as a spectrophotometric line-intensity standard. The three sets of Victoria spectra, two series of BL169 plates taken with different settings of the grating, and one taken with the BL496 grating, are the only ones for which intensity data are available. However, as the average percentage deviations listed in Table 7f show, the agreement between the three sets of observations is excellent and seem to confirm that this stellar spectrum might be suitable for inter-observatory comparisons.

TABLE 7. AVERAGE PERCENTAGE DEVIATIONS FROM MEAN EQUIVALENT WIDTHS

(*g*) 15 VULPECULAE

$\overline{W}$	$IIIL_A$		BL169		Mt. W. 71B		Palomar		Miczaika (1956)	
	%	No.	%	No.	%	No.	%	No.	%	No.
16	−2.6	80	+10.7	90	−3.6	82	−50	56	− 5.9	3
38	−4.2	85	+ 5.3	97	−1.7	79	−44	83	+ 3.4	31
62	+0.9	51	+ 5.0	63	−4.0	49	−32	56	− 2.9	28
88	+0.8	49	+ 0.7	53	−0.1	44	−28	57	− 1.5	30
112	+2.1	46	− 2.0	46	−0.3	38	−26	42	+ 0.8	27
143	+4.8	17	− 5.7	16	−0.5	17	−21	15	+ 1.3	11
174	+3.1	31	− 4.9	29	−0.3	26	−18	32	+ 2.8	22
225	+2.2	27	− 2.4	27	−0.4	23	−13	30	+ 1.4	23
265	+3.8	8	− 5.4	9	−3.6	6	− 6	9	+ 5.6	6
360	+2.2	2	− 0.4	2	−4.9	1	− 2	2	+ 0.6	2
425	+2.8	1	− 2.4	1	—	—	−16	1	+ 1.2	1
3800	—	—	− 0.2	1	−1.4	1	− 0	1	—	—
12250	+4.6	2	+ 3.6	1	+4.6	2	+28	2	−10.0	2
Mean	+0.8	296	+ 1.5	319	−1.5	267	−27.8	302	+ 0.4	168

15 VULPECULAE

This A5 star with a metallic-line spectrum was one of the first for which inter-observatory intensity comparisons were made. In the report to Sub-commission 36a of the International Astronomical Union in 1955 (Wright, 1957), it was noted that the Mount Wilson and Victoria equivalent widths agreed within a very few per cent, and that this agreement was as good as should be expected. The Mount Wilson data have been published by Miczaika et al. (1956). The 1955 Victoria data were based on BL169 plates. Since then, additional plates have been secured and the measures have been included in the results tabulated in Table 3. Victoria $IIIL_A$ observations and also measures made on spectrograms taken with the Mount Wilson grating 71B with the collimator-camera lens of 185 cm focal length are also given. There is some evidence that the lines on the latter plates are slightly broadened, probably the result of flexure in the spectrograph or motion of the grating during the long exposures. However the intensities are comparable with those measured on plates taken with other instruments, and therefore they have been given equal weight in deriving mean equivalent widths. A tracing of Palomar plate 4062b was available at the time of Wright's visit to the California Institute of Technology, and it was measured in the same manner as other similar tracings. However the intensities so derived are much lower than those obtained from the other sets of observations and show large random deviations from the mean; a notation on the tracings stated that there were pin-holes in the plate, which would account for greater intensities found for some strong lines but not for intensities found for the very weak lines which seemed to become progressively weaker at longer wave-lengths. In order to check the accuracy of the measurements, the tracing was remeasured, with similar results. Therefore since only a single plate was available and since the measures were so discordant, the results have not been included in the adopted mean equivalent widths, although the intensity data are included in Table 3. The average differences separated according to line strength are tabulated in Table 7g. They are plotted, with different symbols for three wave-length regions, in Figure 14. There are some systematic trends, but, with the exception of the results from the Palomar plate, the average agreement is quite as good as may be expected in comparisons of this kind.

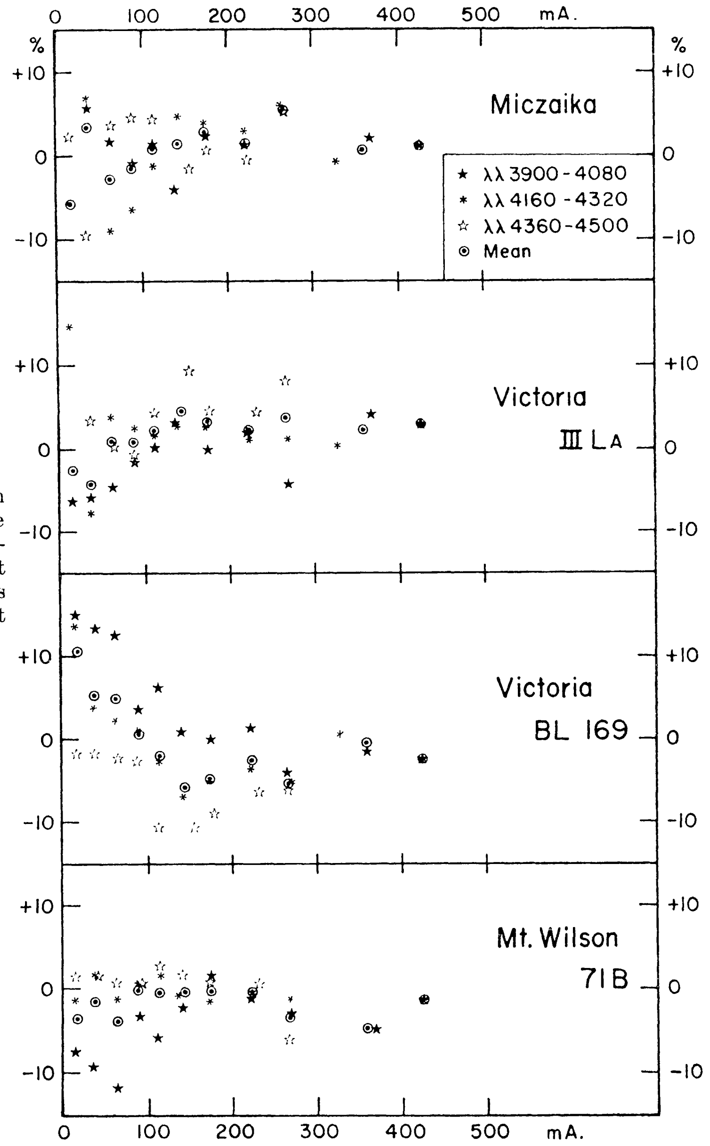


Figure 14

Average percentage differences from the mean equivalent widths of lines measured in the spectrum of 15 *Vulpeculae* for different instruments and by different observers. Each point refers to the average difference for all lines having approximately the same equivalent width in the same spectral region.

TABLE 7. AVERAGE PERCENTAGE DEVIATIONS FROM MEAN EQUIVALENT WIDTHS

(*h*) σ BOOTIS

$\overline{W}$	IIIL$_A$		BL169a Wright		BL169b Wehlau		BL496		Mt. Wilson		Palomar	
	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.
14	− 3.8	118	+19.6	144	+23.9	35	− 2.9	148	+ 7.4	71	−13.9	140
37	+ 3.3	80	+15.5	83	+ 6.2	45	+ 4.1	91	− 8.2	53	−19.8	92
63	+ 7.2	63	+14.6	73	+ 8.8	40	+ 2.6	71	−11.5	50	−18.2	76
86	+ 9.0	53	+10.6	59	+12.1	31	+ 2.6	57	− 8.9	40	−17.1	61
123	+12.1	47	+ 9.9	52	+12.4	41	+ 2.6	54	−11.4	39	−17.7	55
186	+10.3	10	+ 1.7	15	+15.9	13	− 1.4	16	− 9.1	7	− 8.0	16
230	+ 6.1	8	+ 2.7	9	+29.6	7	− 2.5	9	− 2.2	4	−12.1	7
330	+ 6.1	1	+ 4.5	1	+16.7	1	− 7.6	1	+ 9.1	1	−10.6	1
5500	—	—	− 0.6	1	+ 2.1	1	—	—	+ 2.9	1	− 3.3	1
Mean	+ 6.7	252	+12.6	288	+12.2	165	+ 1.7	290	− 8.2	186	−16.8	300

σ BOOTIS

This F2 V sharp-lined spectrum is one of those considered by Melbourne (1960) in his study of line-blanketing effects in dwarfs and sub-dwarfs; it is considered to be a star mildly deficient in metal abundances. This star was also one whose observed Hγ profile, when compared with profiles computed from various model atmospheres by Searle and Oke (1962), indicated that at this spectral type the continuum should be drawn approximately two per cent higher than shown by the highest points of the observed stellar intensity profile in the region of Hγ. However the intensity measurements presented here were completed before the paper by Searle and Oke was published and it was decided to publish these data, which seem to be on a relatively homogeneous scale, relative to the "observed" continuum rather than change the results to agree with a "theoretical" continuum.

Three sets of Victoria observations, three Palomar plates and one Mount Wilson plate were available for study. For the three-prism IIIL$_A$ plates, triangular profiles were assumed for all but the strongest lines, which were measured with the planimeter. The plates were grainy, and the measures were given half weight in calculating the mean equivalent width. Separate standard profiles were drawn for the BL169 and BL496 Victoria grating spectrograms, and they were used to estimate the equivalent widths of individual spectral lines. The tracings from BL169 plates were measured as two series independently but have been incorporated into a single set of measures, BL169a, in Table 4. Most of the BL169 tracings were also measured by Wehlau at the University of Western Ontario in order to obtain additional independent measures of these spectrograms. They have been included in the column labelled BL169b in Table 4, and have been given half weight in computing the mean equivalent widths because fewer tracings were used and fewer lines were measured.

The three Palomar plates had been measured at the California Institute of Technology. The same tracings were measured also at Victoria and many more lines were measured. There were some systematic differences between the two sets of measurements, but the tabulated data have been reduced to the California Institute measures. A single Mount Wilson plate, for which a tracing was made on the Babcock microphotometer, was available for study. This tracing was used as the basis for the original comparison between Mount Wilson and Victoria measures, as reported to the Dublin meeting of the International Astronomical Union (Wright, 1957); additional lines have been measured recently and are included in Table 4. Since they are based on only one plate, these measures are given half weight in the computation of mean equivalent widths. The BL169a measures, the BL496 data and the Palomar intensities have been given full weight in these computations.

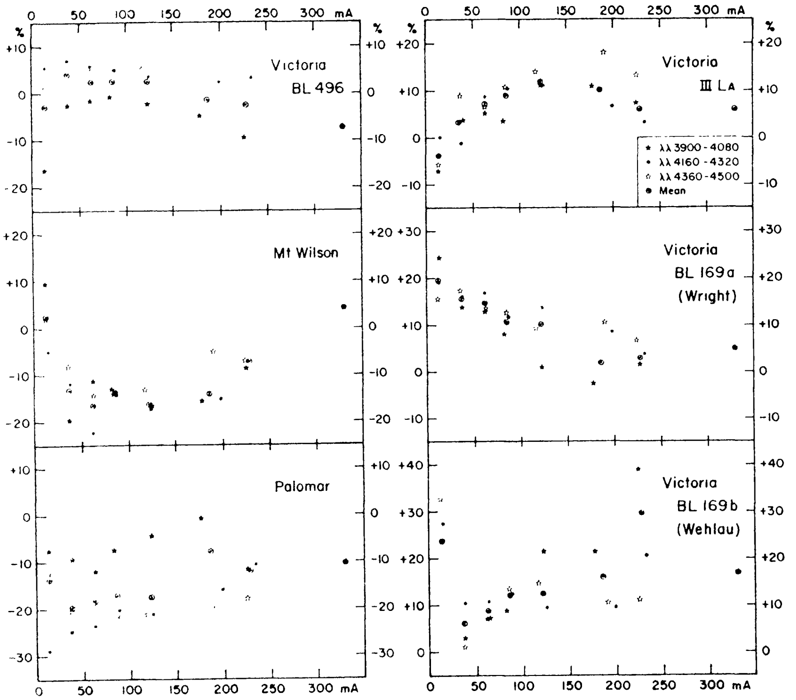


Figure 15

Average percentage differences from the mean equivalent widths of lines measured in the spectrum of σ *Bootis* for different instruments and by different observers. Each point refers to the average difference for all lines having approximately the same equivalent width in the same spectral region.

The line intensities in the spectrum of σ *Bootis* provide a good example of the differences to be expected when several different sets of observations are combined. The mean percentage differences from the mean equivalent widths for lines of increasing strength are listed for each set of observations in Table 7h, and these data, separated according to wavelength are plotted in Figure 15. As noted previously, the scatter for individual observations is rather large, but the mean results are reasonably accordant. However the differences between the Victoria and the Mount Wilson and Palomar observations are disappointingly large.

TABLE 7. AVERAGE PERCENTAGE DEVIATIONS FROM MEAN EQUIVALENT WIDTHS

(*i*) α CANIS MINORIS

$\overline{W}$	IIIL$_A$		Wood		BL84		BL496		9663		Mt. Wilson		Greenstein (1948)		Wright (1948)		Pannekoek (1950)		Wellmann (1955)	
	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.
16	−10.3	34	+11.6	48	+3.3	43	+ 5.0	65	− 2.9	64	− 5.5	65	+40	13	−28	8	+78	41	—	—
37	− 2.7	63	+11.4	65	+6.5	60	− 2.0	87	− 1.4	100	− 5.5	100	+50	26	−44	19	+63	73	+45	4
61	+ 6.6	52	+10.6	52	+1.4	49	− 5.9	69	− 1.2	74	− 5.7	78	+45	26	−38	17	+47	56	+26	9
88	+ 4.2	46	+11.5	38	+0.7	34	− 4.5	71	+ 2.3	73	− 6.1	75	+34	24	−22	14	+30	50	+16	14
122	+ 5.6	90	+11.9	73	−0.6	58	− 8.0	106	+ 2.3	119	− 8.8	123	+23	54	−10	44	+32	91	+17	53
172	+ 7.6	41	+ 9.6	43	+3.0	33	− 5.0	51	+ 4.5	53	− 2.2	48	+ 4	29	+ 6	25	+28	38	+15	16
226	+ 9.5	28	+ 9.8	24	+0.5	20	− 6.8	34	− 3.4	35	− 4.1	31	+14	23	+12	22	+34	27	+ 8	13
335	+ 9.3	7	+10.4	5	−0.3	5	−10.4	8	+ 5.2	8	−10.1	8	+12	7	+ 7	7	+35	7	− 1	8
475	+ 1.1	1	—	—	—	—	−11.6	1	+21.1	1	−11.6	1	+12	1	—	—	—	—	—	—
6400	− 9.6	2	+ 3.9	1	−3.7	1	− 2.7	1	+12.4	2	− 3.0	2	+18	2	− 6	2	− 2	2	+ 7	1
9300	—	—	—	—	—	—	+ 0.3	1	+ 4.8	1	− 5.4	1	—	—	—	—	—	—	—	—
Mean	+ 4.9	307	+10.9	282	+1.6	241	− 3.6	403	+ 1.6	432	− 6.2	432	+25.0	182	− 9.9	142	+39.0	318	+14.8	110

α CANIS MINORIS

Probably as many intensity measurements have been made using spectra of *Procyon* (F5IV-V) as of any other star. In addition to the data given in Table 5, lists of equivalent widths have been published by: Greenstein (1948) and Greenstein and Hiltner (1949), by Wright (1948), by Pannekoek (1951), by Wellmann (1955) and by others. Additional unpublished measures were made by Wrubel in 1952 while on visits to Victoria and to the Mount Wilson and Palomar Observatories, and by Schroeder, using tracings obtained from Victoria plates, at the University of Indiana. While the latter two sets of measurements have been compared with the present results, the numbers of measures are relatively small and have not been included in the mean equivalent widths.

The equivalent widths given in Table 5 in the final column for this star are the mean of the following sets of tracings, each of which were given equal weight in deriving the mean:

IIIL$_A$: New measures of selected three-prism plates which were included in Wright's 1948 publication;

Wood: Since the average deviations from the mean are systematically high, it may be that too large a correction for the ghost intensities has been made;

BL84: In spite of a ghost line very close to the principal line, observable only on high-dispersion laboratory spectra, the intensities obtained from spectrograms taken with this grating are usually remarkably consistent and near the adopted mean values;

BL496: The intensities derived for *Procyon* are a little low, but are quite consistent;

9663: The intensities at the shorter wave-lengths seem to be high and the intensities at longer wave-lengths seem to be low, but on the average the mean deviations for lines measured on spectrograms taken with this grating are consistently close to the mean;

Mount Wilson: The Mount Wilson plates usually give intensities lower than the Victoria measures and the data for *Procyon* are no exception. For one plate, Ce 3309, tracings were made both at Victoria and at the California Institute of Technology; the Victoria tracings gave intensities a few per cent higher, in the mean.

Comparisons with other published results show that earlier data, usually based on spectrograms of lower dispersion, gave higher values for the equivalent widths. Part of this result may be explained as due to unresolved blends which are better separated on high-dispersion spectra. Wright's 1948 results, which are lower than the average, may be explained by his blending corrections which were applied to the observed intensities and which are now believed to have been too large.

TABLE 7. AVERAGE PERCENTAGE DEVIATIONS FROM MEAN EQUIVALENT WIDTHS

(*j*) 110 HERCULIS

$\overline{W}$	BL84		BL169a		BL169b		Mt. Wilson		Wellmann (1955)	
	%	No.	%	No.	%	No.	%	No.	%	No.
17	−12.0	52	+ 5.0	59	+ 7.8	64	− 4.7	62	+26	2
35	− 6.1	63	+ 4.6	71	+ 7.6	68	−13.9	70	+83	3
62	+ 0.1	51	+ 7.2	63	+ 4.5	64	−22.4	64	+36	11
88	+ 0.2	45	+ 8.9	52	+ 2.8	51	−23.0	53	+45	14
123	− 0.1	74	+ 9.4	85	+ 3.0	89	−24.4	86	+38	42
176	+ 1.8	29	+ 8.1	36	+ 3.9	37	−26.9	37	+27	28
238	0.0	14	+ 8.6	18	+ 4.7	17	−25.3	18	+26	14
367	+ 3.7	14	+ 7.0	14	+ 1.8	14	−24.0	14	+16	8
4850	+11.7	1	− 3.9	1	− 1.6	1	−13.4	1	+31	1
Mean	+ 0.9	272	+ 7.8	318	+ 4.1	322	−22.0	322	+33.6	120

TABLE 7. AVERAGE PERCENTAGE DEVIATIONS FROM MEAN EQUIVALENT WIDTHS

(*k*) λ SERPENTIS

$\overline{W}$	BL169a		BL169b		BL169c		Mt. Wilson	
	%	No.	%	No.	%	No.	%	No.
18	+15.3	16	+21.2	15	− 8.4	15	−20.2	11
40	+ 6.9	40	+ 9.0	40	+ 3.4	40	−12.9	33
62	+ 8.1	57	+ 4.1	57	+ 3.4	55	− 9.1	52
87	+ 6.0	46	+ 5.7	45	+ 2.8	46	− 8.6	44
111	+ 7.7	34	+11.3	32	+ 0.1	34	− 7.2	32
136	+ 4.2	18	+ 1.2	18	+ 0.5	18	− 3.7	15
172	+ 4.7	30	+ 3.0	30	+ 1.0	30	− 4.5	26
230	+ 2.7	7	+ 5.5	7	− 0.1	7	− 4.5	6
275	+ 6.8	4	+ 3.2	4	− 3.2	4	− 2.7	4
335	− 8.5	6	− 0.4	6	+ 4.9	6	+ 0.9	5
405	+ 4.9	1	+ 9.9	1	− 1.2	1	− 7.4	1
460	− 3.8	2	+ 4.3	2	+ 5.0	2	− 1.6	2
800	− 5.8	5	− 0.5	5	+ 6.2	5	− 0.2	5
3025	− 4.1	1	+ 8.4	1	− 4.5	1	—	—
Mean	+ 5.8	225	+ 5.6	232	+ 2.0	233	− 7.5	212

110 HERCULIS

The lines in the spectrum of this F6 IV star are definitely broader than those in the spectrum of α *Canis Minoris* and therefore close blends are not so readily resolved. The continuum is also less readily defined and therefore the Victoria plates were not measured below 4000A. Wellmann (1955) made a comparison of line intensities in the spectrum of α *Canis Minoris* and in 110 *Herculis* since, according to Roman (1950, 1952) the former star has a spectrum with strong lines and the latter a spectrum with weak lines.

The mean equivalent widths listed in Table 4 are based on a series of BL84 plates, two sets of BL169 plates, each of which have been given equal weight, and a single 10 A/mm Mount Wilson plate which has been given half weight. Wellmann's observations have not been included in the mean although his Göttingen plates give a dispersion of 8 A/mm at Hγ. They were omitted because his intensities for α *Canis Minoris* were definitely greater than the observations that were included in the mean, especially for the weaker lines, and the same trend seemed to occur in his intensities for 110 *Herculis*. It is quite possible, however, that better results would have been obtained by including Wellmann's observations, especially since the Mount Wilson intensities, which are based on only a single plate, are definitely weaker than the Victoria data. The average differences between the several sets of observations for lines of increasing strength are given in Table 7j. The mean values for all lines indicate that Wellmann's intensities are 34 per cent higher, and the Mount Wilson data 22 per cent lower than the average adopted equivalent widths which, it should be noted, give the Victoria observations higher weight.

λ SERPENTIS

The spectrum of this star, G0 V, is quite similar to that of the sun, and the Utrecht *Photometric Atlas of the Solar Spectrum* (Minnaert, Mulders and Houtgast, 1940) was very valuable in making a selection of lines that were free from blends under the even higher dispersion used in it, and also in the determination of the position of the continuum. In the original 1955 comparison of Victoria and Mount Wilson equivalent widths, Greenstein's measures for 50 lines were 31 per cent lower than the Victoria values. In 1962 tracings were made from some of the same Mount Wilson plates on the microphotometer at the California Institute of Technology. The continuum was then drawn in a manner similar to that adopted for the Victoria spectra. Weak lines were assumed to be triangular in shape and six per cent was added to the measured equivalent width to conform to that of a Gaussian profile as recommended by Greenstein (see Wright, 1957). For stronger lines with extensive wings the areas absorbed from the continuum were measured with the planimeter.

Three sets of Victoria BL169 spectrograms were available and were measured independently. Since three Mount Wilson plates were also available, the Victoria and Mount Wilson data were given equal weight; i.e. if there were two Victoria measures of a line, the Mount Wilson value was given double weight. The differences from the mean for lines of increasing strength shown in Table 7k show reasonable agreement. The Mount Wilson intensities are lower than the Victoria values, but the difference is not as large as originally measured by Greenstein. The better agreement may be the result of drawing the continuum in a more consistent manner.

TABLE 7. AVERAGE PERCENTAGE DEVIATIONS FROM MEAN EQUIVALENT WIDTHS

(*l*) μ HERCULIS

$\overline{W}$	BL169a		BL169b		Mt. Wilson	
	%	No.	%	No.	%	No.
18	+11.3	3	− 8.8	2	+ 0.2	4
37	+14.0	10	+10.1	13	−11.2	14
64	+12.3	32	+ 9.8	24	− 9.1	36
86	+12.8	57	+ 8.3	43	−10.0	60
111	+11.0	38	+ 9.0	32	− 9.5	42
136	+11.3	29	+ 7.6	22	− 9.4	29
176	+ 7.8	43	+ 5.3	35	− 6.4	36
220	+ 9.8	25	+ 3.8	24	− 6.7	24
270	+12.1	6	+ 0.5	7	− 6.1	7
350	+ 3.4	6	+ 2.9	3	− 5.6	4
450	+ 3.7	5	+ 8.8	3	− 4.6	5
600	+ 8.3	5	+14.5	4	+ 1.0	5
1225	+ 6.6	6	− 1.6	3	− 3.6	6
1800	+ 7.3	4	− 4.8	4	− 1.9	4
3050	+ 5.7	1	− 9.3	1	+ 1.6	1
Mean	+10.5	262	+ 6.9	211	− 8.2	266

μ HERCULIS

The spectrum of μ *Herculis,* G5 IV, shows weak lines, according to Roman (1952). However the lines are quite strong and many of the neutral iron lines show pronounced wings. As in any late-type spectrum the continuum is poorly defined, and, with the dispersion employed here, there may be no real continuum. However, as shown in Figures 6, 8, 10 and 12, there are sufficient short stretches of spectrum at approximately the same wavelengths as the continuum adopted for the solar spectrum in the Utrecht *Atlas* and for the spectrum of λ *Serpentis* to define the continuum which has been drawn for μ *Herculis.* In the spectra both of λ *Serpentis* and μ *Herculis,* only lines which appeared to be relatively free from blends were selected for measurement. Weak and moderately strong lines were measured as triangles on the Mount Wilson tracings and, as for λ *Serpentis,* a correction of six per cent was added to allow for the true Gaussian profile. Strong lines were measured with the planimeter. For the Victoria plates, standard profiles were obtained in the same way as for stars of earlier type and most of the line intensities were interpolated from the standard profiles. The strong lines with extensive wings were measured individually with the planimeter.

Two sets of Victoria BL169 plates were measured, and two Mount Wilson plates were studied. The Mount Wilson intensities were given equal weight with the Victoria values in the calculation of the mean equivalent widths. In Table 7l it is seen that the three sets of intensities are consistently independent of line strength and that the Victoria measures are about 15 per cent higher than the Mount Wilson values. This difference is approximately the same as that found by Greenstein and Wright in the 1955 report of these comparisons (Wright, 1957).

TABLE 8. AVERAGE PERCENTAGE DEVIATIONS FROM PHOTOGRAPHIC MEAN EQUIVALENT WIDTHS FOR MOUNT WILSON PHOTOELECTRIC SCANS

ρ LEONIS			γ PEGASI			ι HERCULIS			γ GEMINORUM				
Greenstein and Wright			Oke			Greenstein and Wright				Greenstein and Wright		Oke	
$\overline{W}$	%	No.	$\overline{W}$	%	No.	$\overline{W}$	%	No.	$\overline{W}$	%	No.	%	No.
—	—	—	15.1	−13.2	8	13.3	+140	3	16.3	+ 1.7	32	—	—
40.0	+35.5	3	40.0	+27.1	1	—	—	—	35.0	−24.1	20	−22.9	10
74	+12.6	2	53.5	+36.4	2	—	—	—	68.8	−11.0	13	+23.1	4
116	− 4.3	4	—	—	—	—	—	—	108.6	+ 7.0	3	−16.5	3
173	−16.6	5	—	—	—	—	—	—	—	—	—	—	—
232	− 2.8	2	—	—	—	225	+ 8.9	1	—	—	—	—	—
355	− 0.8	1	—	—	—	—	—	—	405	+ 8.6	1	+28.4	1
840	+39.9	1	—	—	—	—	—	—	—	—	—	—	—
1810	+21.0	1	4380	+15.8	1	1240	+ 7.3	1	12630	+ 2.9	1	—	—
Mean	+ 1.2			+ 9.6			+ 8.1			− 9.3		− 8.1	
Wt.		1			2			1			1		

Since such a large body of data on line intensities is now available, it seemed desirable to make some estimate of differences obtained from different instruments and by different observers. The results cannot be considered definitive, of course, since each stellar spectrum must be studied separately, and different observers will interpret the spectral features, both lines and continuum, according to their own, sometimes pre-conceived, ideas. The new data presented in this paper have been obtained in such a manner as to make the results as homogeneous as possible—though it must be admitted that when tracings were examined some time after the measurements were made it was sometimes felt that the results could have been improved.

In Table 9 the average percentage differences for all lines, as listed in the final line of Tables 7a to 7l, are tabulated for each spectrum according to the instrument or observer. Observations obtained at each Observatory are grouped together as much as possible. The adopted mean percentage difference from the mean equivalent widths computed from the present observations, as given in Tables 2 to 5, are given at the end of Table 9. The following weights have been given to the observations of each star, the weight depending in part on the number of different sets of intensities available, and in part on the type of line observed: γ *Pegasi*, 2, γ *Geminorum*, 2, 15 *Vulpeculae*, 3, σ *Bootis*, 3, α *Canis Minoris*, 4. The other measures have been given unit weight. These weights are given in the last column of Table 9. It is seen that the data from most of the instruments and observers give similar results within the error of ten per cent that has frequently been quoted as to be expected in spectrophotometric measurements. The differences for the different Victoria instruments are usually smaller, but it must be mentioned that the Victoria data have been given high weight in the present compilation.

TABLE 9a. AVERAGE PERCENTAGE DIFFERENCES FOR STANDARD INTENSITY STARS

Star	VICTORIA										Palomar	Wellmann 1955	Weight
	IIIL$_A$	Wood	BL84	BL169 Wright	BL169 Wehlau	BL496	9643 9663	Mt. W. 71 B	Wright	Pannekoek			
ρ LEONIS	+ 0.4 45	—	− 1.1 52	− 5.6 48	—	+ 1.2 54	—	—	—	—	—	—	1
γ PEGASI	+ 9.2 45	—	+ 5.6 50	− 1.6* 55	—	− 1.6* 55	—	—	—	—	—	—	2
ι HERCULIS	− 9.2 37	—	—	+ 6.2 36	—	—	+ 4.0 47	—	—	—	—	—	1
γ GEMINORUM	—	—	—	+ 6.3 105	−12.2 89	—	—	—	—	—	—	—	2
θ LEONIS	+ 0.7 137	—	—	+12.1 144	—	—	—	—	—	—	−11.8 156	—	1
68 TAURI	—	—	—	+ 2.5 220	—	+ 0.1 233	—	—	—	—	—	—	1
15 VULPECULAE	+ 0.8 296	—	—	+ 1.5 319	—	—	—	− 1.5 267	—	—	(−27.8) (301)	—	3
σ BOOTIS	+ 6.7 252	—	—	+12.6 288	+12.2 165	+ 1.7 290	—	—	—	—	−16.8 300	—	2
α CANIS MINORIS	+ 4.9 307	+10.9 281	+ 1.6 241	—	—	− 3.6 403	+ 1.5 432	—	− 9.9 142	+39.0 317	—	+14.8 110	4
110 HERCULIS	—	—	− 0.9 272	+ 6.0 322	—	—	—	—	—	—	—	+33.6 120	1
λ SERPENTIS	—	—	—	+ 4.5 230	—	—	—	—	—	—	—	—	1
μ HERCULIS	—	—	—	+ 8.7 261	—	—	—	—	—	—	—	—	1
Mean Weight	+ 3.3 14	+10.9 4	+ 2.0 8	+ 4.6 16	0.0 4	− 1.3 10	+ 2.0 5	− 1.5 3	− 9.9 4	+39.0 4	−15.6 4	+18.6 5	

* One set of observations.

TABLE 9b. AVERAGE PERCENTAGE DIFFERENCES FOR STANDARD INTENSITY STARS

Star	MOUNT WILSON							McDONALD			Edinburgh 1958 1960	Kopylov 1958	Miczaika 1948	Weight
	Mt. Wilson	Scanner	Aller 1958 1949	Miczaika 1956	Buscombe 1951	Huang and Struve 1956	Williams 1936	Aller 1942	Greenstein 1948	Underhill 1948				
ρ LEONIS	+ 2.4 60	+ 1.2 1	—	—	—	+11.8 18	− 5.4 30	—	—	− 6.5 5	+15.7 6	+53 24	—	1
γ PEGASI	− 5.3 63	+ 9.6 2	− 0.4 45	—	—	—	+15.8 22	—	—	− 5.4 8	+ 7.9 3	+35 18	+60 14	2
ι HERCULIS	— —	+ 8.1 1	(−28.1) (20)	—	—	—	+12.0 19	—	—	— —	+16.0 6	+26 13	—	1
γ GEMINORUM	—	− 8.7 4	—	—	+ 4.1 93	—	—	− 5.8 62	—	—	—	—	—	2
θ LEONIS	—	—	—	—	—	—	—	—	—	—	—	—	—	1
68 TAURI	—	—	—	—	—	—	—	—	—	—	—	—	—	1
15 VULPECULAE	—	—	—	+ 0.4 168	—	—	—	—	—	—	—	—	—	3
σ BOOTIS	− 8.2 186	—	—	—	—	—	—	—	—	—	—	—	—	2
α CANIS MINORIS	− 6.2 432	—	—	—	—	—	—	—	+25.0 182	—	—	—	—	4
110 HERCULIS	(−22.0) (322)	—	—	—	—	—	—	—	—	—	—	—	—	1
λ SERPENTIS	− 7.5 212	—	—	—	—	—	—	—	—	—	—	—	—	1
μ HERCULIS	− 8.2 266	—	—	—	—	—	—	—	—	—	—	—	—	1
Mean	− 5.9	− 0.8	− 0.4	+ 0.4	+ 4.1	+11.8	+ 9.6	− 5.8	+25.0	− 5.8	+13.2	+37	+60	
Weight	11	4	2	3	2	1	4	2	4	3	3	4	2	

The principal conclusion to be drawn from the above results would seem to be that on low-dispersion spectra only the strongest lines should be measured for intensities and then only for spectra with relatively few lines. In late-type spectra, the compressing of the spectrum produces numerous blends which can be separated on spectra of high dispersion, and the short stretches of spectrum that may be considered the apparent continuum with high dispersion, disappear completely with the blending of the lines.

The equivalent-width measurements obtained from the spectral scans, which are tabulated in Tables 6a and 6b do not add greatly to the main body of data presented here. The percentage deviations of these photoelectric measurements, computed as differences from the photographic means of Tables 2 and 3 in the same way as for Table 7 are listed in Table 8. These results are very valuable in indicating that the photoelectric data are comparable with those obtained when photographic techniques are employed. There do not seem to be any major sources of error in photographic spectrophotometry. The scans do not, however, check the amount of scattered light in the spectrograph. They do indicate that undesirable effects produced in the emulsion by the Eberhard effect and photographic spreading are small, and that the averaging effects produced by the breadth of the analyzing slit in the microphotometer are also satisfactorily small. Thus it would appear that many of the differences noted in the results obtained by different observers arise from the diverse habits of drawing the continuum and of sketching the profiles on the tracings. Only when adequate precautions have not been taken in the photometric procedures should the differences in the measured equivalent widths be attributed mainly to the photographic method.

VI. THE HYDROGEN Hγ PROFILES

The Hγ profiles were included as an integral part of the program of line-intensity standards. It has been stated by Greenstein (1948) that it is difficult to measure intensities of shallow broad lines and the very broad hydrogen lines on high-dispersion spectra. The reason for this is that the wings are so extensive that it is difficult to know where the line ends at the continuum. However this applies also to low-dispersion spectra where, in addition, the relatively larger grains of the plate make the determination of the line profiles, as well as of the continuum, even more difficult. On low-dispersion spectra the lines in the hydrogen wings are often partially blended and, especially near the core of the line, the true shape of the profile becomes very difficult to estimate. The hydrogen lines can probably be measured best on low-magnification tracings of high-dispersion spectra. However in the present study, the hydrogen profiles and their equivalent widths were drawn and measured directly on the high-magnification tracings that were used for the measurement of the other absorption lines.

On most of the Victoria grating spectra, H δ was set between the two plates, and was not measured. Therefore Hγ is the only hydrogen line that will be discussed here. It was assumed that the continuum could be represented by a straight line on the logarithmic tracings. Thus regions of the spectrum which were judged to represent the continuum were jointed by straight lines even though they might be separated by as much as 65 angstroms. For the spectra studied here it appeared that regions of the apparent continuum could be found at about 4312A. and 4370A. There was little or no change in slope between the line joining these points and regions farther from the hydrogen line, and therefore for this study these points were considered as defining the continuum. The general appearance of the tracings in the region of Hγ for the stars studied here is shown in Figures 9 and 10.

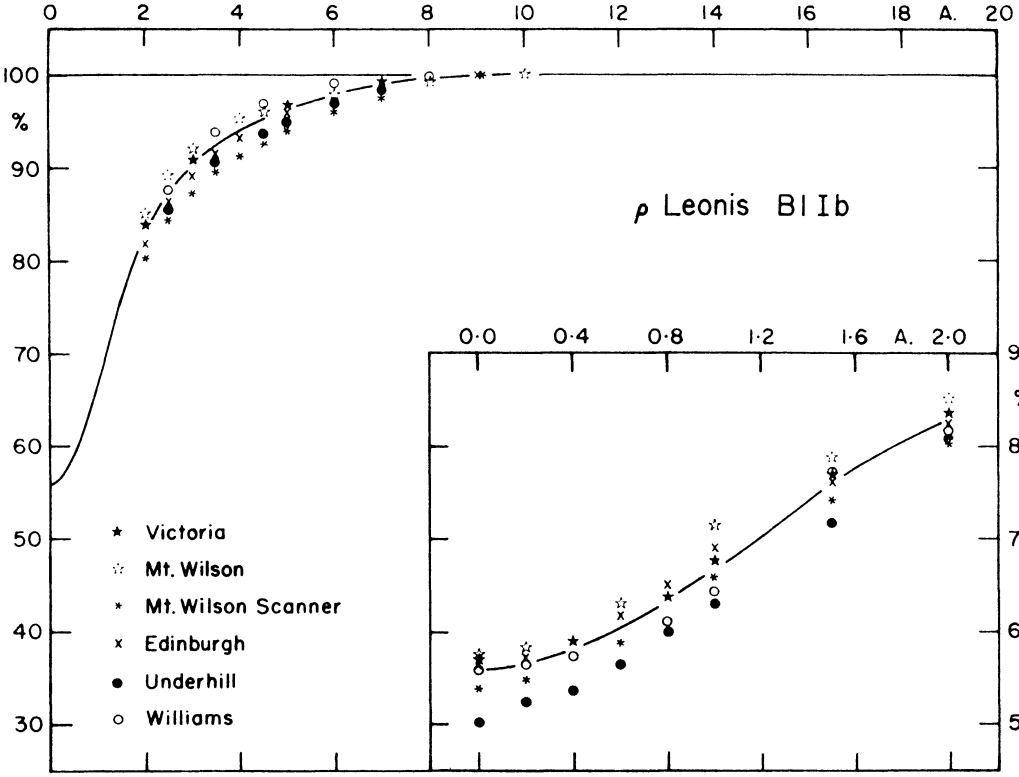
It has been assumed that the hydrogen profiles are symmetrical about the centre of the line, and that any asymmetries are produced by additional absorption lines. When additional lines occur five or more angstroms from the centre of Hγ it is usually not difficult to estimate the probable profile of Hγ. When there are lines only a few angstroms from the centre, however, as, for example, the lines of Fe I and Ti II at 4337A. in the A-type stars and also a line at 4344A. in these same stars, the profile near the line centre cannot be well defined.

Profiles of the Hγ line in the spectra of the twelve stars analyzed in this publication are shown in Figures 16 to 21, and the observed intensities for the different spectrographic combinations are listed in Tables 10a to 10d. The central intensity is given in the first line and succeeding lines give the intensities of the symmetrical profile in steps of 0.2A. to a distance of 1.0A. from the centre, then in steps of 0.5A. to 5A. in steps of 1A. to 10A. and finally in steps of 2A. until the continuum is reached. The notations for the various spectrographic combinations are the same as those given in Table 1 and used in Tables 2 to 5. The observations made with the Mount Wilson photoelectric scanner are also included. The mean values of the intensity at the listed distance from the centre of the line are given in the last column; each series of observations has been given equal weight. The mean intensities include the data from the observers listed in Figures 16 to 21. Only the redward half of the line is shown in the diagrams since the line is assumed to be symmetrical. The upper portion of each figure where the data listed in Table 10 are plotted, shows the mean profile beyond 2A. from the line centre. Where the plotting of all existing sets of observations would have impaired the clarity of the diagram, mean values for each observatory have sometimes been plotted. In the lower right hand section of the diagram, the region near the centre of the line has been plotted on an expanded dispersion scale in order that individual observations may be shown more clearly.

The different sets of observations, marked by different symbols, are listed on each diagram. Nearly all of these data have been mentioned in the discussion of the equivalent widths in the spectra of each star in Section V, where the references are listed. In a few of these references no information is given concerning the profile of Hγ; in others the points plotted here have been taken from the published diagrams and should be sufficiently accurate for illustrative purposes.

The profile of Hγ in the spectrum of γ *Pegasi* has been measured in the course of Aller's study of this star and has been published by Aller and Jugaku (1958b). Williams (1932)

95034—8



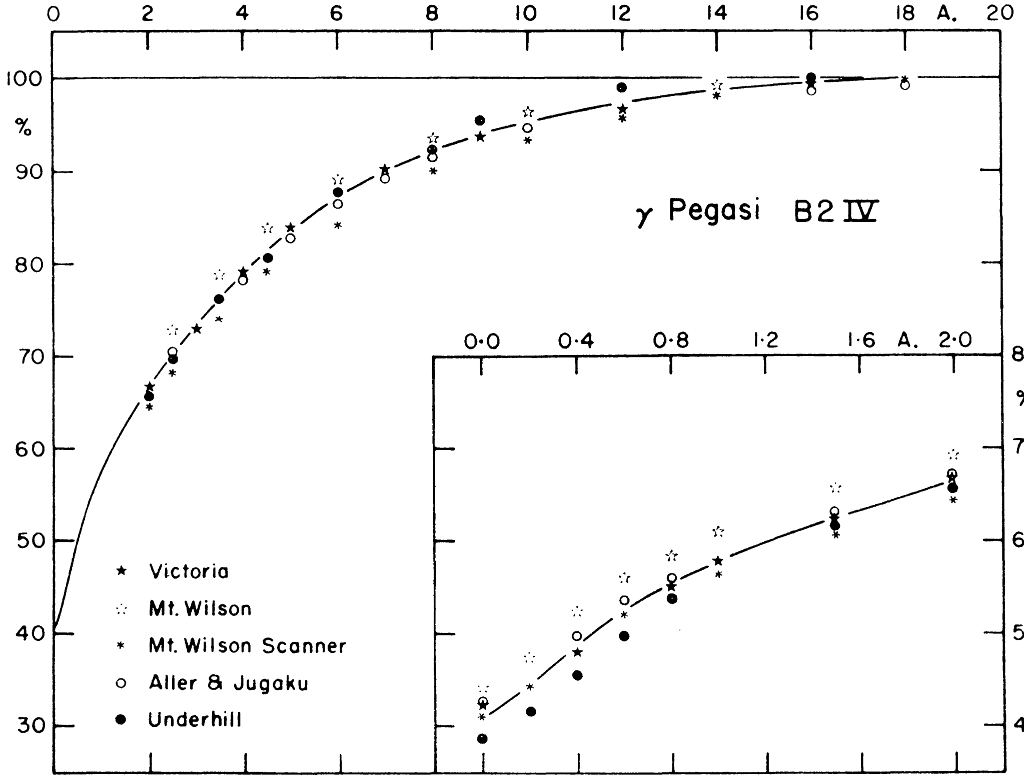


Figure 16. Observed profiles of Hγ in the spectra of *ρ Leonis*, B1 Ib, and *γ Pegasi*. B2 IV. The observed profile, the mean of all observations indicated here, is shown as a solid line. The core of the line, drawn on an expanded scale in the direction of the dispersion, is shown at the lower right.

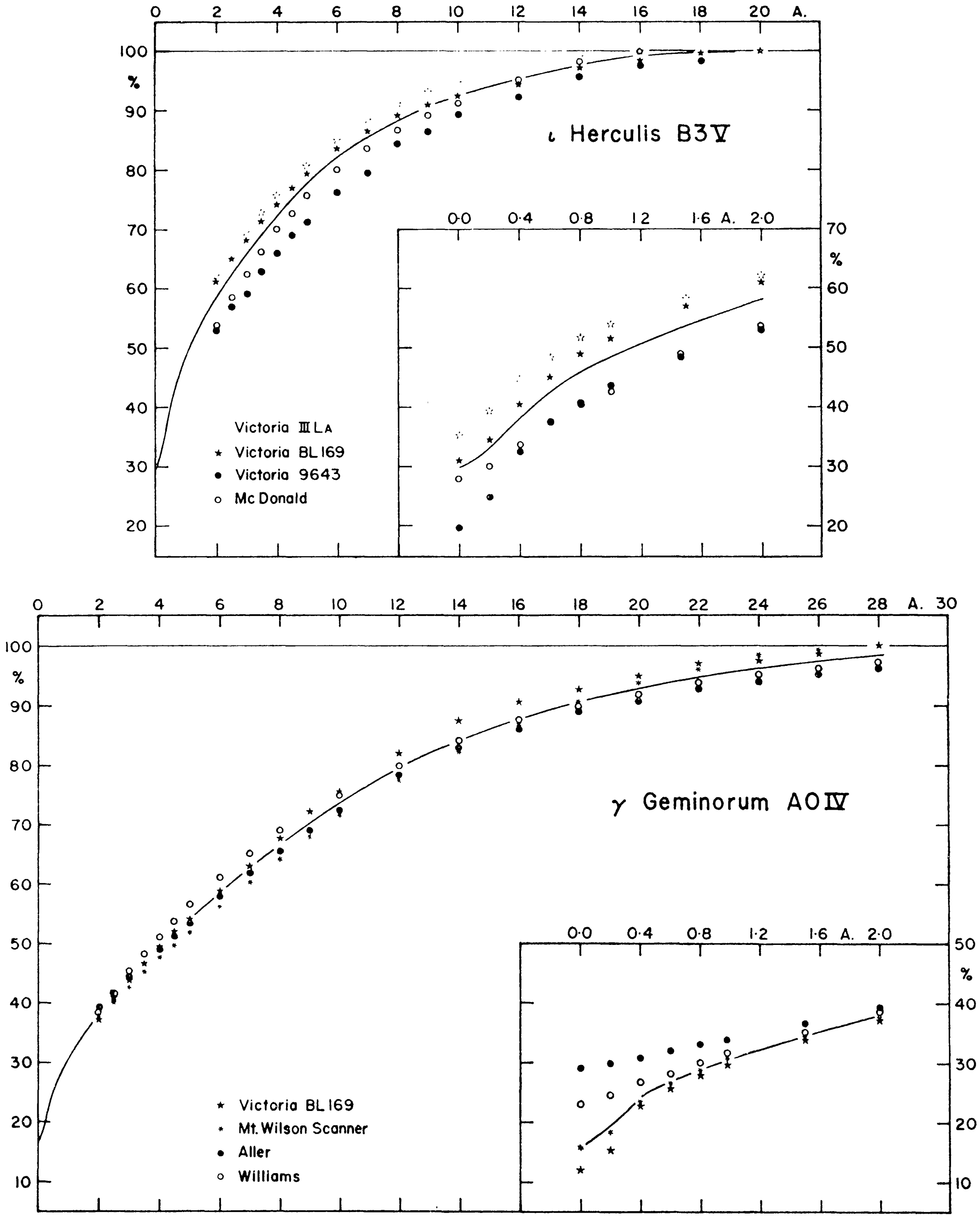


Figure 17. Observed profiles of Hγ in the spectra of *ι Herculis*, B3 V, and *γ Geminorum*, A0 IV. The observed profile, the mean of all observations indicated here, is shown as a solid line. The core of the line, draw on an expanded scale in the direction of the dispersion, is shown at the lower right.

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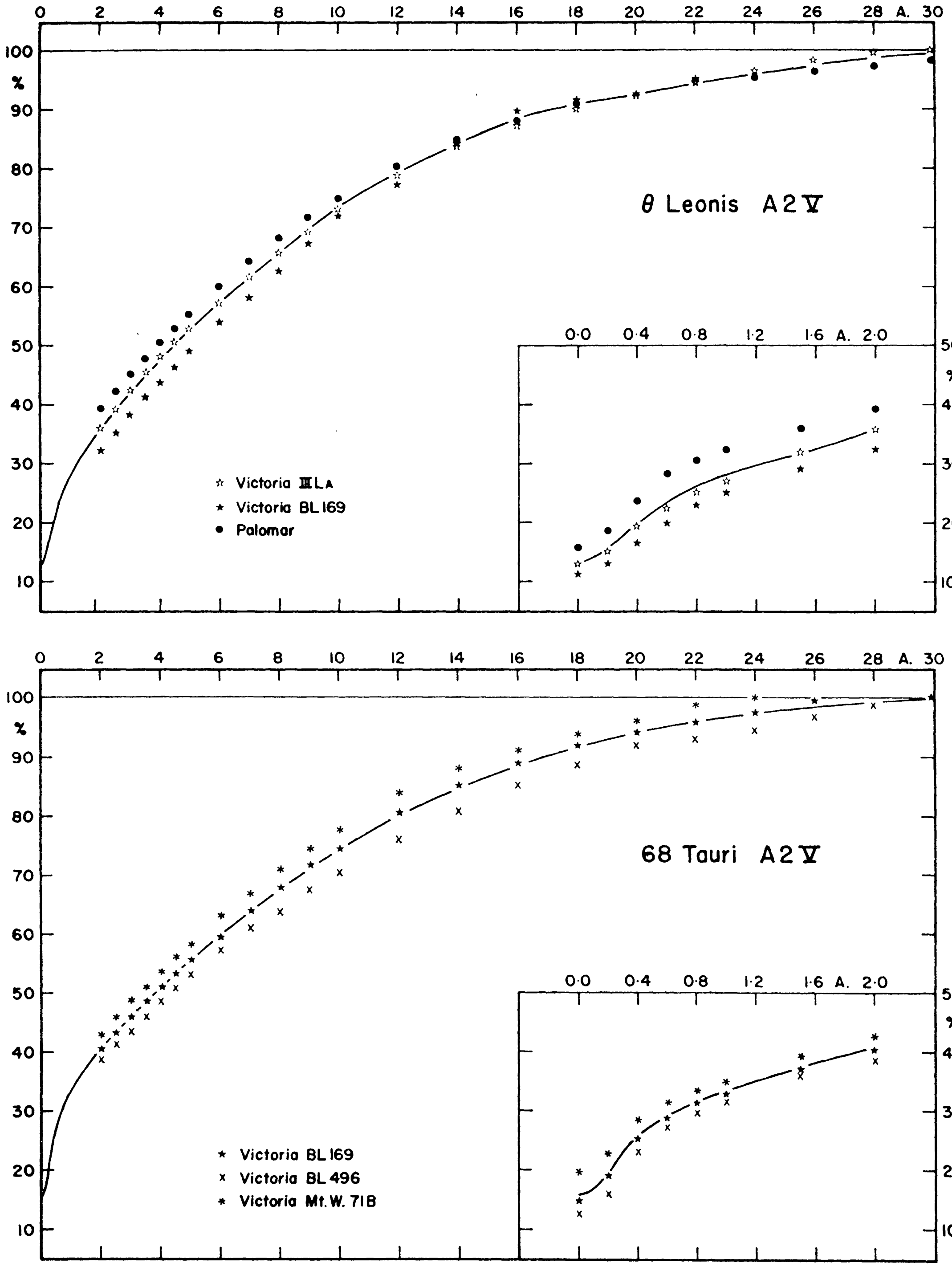
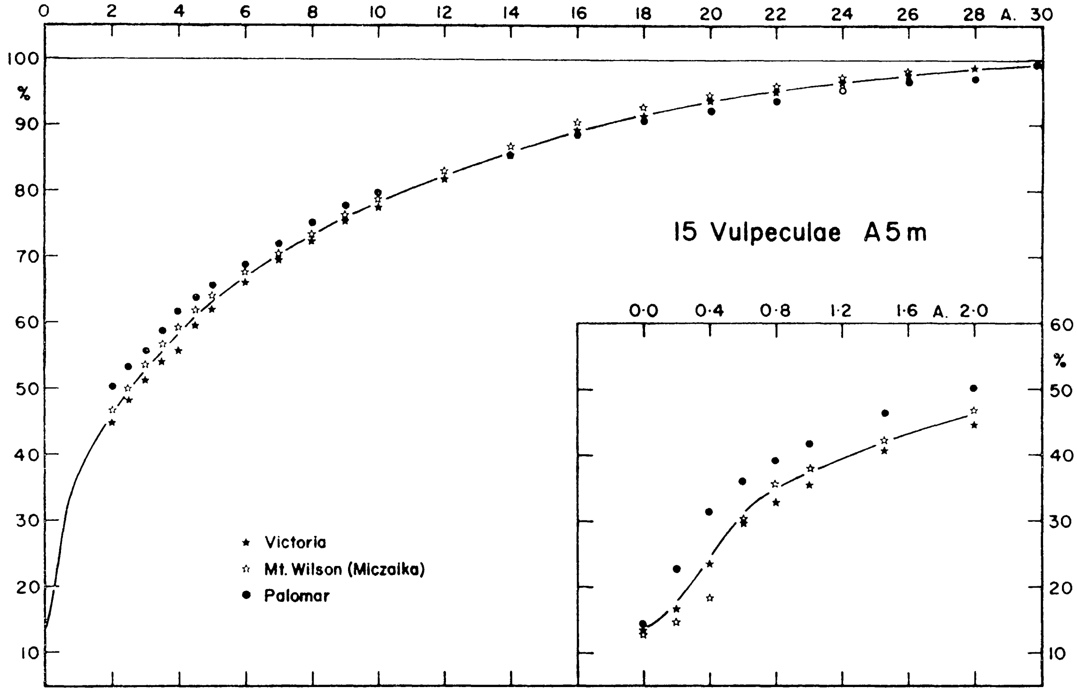


Figure 18. Observed profiles of Hγ in the spectra of *θ Leonis*, A0 V, and 68 *Tauri*, A2 V. The observed profile, the mean of all observations indicated here, is shown as a solid line. The core of the line, drawn on an expanded scale in the direction of the dispersion, is shown at the lower right.



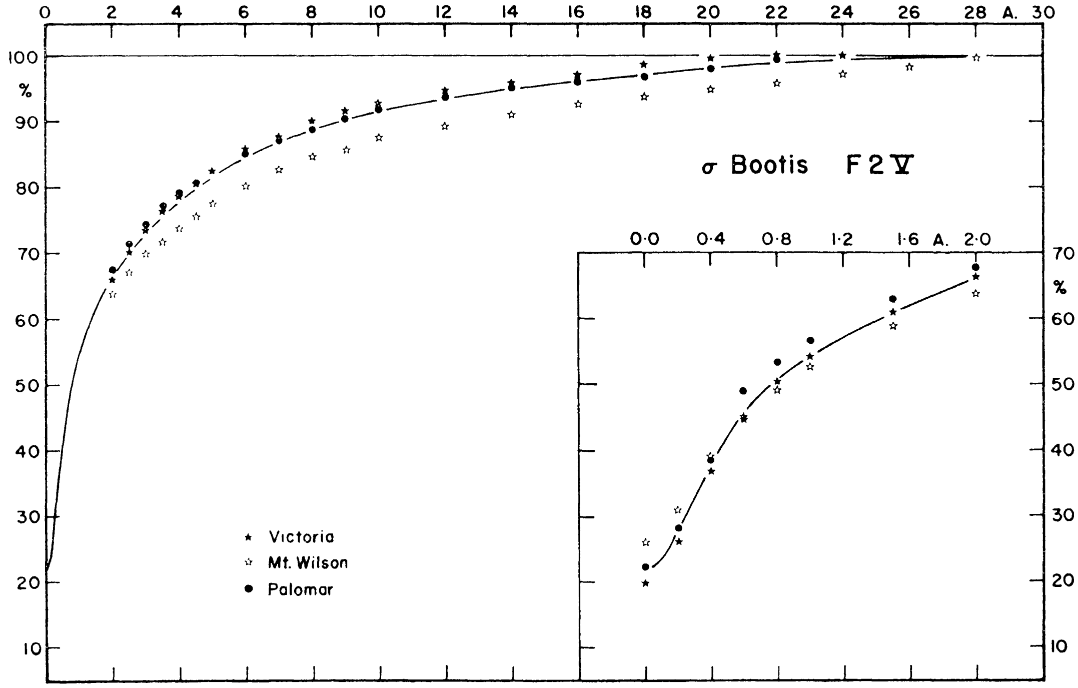


Figure 19. Observed profiles of Hγ in the spectra of 15 *Vulpeculae*, A5 m, and *σ Bootis*, F2 V. The observed profile, the mean of all observations indicated here, is shown as a solid line. The core of the line, drawn on an expanded scale in the direction of the dispersion, is shown at the lower right.

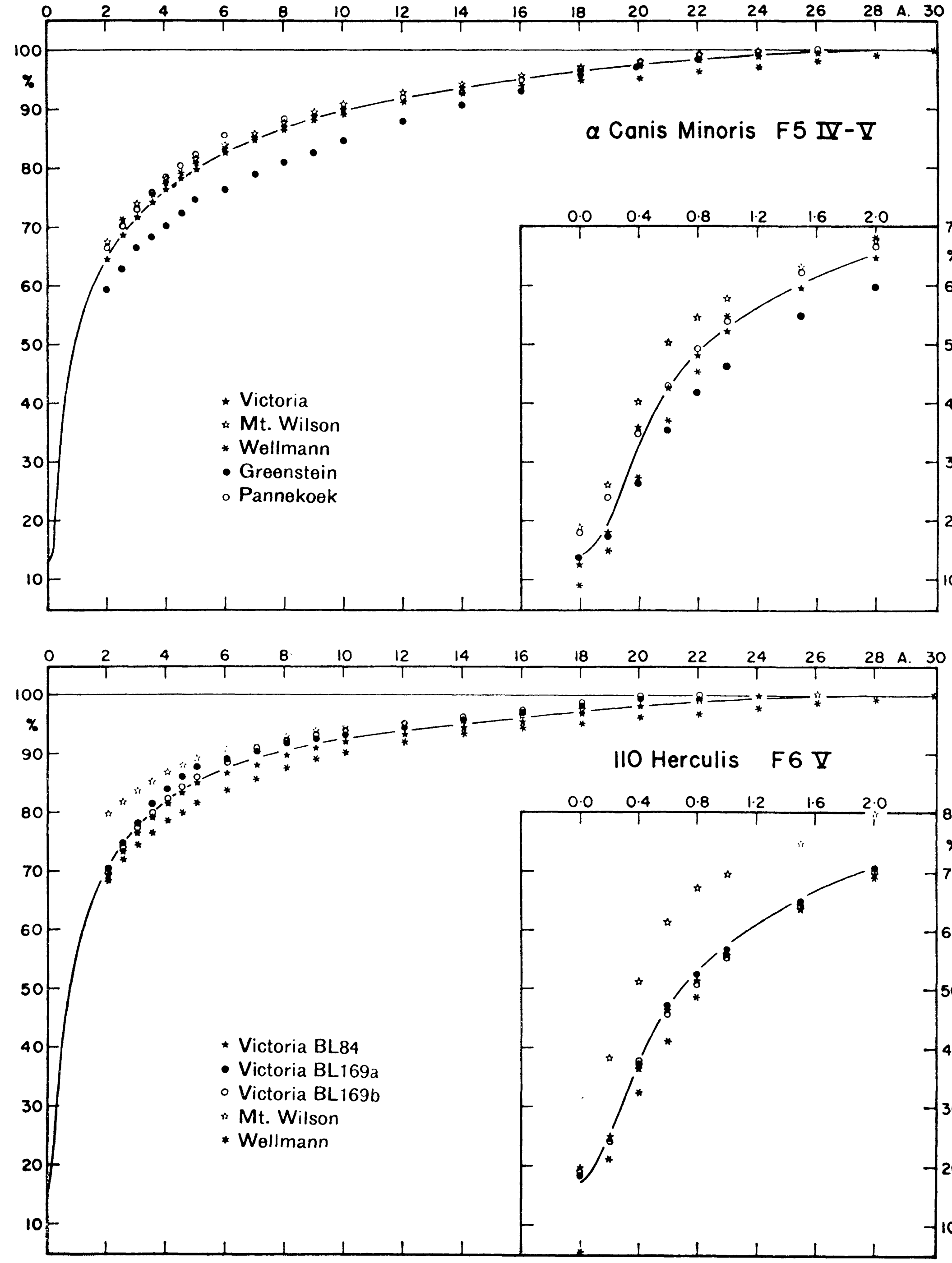


Figure 20. Observed profiles of $H\gamma$ in the spectra of *α Canis Minoris*, F5, IV-V, and 110 *Herculis*, F6 IV. The observed profile, the mean of all observations indicated here, is shown as a solid line. The core of the line, drawn on an expanded scale in the direction of the dispersion, is shown at the lower right.

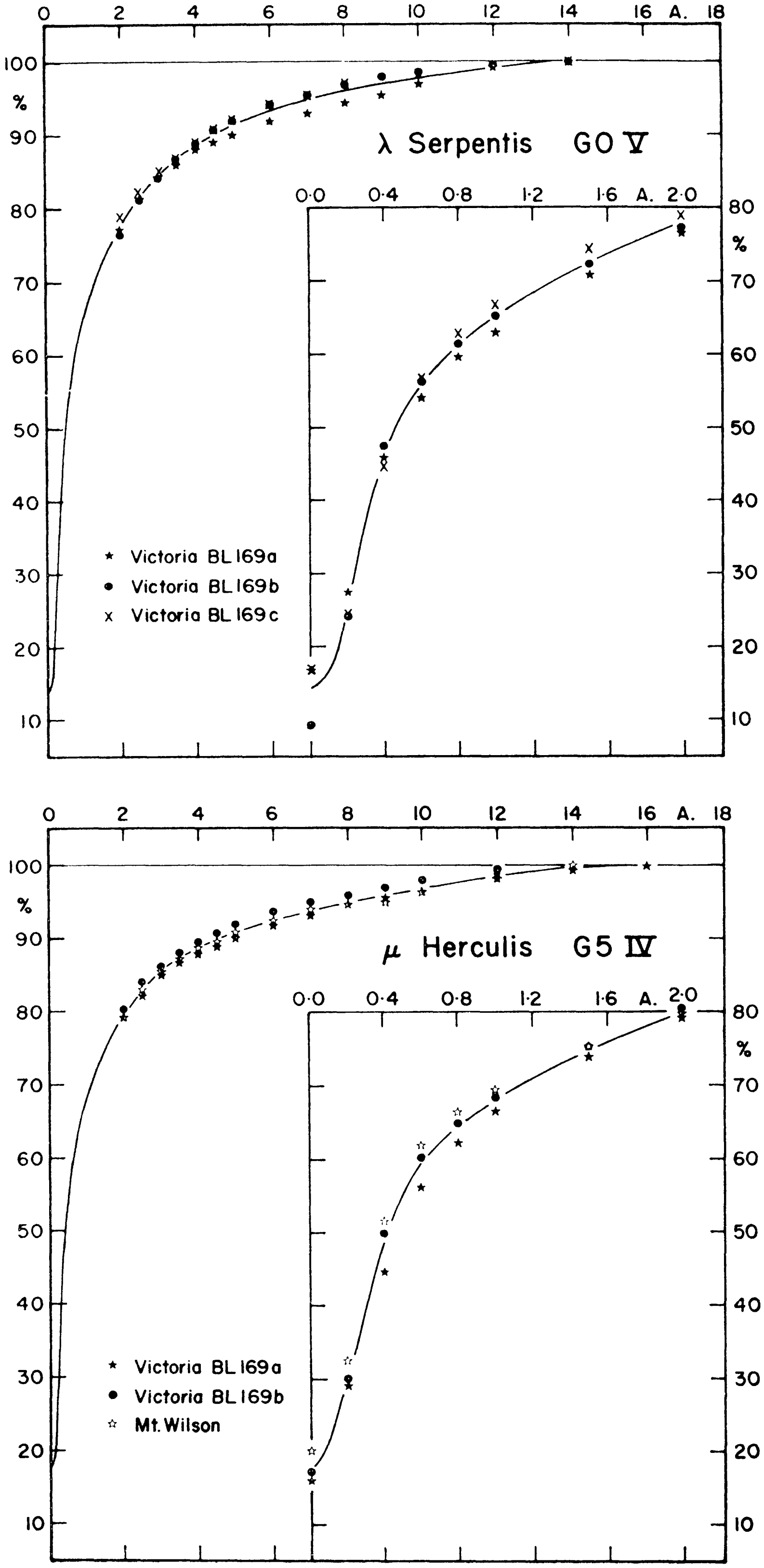


Figure 21

Observed profiles of Hγ in the spectra of λ *Serpentis*, G0 V, and μ *Herculis*, G5 IV. The observed profile, the mean of all observations indicated here, is shown as a solid line. The core of the line, drawn on an expanded scale in the direction of the dispersion, is shown at the lower right.

TABLE 10a. OBSERVED INTENSITIES OF Hγ PROFILES

Δλ	ρ LEONIS							γ PEGASI						ι HERCULIS			
A.	IIIL$_A$	BL84	BL169	BL496	Mt. Wilson	Scanner	Mean	IIIL$_A$	BL84	BL169 BL496	Mt. Wilson	Scanner	Mean	IIIL$_A$	BL169	9643	Mean
0	55.2	60.1	57.6	55.9	57.4	53.9	55.8	41.8	40.9	44.2	44.2	41.1	40.9	35.4	31.1	19.3	29.8
0.2	55.7	60.2	58.1	56.2	58.2	54.7	56.5	43.4	43.0	46.4	47.6	44.5	44.5	39.4	34.4	24.9	33.2
0.4	56.6	61.2	59.4	57.8	59.9	56.3	57.9	46.2	47.8	50.6	52.4	49.4	48.8	44.9	40.3	32.7	38.6
0.6	58.3	62.8	61.7	60.4	63.0	58.7	60.2	50.7	51.6	54.2	56.2	52.2	52.6	48.5	45.0	37.7	42.8
0.8	61.2	65.2	64.8	64.0	67.4	62.1	63.5	54.0	54.7	57.1	58.6	54.0	55.4	51.8	48.8	40.9	46.1
1.0	65.1	68.2	69.0	68.0	71.4	65.9	66.5	56.2	57.6	59.4	61.0	56.4	57.9	54.0	51.6	43.6	48.6
1.5	74.2	76.4	78.3	78.5	78.9	74.2	76.2	61.0	62.4	64.2	65.8	60.7	62.6	58.3	57.0	48.6	53.8
2.0	81.4	82.7	84.8	85.5	85.0	80.2	82.6	65.2	66.3	68.8	69.4	64.6	66.7	62.1	61.2	53.0	58.1
2.5	85.7	87.0	89.4	89.2	89.2	84.3	87.1	69.2	69.8	71.4	73.0	68.1	70.2	66.3	65.0	56.9	62.4
3.0	88.5	90.0	92.2	92.4	92.0	87.4	90.1	72.1	72.8	74.0	76.2	71.1	73.2	69.4	68.2	59.4	65.6
3.5	90.8	92.0	94.1	94.5	93.8	89.4	92.3	75.6	76.0	77.4	78.8	74.0	76.3	72.8	71.4	63.0	69.1
4.0	92.2	93.8	95.8	96.0	95.0	91.1	93.9	78.5	78.6	80.4	81.2	76.8	79.0	75.6	74.2	66.0	72.2
4.5	93.6	95.1	96.4	97.4	96.2	92.5	95.1	81.2	81.1	83.0	83.9	79.2	81.4	78.1	77.0	69.0	74.9
5.0	95.0	96.1	97.2	98.1	96.6	93.9	96.1	83.3	83.2	85.0	85.7	81.0	83.6	80.6	79.6	71.3	77.6
6.0	96.8	98.0	98.4	99.2	97.9	96.0	97.7	86.8	86.8	88.0	89.3	84.2	87.1	85.0	83.4	76.2	81.9
7.0	98.0	98.8	99.9	100.0	98.7	97.7	98.9	90.0	89.0	90.8	91.8	87.2	89.9	88.3	86.5	79.6	85.2
8.0	99.0	99.4	100.0	—	99.2	99.3	99.6	92.4	90.2	92.8	93.5	90.0	92.0	91.0	89.0	84.5	88.2
9.0	100.0	100.0	—	—	99.4	100.0	99.9	94.3	91.5	94.3	95.1	91.8	93.6	93.0	90.7	86.4	90.3
10.0	—	—	—	—	99.7	—	100.0	95.9	93.2	95.7	96.5	93.2	95.2	94.5	92.2	89.3	92.1
12.0	—	—	—	—	100.0	—	—	97.5	95.0	97.4	98.5	95.9	97.2	97.0	94.4	92.2	95.0
14.0	—	—	—	—	—	—	—	98.8	96.9	99.1	99.1	98.2	98.6	99.0	96.1	95.7	97.5
16.0	—	—	—	—	—	—	—	99.8	98.6	100.0	100.0	99.6	99.5	100.0	98.2	97.7	99.2
18.0	—	—	—	—	—	—	—	100.0	99.7	—	—	100.0	100.0	—	99.4	98.5	99.6
20.0	—	—	—	—	—	—	—	—	100.0	—	—	—	—	—	100.0	100.0	100.0

TABLE 10b. OBSERVED INTENSITIES OF H γ PROFILES

Δλ	γ GEMINORUM			68 TAURI				θ LEONIS				15 VULPECULAE				
A.	BL169	Scanner	Mean	BL169b	BL496	Mt. W. 71 B	Mean	IIIL$_A$	BL169	Palomar	Mean	IIIL$_A$	BL169	Mt. W. 71 B	Palomar	Mean
0	12.0	15.7	16.9	14.8	12.8	19.7	15.8	13.0	11.1	15.9	13.3	11.5	10.9	17.3	14.3	13.3
0.2	15.2	18.4	19.3	19.1	16.0	22.9	19.3	15.2	13.0	18.8	15.7	16.2	13.5	20.2	22.8	17.4
0.4	22.8	23.3	24.3	25.2	23.1	28.4	25.6	19.4	16.6	23.8	19.9	21.6	21.7	27.5	31.4	24.1
0.6	25.6	26.4	26.7	28.8	27.2	31.4	29.1	22.6	20.0	28.3	23.6	28.0	28.1	33.4	36.1	31.1
0.8	27.8	28.8	28.8	31.3	29.8	33.4	31.5	25.1	23.0	30.5	26.2	31.1	31.6	35.7	39.2	34.7
1.0	29.6	30.6	30.5	32.9	31.9	35.0	33.3	27.0	25.1	32.4	28.2	33.8	34.2	38.2	41.9	37.2
1.5	33.9	34.4	34.3	37.0	36.0	39.2	37.4	32.0	29.0	34.0	31.7	38.8	39.4	43.8	46.3	42.1
2.0	37.2	37.4	38.0	40.4	38.8	42.8	40.7	36.0	32.3	39.3	35.9	42.6	43.2	47.7	50.2	46.0
2.5	40.8	40.2	41.1	43.2	41.2	45.8	43.4	39.2	35.2	42.3	38.9	45.9	46.8	51.4	53.3	49.5
3.0	43.8	42.8	44.1	46.0	43.5	48.7	46.1	42.6	38.2	45.1	42.0	49.0	49.8	54.4	55.9	52.5
3.5	46.6	45.3	46.6	48.6	46.0	51.0	48.5	45.6	41.0	47.9	44.8	51.8	52.8	57.4	58.9	55.5
4.0	49.3	47.6	49.2	50.8	48.6	53.6	51.0	48.1	43.6	50.4	47.4	54.3	55.4	60.5	61.7	58.2
4.5	51.8	49.8	51.5	53.0	50.9	56.1	53.3	50.7	46.2	53.0	50.0	56.9	58.2	63.4	63.8	60.8
5.0	54.0	51.8	53.9	55.5	53.1	58.2	55.6	52.9	49.0	55.4	52.4	59.4	60.1	66.2	65.6	63.1
6.0	58.7	56.2	58.4	59.4	57.2	63.2	59.9	57.2	53.9	60.0	57.0	63.3	64.7	70.0	68.8	66.9
7.0	63.1	60.2	62.5	63.8	61.0	66.9	63.9	61.7	58.2	64.3	61.4	66.8	68.6	72.6	71.9	70.0
8.0	67.4	64.2	66.5	67.8	63.9	70.8	67.5	65.8	62.8	68.2	65.6	69.8	72.1	75.2	75.1	73.1
9.0	72.0	68.0	70.2	71.6	67.4	74.4	71.1	69.2	67.4	71.8	69.5	72.4	75.6	77.7	77.5	75.9
10.0	75.6	71.5	73.6	74.4	70.6	77.8	74.3	73.0	72.0	74.9	73.3	74.9	78.0	79.2	79.4	78.0
12.0	81.9	77.4	79.4	80.5	76.1	83.8	80.1	78.5	78.0	80.2	78.9	79.1	82.0	84.0	82.9	82.1
14.0	87.4	82.4	84.1	85.1	81.0	88.0	84.7	83.8	84.0	84.3	84.0	83.0	85.7	87.9	85.3	85.7
16.0	90.6	86.7	87.7	89.0	85.3	91.0	88.4	87.2	89.8	87.8	88.3	86.2	89.4	91.0	88.5	89.1
18.0	92.6	90.7	90.4	91.9	88.8	93.8	91.5	90.0	91.4	90.6	90.7	89.0	91.6	92.9	90.5	91.3
20.0	94.8	93.9	92.8	94.1	92.0	96.2	94.1	92.0	92.4	92.3	92.2	91.3	93.6	95.2	92.1	93.4
22.0	96.6	96.6	94.8	95.8	93.1	98.6	95.8	94.4	94.6	94.2	94.4	93.3	95.1	96.8	93.6	95.0
24.0	97.5	98.4	96.2	97.4	94.5	100.0	97.3	96.2	96.4	95.4	96.0	95.2	96.8	97.6	95.0	96.3
26.0	98.6	99.4	97.3	99.4	96.8	—	98.7	98.1	98.0	96.3	97.5	96.2	98.0	99.6	96.4	97.6
28.0	100.0	100.0	98.3	100.0	99.0	—	99.3	99.6	99.7	97.3	98.9	97.4	98.3	100.0	97.8	98.4
30.0	—	—	98.8	—	100.0	—	100.0	100.0	100.0	98.3	99.4	98.7	99.2	—	99.0	99.2
32.0	—	—	99.4	—	—	—	—	—	—	99.2	99.7	100.0	100.0	—	99.6	99.9
34.0	—	—	99.8	—	—	—	—	—	—	99.8	99.9	—	—	—	100.0	100.0
36.0	—	—	100.0	—	—	—	—	—	—	100.0	100.0	—	—	—	—	—

TABLE 10c. OBSERVED INTENSITIES OF Hγ PROFILES

Δλ A.	σ BOOTIS						α CANIS MINORIS						
	IIIL_A	BL169	BL496	Mt. Wilson	Palomar	Mean	IIIL_A	Wood	BL84	BL496	9663	Mt. Wilson	Mean
0.0	18.8	20.8	19.5	25.8	22.0	21.4	12.5	6.3	14.0	17.9	11.0	18.7	13.3
0.2	23.9	27.0	26.9	30.5	28.0	27.3	17.2	11.6	19.8	22.6	18.2	25.8	18.9
0.4	35.3	37.2	37.2	38.8	38.8	37.5	30.9	25.1	32.2	37.5	32.5	40.0	31.7
0.6	43.4	44.0	46.5	44.6	49.0	45.5	40.7	37.0	42.9	47.7	42.7	50.1	41.7
0.8	49.1	49.3	52.3	49.0	53.2	50.6	47.7	43.1	48.4	52.4	47.7	54.3	47.7
1.0	52.6	53.2	56.3	52.3	56.4	54.2	52.2	48.0	52.4	56.1	51.1	57.6	52.4
1.5	59.6	59.7	63.8	58.9	63.0	61.0	59.6	55.9	60.2	62.9	58.4	63.2	60.0
2.0	64.5	64.8	69.1	63.6	67.6	65.9	64.7	61.6	65.7	67.4	63.1	67.6	64.9
2.5	68.4	69.0	72.7	67.0	71.5	69.7	68.5	65.9	70.0	71.0	66.9	71.0	68.7
3.0	71.7	72.6	76.0	69.8	74.4	72.9	71.5	69.1	72.7	73.8	69.7	74.0	71.5
3.5	74.8	75.8	78.2	71.8	77.1	75.5	74.1	72.0	75.9	76.3	72.6	76.2	74.1
4.0	77.1	78.4	80.0	73.8	79.1	77.7	76.2	74.6	77.9	78.4	75.0	78.2	76.3
4.5	79.0	80.4	82.0	75.6	80.9	79.6	78.3	76.1	79.9	79.9	76.7	79.7	78.1
5.0	81.0	82.5	84.0	77.6	82.6	81.5	80.1	78.0	81.0	81.5	78.4	81.5	79.8
6.0	84.1	85.4	86.9	80.2	85.2	84.4	82.9	81.0	83.8	83.5	81.4	84.0	82.4
7.0	86.1	87.6	89.3	82.8	87.2	86.6	85.3	83.4	86.0	85.5	84.0	85.8	84.7
8.0	88.4	89.6	91.4	84.6	88.8	88.6	87.2	85.8	88.0	87.4	86.0	87.6	86.7
9.0	90.0	91.2	92.8	85.7	90.4	90.0	88.9	88.0	89.7	89.6	87.6	89.3	88.4
10.0	91.4	92.8	94.0	87.6	91.8	91.5	90.2	89.8	90.8	90.2	88.6	90.4	89.7
12.0	93.8	94.0	95.8	89.2	93.7	93.3	92.2	92.2	92.4	91.4	90.8	92.6	91.8
14.0	95.3	95.3	96.6	91.0	95.1	94.7	94.2	94.6	93.9	92.4	92.4	94.0	93.5
16.0	96.6	96.5	97.8	92.5	96.0	95.9	96.0	96.2	95.3	93.8	93.9	95.4	95.1
18.0	98.0	97.8	99.0	93.6	96.8	97.0	97.2	97.4	96.7	95.0	95.1	97.1	96.5
20.0	99.6	99.3	100.0	94.8	98.0	98.3	98.5	98.0	97.7	96.1	96.1	97.8	97.5
22.0	100.0	99.7	—	95.9	99.4	99.0	99.5	98.9	98.6	97.6	97.2	99.3	98.5
24.0	—	100.0	—	97.0	—	99.4	99.9	99.6	99.4	98.7	98.2	100.0	99.2
26.0	—	—	—	98.2	—	99.6	100.0	100.0	100.0	99.9	99.4	—	99.9
28.0	—	—	—	99.4	—	99.9	—	—	—	100.0	100.0	—	100.0
30.0	—	—	—	100.0	—	100.0	—	—	—	—	—	—	—

TABLE 10d. OBSERVED INTENSITIES OF Hγ PROFILES

$\Delta\lambda$ A.	110 HERCULIS					λ SERPENTIS				μ HERCULIS			
	BL84	BL169a	BL169b	Mt. Wilson	Mean	BL169a	BL169b	BL169c	Mean	BL169a	BL169b	Mt. Wilson	Mean
0.0	19.5	18.2	18.9	31.3	17.2	16.8	9.3	16.8	14.3	16.0	17.2	20.3	17.8
0.2	24.9	24.8	24.3	38.1	25.4	27.4	24.3	24.4	25.4	29.2	30.0	32.6	30.6
0.4	36.5	37.0	37.4	51.2	37.5	46.0	47.4	44.6	46.0	44.6	49.9	51.3	48.6
0.6	46.1	47.0	45.8	61.2	46.8	54.1	56.2	56.3	55.5	56.2	60.2	61.8	59.4
0.8	51.0	52.4	51.0	67.2	52.6	59.6	61.4	62.6	61.2	62.2	64.9	66.4	64.5
1.0	55.6	56.4	55.1	69.9	57.3	63.0	65.2	66.5	64.9	66.4	68.4	69.3	68.0
1.5	63.4	64.9	63.9	74.8	65.4	70.6	72.2	74.0	72.3	73.9	75.2	75.2	74.8
2.0	69.3	70.4	69.8	79.8	70.7	76.8	76.8	78.8	77.5	79.2	80.4	79.2	79.6
2.5	73.4	74.8	74.1	81.8	74.4	81.2	81.0	82.2	81.5	82.1	84.0	82.9	83.0
3.0	76.5	78.2	77.4	83.7	77.4	84.2	84.2	85.0	84.5	84.9	86.2	85.4	85.5
3.5	79.0	81.4	80.0	85.4	79.9	86.0	86.8	87.1	86.6	86.8	88.0	87.3	87.4
4.0	81.3	84.0	82.4	86.8	82.2	88.0	88.8	89.2	88.7	88.0	89.6	88.5	88.7
4.5	83.3	86.0	84.4	88.0	84.1	89.0	90.6	91.0	90.2	89.1	90.8	89.4	89.8
5.0	85.0	87.8	86.0	89.1	85.5	90.0	92.0	92.2	91.4	90.0	92.0	90.6	90.9
6.0	86.7	89.0	88.7	90.6	87.5	91.6	94.0	94.1	93.2	91.8	93.8	92.3	92.6
7.0	88.1	90.4	90.7	91.7	89.0	93.0	95.5	95.8	94.8	93.1	95.0	94.0	94.0
8.0	89.6	91.8	92.0	92.8	90.6	94.3	97.0	96.9	96.1	94.4	96.0	94.5	95.0
9.0	90.8	92.6	92.9	93.6	91.5	95.3	97.9	97.5	96.6	95.6	97.0	95.1	95.9
10.0	92.0	93.2	93.8	94.2	92.4	96.8	98.4	98.1	97.8	96.4	98.0	96.4	96.9
12.0	93.4	94.4	95.0	95.0	93.8	99.4	99.6	99.4	99.5	98.2	99.6	98.1	98.6
14.0	94.4	95.8	96.2	95.8	95.1	100.0	100.0	100.0	100.0	99.4	100.0	100.0	99.8
16.0	95.6	97.0	97.4	96.6	96.1	—	—	—	—	100.0	—	—	100.0
18.0	97.0	98.2	98.5	97.5	97.2	—	—	—	—	—	—	—	—
20.0	98.2	99.4	99.6	98.2	98.3	—	—	—	—	—	—	—	—
22.0	99.2	100.0	100.0	99.0	98.9	—	—	—	—	—	—	—	—
24.0	100.0	—	—	99.9	99.4	—	—	—	—	—	—	—	—
26.0	—	—	—	100.0	99.7	—	—	—	—	—	—	—	—
28.0	—	—	—	—	99.8	—	—	—	—	—	—	—	—
30.0	—	—	—	—	100.0	—	—	—	—	—	—	—	—

published profiles of Hγ for ρ *Leonis*, γ *Pegasi*, and γ *Geminorum*. McDonald (1955) published a profile of Hγ in the spectrum of ι *Herculis*, based on two-prism plates taken at Victoria.

Although the agreement of the individual observations is not as good as one might wish, it seems to be no worse than should be expected in view of the differences found for the equivalent-width measurements in Table 7. However it should be noted that the Hγ profile is sometimes deeper for certain spectrographic combinations even though the mean equivalent widths shown in Table 9 are less than average. An examination of the original data shows that in these cases the equivalent widths in the region near Hγ are also greater than the average values listed in Table 7. Thus it would appear that the differences are the result of variations in the adopted position of the continuum rather than of calibration effects, which could produce different results for strong and weak lines.

The Hγ profiles measured by different authors do vary by a few per cent, and this variation results in considerable differences in the extent of the wings. It would seem, however, that these differences are rather less than those observed for other lines. Thus a comparison of the profile of a broad line such as Hγ may be at least as valid a test of calibration procedures as the measurement of many equivalent widths.

The observed profiles of Hγ shown in Figures 16 to 21 should be as accurate as any other published profiles. Although they have not been corrected for instrumental effects produced by the finite slit width, these effects should be inappreciable even in the core of the sharpest hydrogen lines shown here. Since this paper is intended only as a compilation of observational data, with a brief discussion of differences between observers and instruments, no comparisons with theory are made here. However a comparison of observed profiles with profiles calculated for appropriate model atmospheres, such as were computed by Searle and Oke (1962) should be most valuable.

VII. SUMMARY AND CONCLUSIONS

This paper has presented nearly complete equivalent-width data, in the spectral region 3900A-4500A., for representative main-sequence stars of spectral types B2 to G5 and one supergiant B1 star. Observations were made with five spectrographic combinations attached to the 72-inch telescope and two combinations of the coudé spectrograph of the 48-inch telescope at Victoria as well as with the spectrographs and photoelectric scanner of the Mount Wilson and Palomar Observatories. Intensity tracings have been made from all spectrograms using standard reduction procedures, and the continuum has been drawn in a similar fashion for each tracing. The measurement of equivalent widths has also been standardized as much as possible. For the Victoria data, standard profiles have been drawn and measures of individual lines have been made by interpolation from the standard profiles. For the Mount Wilson and Palomar plates, and for the Victoria three-prism spectrograms, the lines have been assumed to be triangular in shape and the resulting equivalent widths have been corrected either by calculation or by empirical correction. The equivalent widths of strong lines have been measured directly with the planimeter. The original observational material has been illustrated by a series of spectra and intensity tracings. Profiles of the hydrogen Hγ line have also been presented both in diagrammatic and tabular form.

The results have been compared for the different spectrographic combinations, and with data published by other observers. Although quite large differences may occur between the equivalent widths of the same line in the spectrum of a star measured on different spectrograms, most of the results based on several spectrograms of high-dispersion agree within five per cent of the adopted mean equivalent widths. Results obtained by the first investigators in the field of spectrophotometry using low-dispersion spectrograms do not agree nearly so well. The reasonably good agreement of the present data, however, arises from the treatment of all the mater al in a quite homogeneous manner. These results give high weight to the Victoria observations since the bulk of the material was obtained at the Dominion Astrophysical Observatory. The equivalent-width data thus represent the results obtained when the procedures set up at this Observatory are consistently followed. For spectra of which the continua can be readily defined, similar results should be obtained elsewhere, but for late-type spectra, where the many lines affect the position of the continuum over almost the whole spectral region covered in this paper, the results may depend not only on the dispersion used, but also on the techniques employed in drawing the continuum and the lines. The interagreement of measures of the $H\gamma$ profiles is much better for all observations, both early and modern. This line is so broad that its shape in a given spectrum, is almost independent of the dispersion. Measures of strong lines by different observers, especially in early type spectra, agree better than do measures of weak lines.

The principal conclusion to be drawn from the present observations and the comparisons with other published data seems to be that only lines with equivalent widths greater than 100 mA. can be considered to give reliable intensities unless high-dispersion (10 A/mm or better) spectrograms are employed. Since, for detailed quantitative analysis of abundances in stellar atmospheres, both strong and weak lines are required, and since the theory involved in this analysis is applied more readily to weak lines, it would seem that most quantitative studies of this kind should be undertaken only when high-dispersion spectra are available. The present comparisons do show that moderately consistent results can be obtained with different instruments if care in the calibrations and in the reduction of the data is taken. Although the coarse grain and the non-uniformity of the photographic plates used for most astronomical spectrograms are undoubtedly the source of many of the differences that are found when the various results are compared, the large range in equivalent widths such as have been found even between the different sets of Victoria observations, where several spectra have been combined to form one such set, would seem to indicate that it may be necessary to consider other sources of error that have not been studied in detail recently. The intermittency effect, changes in slope of the characteristic curve and other sources of error, photographic and instrumental, may require more careful study when an accuracy better than five pe · cent is required. Great care is required in setting up suitable calibration procedures, but once a calibration system has been shown to be adequate, it is usually sufficient to check the uniformity of the calibration pattern at the camera occasionally, by removing the step-sector, step-weakener, V-wedge or whatever the calibrating device may be.

The equivalent-width data presented in Tables 2 to 5 have been prepared for the former Sub-Committee on Line Intensity Standards of Commission 29 (Stellar Spectra) of the International Astronomical Union. It is hoped that the moderately strong unblended lines ($>$ 100 mA.) and the hydrogen Hγ profiles in the spectra of these stars will be suitable for use as standards that may be compared with results obtained by workers at other observatories. Although the present adopted equivalent widths cannot be considered as definitive, they should be useful for comparison purposes. If such comparisons are made, and related to data used in the calculation of atomic abundances in stellar atmospheres, then it should be possible to define a uniform system, and abundance differences in stellar atmospheres should become more easily detectable, even when observations made at different observatories are used.

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