The Third Spectrum of Cerium (Ce III)

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Thirty-three triplet and singlet terms of Ce III have been recognized, and account for 294 lines, including almost all of wave-length exceeding 2000A. The *electron configurations* $4f5d$, $4f6p$, $(5d)^2$, $4f6s$, $4f6d$, and $5d6s$, have been almost completely identified. The last three show evidence of JJ coupling. *Zeeman data* by de Bruin and King confirm the classification. The *lowest known level* is $4f5d\ {}^1G_4$ and the *ionization potential* from this to $4f\ {}^2F_{2\frac{1}{2}}$ of Ce IV is 19.5 volts. *The* $(4f)^2$ *configuration may be lower*, but has not been discovered, as its combinations lie in the infrared and the far ultraviolet. *The ultimate lines must be in the infrared*, as is probably the case for the third spectrum of most of the rare earths.

MANY strong lines of cerium in the ultraviolet evidently arise from doubly ionized atoms. A list of these was published by A. S. and R. B. King in 1932.[1] The first attempt to analyze the spectrum was made by Kalia,[2] who found a considerable array of energy levels. Almost all these are real, although their interpretation by means of electron configurations and terms requires change.

Recently de Bruin[3] has published observations of the Zeeman effect, which he employs to correct Kalia's term designations (while confirming his energy levels). The g values, though somewhat perturbed, suffice for unequivocal identification of the term components.

The present work was begun more than three years ago. It is based upon the observations of the Kings at Mount Wilson and on measures with the vacuum spectrograph at Edmonton by Lang, and has resulted in the classification of all but a few weak lines with wave-lengths greater than 2100A, and many beyond this.

In the region of longer wave-length the lines fall into two classes, one sharp, the other diffuse. From general experience it was certain in advance[4] that the former arise from transitions between low and middle energy-levels, and the latter from transitions between these and higher levels. It was soon found that the sharp and diffuse lines corresponded to transitions from Kalia's "low" levels to other groups lying on opposite sides of them, showing that these were really the middle levels and that Kalia's energy scheme was upside down.

The same correction has been made by de Bruin without, however, identifying the high levels or all the lower ones.

An extensive scheme of levels was thus developed. They should form a system of triplets and singlets. To group these into terms was not easy. As might be expected for so heavy an atom, the separations of the components are very wide; the interval rules are not even roughly obeyed; the various terms overlap extensively, and intersystem combinations are strong. Some tentative multiplets were picked out and confirmed by Zeeman observations. These measures [obtained by one of us (R.B.K.) in Pasadena] did not completely resolve any patterns and hardly permitted the calculation of exact g values; but they settled without doubt which levels had the larger inner quantum numbers and showed that the arrangement of the components was "normal" —as might have been assumed in advance, since Ce III is a two-electron system. It was not, however, till the analysis was far advanced that the actual J values could be determined.

It finally became clear that the lowest levels represented a group of triplet and singlet $P\ D\ F\ G\ H$ terms, of which the lowest is the ${}^1G$

[1] A. S. and R. B. King, Astrophys. J. **75**, 40 (1932); Mt. Wilson Contribution No. 441.
[2] Kalia, Ind. J. Phys. **8**, 137 (1933).
[3] de Bruin, Proc. Kon. Akad. Wet. Amsterdam **40**, 334 (1937).
[4] Astrophys. J. **75**, 44 (1932); Mt. Wilson Contribution No. 441, p. 5.

term. Above these and conspicuously isolated were a ^3F and ^1F. The lowest of the middle terms was ^3F, followed by ^3P, $^3G\,^3F\,^3D$, ^1F and two ^1D and ^1G terms.

This unprecedented arrangement can be completely explained if the electron configuration of lowest energy is $4f5d$, followed by $4f6s$. The middle levels are then $5d^2$ and $4f6p$, which account for everything, except one ^1S term predicted and not found (as usually happens). This analysis was completed long before the publication of de Bruin's work, which agrees completely in the assignment of the configurations $4f6s$ and $4f6p$. His unclassified term X_4 is our $d^2\,^1G_4$.

A considerable portion of the array $4f5d-4f6p$

TABLE I. *Relative Terms in the Ce III Spectrum.*

Electron Configuration	Term	Level	Level Separations	g Obs.
$4f5d$	$^1G_4^0$	*0.00*		
$4f5d$	$^3F_2^0$	*545.06*	1680.54	
	$^3F_3^0$	*2225.60*	1647.95	
	$^3F_4^0$	*3873.55*		
$4f5d$	$^3H_4^0$	*1850.80*	1233.70	
	$^3H_5^0$	*3084.50*	1989.17	
	$^3H_6^0$	*5073.67*		
$4f5d$	$^3G_3^0$	*2988.50*	1571.53	
	$^3G_4^0$	*4560.03*	1488.83	
	$^3G_5^0$	*6048.86*		
$4f5d$	$^1D_2^0$	*3294.49*		
$4f5d$	$^3D_1^0$	*5645.27*	978.37	
	$^3D_2^0$	*6623.64*	226.09	
	$^3D_3^0$	*6849.73*		
$4f5d$	$^3P_0^0$	*8300.30*	35.47	
	$^3P_1^0$	*8335.77*	1028.89	
	$^3P_2^0$	*9364.66*		
$4f5d$	$^1F_3^0$	*9223.85*		
$4f5d$	$^1H_5^0$	*12875.22*		
$4f5d$	$^1P_1^0$	*15166.50*		
$4f6s$	$^3F_2^0$	*15958.27*	228.25	0.665
	$^3F_3^0$	*16186.52*	2012.08	1.07
	$^3F_4^0$	*18198.60*		1.27
$4f6s$	$^1F_3^0$	*18571.47*		1.035
$(5d)^2$	$^3F_2$	37163.31	1498.32	
	$^3F_3$	38661.63	1578.82	
	$^3F_4$	40240.45		
$(5d)^2$	$^1D_2$	43612.74		
$(5d)^2$	$^3P_0$	44798.84	598.09	
	$^3P_1$	45396.93	1369.59	
	$^3P_2$	46766.52		
$4f6p$	$^3G_3$	44989.30	4173.93	0.87
	$^3G_4$	49163.23	1752.88	1.135
	$^3G_5$	50916.11		1.21
$4f6p$	$^3F_2$	45127.12	2857.23	0.85
	$^3F_3$	47984.35	27.43	0.29
	$^3F_4$	48011.78		1.90
$(5d)^2$	$^1G_4$	46780.19		1.06

Electron Configuration	Term	Level	Level Separations	g Obs.
$4f6p$	$^1F_3$	47097.24		1.16
$4f6p$	$^3D_1$	48654.50	−291.63	0.40
	$^3D_2$	48362.87	1975.48	0.99
	$^3D_3$	50338.35		1.24
$4f6p$	$^1G_4$	51271.60		1.05
$4f6p$	$^1D_2$	51278.60		1.08
$5d6s$	$^3D_1$	60056.73	675.52	
	$^3D_2$	60732.25	1540.12	
	$^3D_3$	62272.37		
$5d6s$	$^1D_2$	62556.2		
$4f6d$	$^3F_2^0$	*86070.10*	312.26	
	$^3F_3^0$	*86382.36*	2177.36	
	$^3F_4^0$	*88559.72*		
$4f6d$	$^3D_1^0$	*86315.47*	628.07	
	$^3D_2^0$	*86943.54*	1857.15	
	$^3D_3^0$	*88800.69*		
$4f6d$	$^3G_3^0$	*86463.55*	343.27	
	$^3G_4^0$	*86806.82?*	2093.58	
	$^3G_5^0$	*88900.40*		
$4f6d$	$^3H_4^0$	*86765.35*	613.72	
	$^3H_5^0$	*87379.07*	1867.48	
	$^3H_6^0$	*89246.55*		
$4f6d$	$^3P_0^0$	—		
	$^3P_1^0$	*87598.66*	1826.69	
	$^3P_2^0$	*89425.35*		
$4f6d$	$^1F_3^0$	*88642.27*		
$4f6d$	$^1G_4^0$	*88480.12*		
$4f6d$	$^1D_2^0$	*88738.90*		
$4f6d$	$^1H_5^0$	*89946.60*		
	1^0	*88455.93*		
	2_3^0	*88674.42*		
$5d6p$?	3_1^0	*92288.61*		
	4_2^0	*92548.41*		
	5_3^0	*92744.25*		
	6_2^0	*93097.15*		
	7_3^0	*94686.28*		
	8_4^0	*95890.54*		
	9_2^0	*97689.62*		
	10_1^0	*98967.75*		

Table II. *Intensities in multiplets of Ce III.*

		$(5d)^2$								4f6p													
		^3F			^3P			^1G	^1D	^3G			^3F			^3D			^1G	^1F	^1D
4f5d	J	4	3	2	2	1	0	4	2	5	4	3	4	3	2	3	2	1	4	3	2
$^3H^0$	6									100											
	5							12		9	75		40						4		
	4	4								5	2	20	5	100		15			10	12	
$^3G^0$	5	100†						15		[135]	30		12						15		
	4	10	100					15		2	15	[15]	20	25		15			3	35	
	3		10	80					[8]		2	30			35	5*	20		2		
$^3F^0$	4	50	25					6		15*	20		20	2		30			25	7	
	3	4	60	15				4				12	12	15	6	m	20			20	18
	2		4	60	2d							18		3	25		8	15			
$^3D^0$	3		2		6			10	60		40	15	10	15	[2]	10	12			20	3
	2				3	30								10d*	[2]		25	10		20	15
	1					4	12								18			15			[3]
$^3P^0$	2		4		10	8						1		2		30	6	[8]		50	15
	1				4		5		8						10		20	15*			3
	0					6												12			
$^1H^0$	5							15			80		10						400		
$^1G^0$	4	5						30			25	40	7	35*		15			30	12	
$^1F^0$	3				30				30			8		6		35	[3]		18	4	18
$^1D^0$	2								50*			3		10		15*	20	12		8	35
$^1P^0$	1				2										1		8				150
4f6s																					
$^3F^0$	4							60		600	400		150	m		200			200	200	
	3				2			4			500	300	250	200	150	10	200		80	7	
	2				3							150		400	125		200	100		3	
$^1F^0$	3				3			80	m		6h		50	20		300			200	100	125
4f6d																					
$^3H^0$	6									150h											
	5									m	60h		20h								
	4									[2]	3h	2h		80h							
$^3G^0$	5							6h		30h	4h		10h						[12]		
	4										20h*	1*		20h			20h§			1h	
	3											30h			10h		4h		1h		
$^3F^0$	4									20h*	2h		4h						2h	6h	
	3										10h		2h		10h				3h		
	2													3	20h			1			
$^3D^0$	3										4h					30h			10h		
	2													2h	1		15h	4h			
	1																4h	6h			
$^3P^0$	2															30h					2h
	1																5h	4h			
	0																				
$^1H^0$	5							8											70h		
$^1G^0$	4																		10h	60h	
$^1F^0$	3																		4h	20h	2h
$^1D^0$	2																			10h	8h

† Blend with Ce II. * Blend. *m* Masked. § May be accidental.

extends into the vacuum region, as far as 1950A. Lang's measures complete it, and leave very few lines of the super-multiplet missing.

The high levels, like the low, are odd. They can be matched in a fairly satisfactory way with the configuration $4f6d$. The intensities are irregular (which is not surprising) and the assignments of some levels (such as that here called $^3G_4{}^0$) are uncertain, but the general scheme appears to be reliable. Later study revealed higher middle terms ^3D, ^1D evidently from $5d6s$, giving good multiplets, and combining with still higher levels (about 95,000) which probably belong to $5d6p$—though they are not completely enough known to group into terms.

The scheme thus developed accounts for 294 lines including all those of any strength in wavelength exceeding 2000A. Under ordinary circumstances, it might be concluded that the spectrum was almost completely analyzed. But no evidence at all has been found of the $(4f)^2$ configuration. This might be expected to be very low—as $4f$ is nearly 50,000 cm^{-1} below $5d$ in Ce IV. Failure to find it can be explained only by assuming that it is so nearly at the same level as $4f5d$ that the transitions between the two give lines lying exclusively in the infrared. In this case the $(4f)^2$ terms could be detected only by their combinations with $4f6d$, which would have wave numbers of the order of 90,000. The $4f5f$ configuration should then be almost superposed upon $4f6d$, and be observable only by the combinations with $4f5d$—also far in the Schumann region. The spectrum of the cerium hot-spark in this region is very rich, but it has not yet been practicable to disentangle such combinations from it.

The lowest observed level, $df\ ^1G^0$, may therefore not be the ground level, although all known strong lines of easy excitation have been accounted for. A similar situation exists in La III, where the $4f\ ^2F$ term has not yet been found, and may be lower than $5d\ ^2D$; and the same may happen in the third spectra of other rare earths. As the analysis of Ce III stands, it affords the first exception to Hund's rule that the lowest level of the ground configuration is that of highest L value among the terms of greatest multiplicity.

The term values finally adopted are given in Table I. The terms are grouped separately, in order of the lowest level in each—though the high odd levels, for which the term assignments are not always certain, might as well have been arranged in the order of the individual energy levels.

The usual custom of denoting the terms by letters has been deliberately avoided, since it is not certain whether the $4f5d$ group is the lowest

TABLE III. *Levels in each configuration measured from lowest level within it.*

$4f5d$			$4f6p$			$4f6s$			$(5d)^2$			$5d6s$		
Term	Ce III	La II	Term	Ce III	La II	Term	Ce III	La II	Term	Ce III	La II	Term	Ce III	La II
$^1G_4{}^0$	0	0	$^3G_3$	0	0	$^3F_2{}^0$	0	0	$^3F_2$	0	0	$^3D_1$	0	501
$^3F_2{}^0$	545	612	$^3F_2$	138	335	$^3F_3{}^0$	228	227	$^3F_3$	1498	1016	$^3D_2$	675	1197
$^3H_4{}^0$	1850	1226	$^1F_3$	2408	1757	$^3F_4{}^0$	2240	1551	$^3F_4$	3077	1971	$^3D_3$	2216	1856
$^3F_3{}^0$	2225	1636	$^3F_3$	2995	1502	$^1F_3{}^0$	2613	1626	$^1D_2$	6449	10095	$^1D_2$	2500	0
$^3G_3{}^0$	2988	3803	$^3F_4$	3022	2338				$^3P_0$	7636	5249			
$^3H_5{}^0$	3084	1981	$^3D_2$	3373	2769				$^3P_1$	8234	5718			
$^1D_2{}^0$	3294	2296	$^3D_1$	3665	3081				$^3P_2$	9603	6227			
$^3F_4{}^0$	3873	2615	$^3G_4$	4174	1720				$^1G_4$	9617	7473			
$^3G_4{}^0$	4560	4732	$^3D_3$	5349	3950				$^1S_0$	—	—			
$^3H_6{}^0$	5073	3150	$^3G_5$	5927	3565									
$^3D_1{}^0$	5645	4842	$^1G_4$	6283	3769									
$^3G_5{}^0$	6048	5683	$^1D_2$	6289	5005									
$^3D_2{}^0$	6623	5507												
$^3D_3{}^0$	6849	5938												
$^3P_0{}^0$	8300	6084												
$^3P_1{}^0$	8335	6106												
$^1F_3{}^0$	9223	7923												
$^3P_2{}^0$	9364	6647												
$^1H_5{}^0$	12875	11926												
$^1P_1{}^0$	15166	10824												

—in which case the rules assign to its terms the letters *a*, *b*, *c*,—or next to the lowest when they get the letters *z*, *y*, *x*. The electron configurations —which are securely known in this relatively simple spectrum—are used instead. In the abbreviated form $fs=4f6s$, $fp=4f6p$, $fd=4f5d$, $d^2=(5d)^2$, and $f\cdot d=4f6d$.

The *g* values derived by de Bruin are added for completeness.

The intensities of the combinations between the terms of the configurations d^2, fp, and fd, fs, $f\cdot d$ are given in Table II. King's estimates are in Roman figures, Lang's in italics. As the two are on different scales, all the lines in a given multiplet have been recorded (when possible) on the same system.

The relative arrangement of the levels belonging to the same configuration is strikingly similar in La II and Ce III. Table III gives the levels in each configuration, measured from the lowest level within it, in the order in which they appear in Ce III. The order in La II is very nearly the same. The discordance for $d^2\,{}^1D$, ds^1D arises from a well-known perturbation in La II—where there is also a perturbation between fd^3F_4, fd^3G_4. The $(4f)^2$ configuration in La II extends from e^3H_4 at 55107 to f^3P_2 (62506) and g^1S_0 (69505). The corresponding terms in Ce III should be more widely spaced, and range over about 12,000 units (not counting the ${}^1S_0$). If their median were more than about 10,000 units away from that of $4f5d$, some of the combinations should be observable in the deep red.

The general arrangement of the terms in the fd, fp, and d^2 configurations indicates an approximation to *LS* coupling, as Condon and Shortley[5] have shown to be the case for La II. The fs and ds groups, however, approach *JJ* coupling, and the same is true for $4f6d$. Here the singlets, and the component of highest *J* in the triplets, lie between 88480 and 89946, while the other components of the triplets are all between 86070 and 87598. The means for the groups, 88971 and 86747, differ by 2224, while the separation of the parent $4f^2F$ term in Ce IV is 2253.[6] For $4f6s$ the corresponding difference is 2193.

The application of a Rydberg formula to the corresponding components of the $4f5d$ and $4f6d$ terms gives values for the upper limit ranging from 173800 to 170400, with mean 172500, and for the lower limit 171900 to 168800, mean 170500. This corresponds to an ionization potential of 21.0 volts from fd^1G_4 of Ce III to $f^2F_{2\frac{1}{2}}$ of Ce IV.

It is however certain that the Rydberg denominator n^* increases considerably from $5d$ to $6d$. The increase Δn^* in the comparable case of La II has been estimated as 0.15,[7] though it may be as great as 0.20. Taking the mean of the nine levels with limit ${}^2F_{3\frac{1}{2}}$, and of the nine with limit ${}^2F_{2\frac{1}{2}}$, we find easily with the aid of the Rydberg tables[8]

Limit	${}^2F_{3\frac{1}{2}}$		${}^2F_{2\frac{1}{2}}$
mean for $5d$	6289		3984
mean for $6d$	88971		86747
n^*	2.5142		2.5133
	3.6642		2.6633
Terms	156240		156357
	73557		73593
Limit	162529		160341
Level in Ce IV	2253		0
I.P.	160276		160341
Mean	160308	=	19.77 volts

If Δn is assumed to be 0.20, the I.P. is 157450 or 19.42 volts. The f^2 configuration may be as much as a volt lower than fd, but not two volts. The approximate value 20 ± 1 volts may therefore be adopted. This is lower than any other third ionization potential except that of La III (19.1).

The isoelectronic sequence Ba I, La II, Ce III, is of unusual interest. In Ba I the lowest configurations are $(6s)^2$ and $6s5d$; in La II, $(5d)^2$ and $5d6s$; in Ce III, so far as known, $4f5d$ and $4f6s$. These three spectra, though similar in nature, are all very different in detail. The next member of the sequence, Pr IV, will have $(4f)^2$ as the low configuration, and again be quite different.

A list of all the classified lines of Ce III is given in Table IV. The first column gives the wave-length according to King and King; the second, the decimal part from Lang's unpublished measures; the third, King's intensity in the spark in air; the fourth, Lang's intensity in the vacuum spark, or, in a few cases, in the spark in nitrogen (denoted by parentheses) or in air (by brackets). Next follows the wave number

[5] Shortley, Phys. Rev. **37**, 1025 (1931).
[6] Lang, Can. J. Res. **A14**, 127 (1936).

[7] Russell and Meggers, Nat. Bur. Stand. J. Research **9**, 664 (1932).
[8] Princeton, 1934.

TABLE IV. *Classified lines of Ce III.*

λ King	λ Lang	Intensity King	Intensity Lang	Wave Number Vac.	Wave Number $o-c$ King	Wave Number $o-c$ Lang	Multiplet Designation
3543.999		80		28208.68	−0.04		$fs^1F_3^0 - d^2\,^1G_4$
3504.596		100		28525.83	+0.06		$fs^1F_3^0 - fp^1F_3$
3497.755		60		28581.62	+0.03		$fs^3F_4^0 - d^2\,^1G_4$
3470.894		300		28802.80	+0.02		$fs^3F_3^0 - fp^3G_3$
3459.374		200		28898.71	+0.07		$fs^3F_4^0 - fp^1F_3$
3454.368		150		28940.59	−0.01		$fs^3F_3^0 - fp^3F_2$
3443.609		150		29031.01	−0.02		$fs^3F_2^0 - fp^3G_3$
3427.332		125		29168.88	+0.03		$fs^3F_2^0 - fp^3F_2$
3412.334		4		29297.08	+0.11		$fd^3P_2^0 - d^2\,^3F_3$
3398.910		20		29412.79	−0.09		$fs^1F_3^0 - fp^3F_3$
3395.735		50		29440.28	−0.03		$fs^1F_3^0 - fp^3F_4$
3356.410[1, 2]		6		29785.21	−0.54		$(fs^3F_4^0 - fp^3F_3)$
3353.262		150		29813.17	−0.01		$fs^3F_4^0 - fp^3F_4$
3336.742		1		29960.77	+0.15		$fd^1P_1^0 - fp^3F_2$
3280.78		2		30471.81	−0.07		$ds^3D_3 - 5_3^0$
3269.129		2		30580.40	+0.40		$fs^3F_3^0 - d^2\,^3P_2$?
3267.92		6*h*		30591.72	−0.04		$fs^1F_3^0 - fp^3G_4$
3267.72		4		30593.59	−0.08		$fs^3F_3^0 - d^2\,^1G_4$
3244.950		3		30808.26	+0.01		$fs^3F_2^0 - d^2\,^3P_2$
3234.161[3]		7		30911.03	+0.31		$fs^3F_3^0 - fp^1F_3$?
3228.564		400		30964.61	−0.02		$fs^3F_4^0 - fp^3G_4$
3210.48		3		31139.02	+0.05		$fs^3F_2^0 - fp^1F_3$
3168.02		25*h*		31556.36	0.00		$ds^3D_2 - 3_1^0$
3163.644		2		31600.00	−0.02		$fd^1P_1^0 - d^2\,^3P_2$
3147.05		300		31766.62	−0.26		$fs^1F_3^0 - fp^3D_3$
3143.956		200		31797.88	+0.05		$fs^3F_3^0 - fp^3F_3$
3142.551		2		31812.09	+0.19		$fd^3D_3^0 - d^2\,^3F_3$
3141.247		250		31825.30	+0.04		$fs^3F_3^0 - fp^3F_4$
3122.93		4*h*		32011.96	−0.04		$ds^3D_2 - 5_3^0$
3121.548		400		32026.13	+0.05		$fs^3F_2^0 - fp^3F_3$
3110.516		200		32139.71	−0.04		$fs^3F_4^0 - fp^3D_3$
3106.974		200		32176.35	0.00		$fs^3F_3^0 - fp^3D_2$
3088.86		5*h*		32365.04	+0.14		$ds^3D_2 - 6_2^0$
3085.089		200		32404.60	0.00		$fs^3F_2^0 - fp^3D_2$
3076.82		6*h*		32491.68	0.00		$ds^3D_1 - 4_2^0$
3057.575		100		32696.18	−0.05		$fs^3F_2^0 - fp^3D_1$
3057.214		200		32700.04	−0.09		$fs^1F_3^0 - fp^1G_4$
3056.556		125		32707.08	−0.05		$fs^1F_3^0 - fp^1D_2$
3055.585		600		32717.47	−0.04		$fs^3F_4^0 - fp^3G_5$
3031.559		500		32976.76	+0.05		$fs^3F_3^0 - fp^3G_4$
3025.73		8		33040.28	−0.14		$ds^3D_1 - 6_2^0$
3022.736		200		33073.01	+0.01		$fs^3F_4^0 - fp^1G_4$
3011.493		8		33196.48	+0.11		$fd^1P_1^0 - fp^3D_2$
2973.716		50		33618.17	0.00		$ds^3D_3 - 8_4^0$
2948.564		15		33904.93	−0.04		$fd^1H_5^0 - d^2\,^1G_4$
2944.3		15		33954.0	0.0		$ds^3D_2 - 7_3^0$
2931.558		100		34101.60	0.00		$fd^3G_4^0 - d^2\,^3F_3$
2927.258		10		34151.70	−0.13		$fs^3F_3^0 - fp^3D_3$
2925.283		80		34174.75	−0.06		$fd^3G_3^0 - d^2\,^3F_2$
2923.84		100		34191.62	+0.03		$fd^3G_5^0 - d^2\,^3F_4$
2907.064		30		34388.92	+0.03		$fd^1F_3^0 - d^2\,^1D_2$
2873.722		25		34787.89	−0.19		$fd^3F_4^0 - d^2\,^3F_3$
2861.416		15		34937.50	−0.21		$fd^3F_3^0 - d^2\,^3F_2$
2849.372		80		35085.17	+0.09		$fs^3F_3^0 - fp^1G_4$
2847.3		3*h*		35110.7	−0.1		$fp^1G_4 - f\cdot d^3F_3^0$
2845.19		10		35136.73	+0.17		$fd^1H_5^0 - fp^3F_4$
2840.7		1*h*		35192.3	+0.3		$fp^1G_4 - f\cdot d^3G_3^0$
2833.868		8		35277.11	+0.14		$fd^3P_1^0 - d^2\,^1D_2$
2822.648		8		35417.33	+0.08		$ds^3D_3 - 9_2^0$
2806.3		1		35623.6	−1.0		$fd^3P_2^0 - fp^3G_3$
2802.408		10*s*		35673.11	−0.02		$fd^3G_3^0 - d^2\,^3F_3$
2801.824		10*s*		35680.54	+0.12		$fd^3G_4^0 - d^2\,^3F_4$
2795.158		8		35765.63	+0.18		$fd^1F_3^0 - fp^3G_3$

[1] This line is due to Ce II and masks the expected line of Ce III.
[2] Parentheses in last column denote that line is masked.
[3] Near strong line of Ce II.

TABLE IV—(*Continued*).

λ King	λ Lang	Intensity		Wave Number Vac.	Wave Number $o-c$		Multiplet Designation
		King	Lang		King	Lang	
2788	66		2	35849.0		[−0.2]	$fp^3G_5 - f\cdot d^3H_4^0$
2774.473		8s		36032.26	−0.01		$fd^3P_2^0 - d^2\,{}^3P_1$
2768.339		150		36112.10	0.00		$fd^1P_1^0 - fp^1D_2$
2754.912		80		36288.10	+0.09		$fd^1H_5^0 - fp^3G_4$
2748.936		50s		36366.98	+0.08		$fd^3F_4^0 - d^2\,{}^3F_4$
2743.736		60s		36435.90	−0.13		$fd^3F_3^0 - d^2\,{}^3F_3$
2741.688		5		36463.11	+0.04 +0.15		$fd^3P_1^0 - d^2\,{}^3P_0$ $(fp^3G_5 - f\cdot d^3H_5^0)$
2730.069		60s		36618.29	+0.04		$fd^3F_2^0 - d^2\,{}^3F_2$
2719.329		60s		36762.90	−0.11		$fd^3D_3^0 - d^2\,{}^1D_2$
2717.22		10		36791.44	+0.09		$fd^3P_1^0 - fp^3F_2$
2705.026		2		36957.28	−0.09		$ds^3D_2 - 9_2^0$
2694.857		6s		37096.73	+0.10		$fd^3P_0^0 - d^2\,{}^3P_1$
2686.74		10h		37208.80	+0.28		$fp^1G_4 - f\cdot d^1G_4^0$
2685.99		10h		37219.18	+0.05		$fp^3G_4 - f\cdot d^3F_3^0$
2681.03		2h		37288.04	−0.08		$fp^1G_4 - f\cdot d^3F_4^0$
2675.6		2h		37363.7	0.0		$fp^1D_2 - f\cdot d^1F_3^0$
2675.08		4h		37370.97	+0.30		$fp^1G_4 - f\cdot d^1F_3^0$
2673.3		4h		37395.8	0.0		$fp^1D_2 - 2_3^0$
2672.857		10s		37402.05	+0.19		$fd^3P_2^0 - d^2\,{}^3P_2$
2671.9		1		37415.4	−0.2		$fp^3D_1 - f\cdot d^3F_2^0$
2668.69		8h		37460.45	+0.15		$fp^1D_2 - f\cdot d^1D_2^0$
2663.80		10h		37529.21	+0.12		$fp^1G_4 - f\cdot d^3D_3^0$
2662.836		30s		37542.79	+0.12		$fd^1F_3^0 - d^2\,{}^3P_2$
2658.6		3h		37602.6	+0.5		$fp^3G_4 - f\cdot d^3H_4^0$
2656	77		[12]	37628.5		−0.3	$fp^1G_4 - f\cdot d^3G_5^0$
2655.71		20h		37643.53	−0.08 −0.06		$fp^3G_5 - f\cdot d^3F_4^0$ $fp^3G_4 - f\cdot d^3G_4^0$?
2654.48		6h		37660.97	0.00		$fp^3D_1 - f\cdot d^3D_1^0$
2649.418		50		37732.92	+0.34		$fd^3P_2^0 - fp^1F_3$
2639.57		4		37873.69	+0.30		$fd^1F_3^0 - fp^1F_3$
2634.08		4h		37952.62	+0.02		$fp^3D_2 - f\cdot d^3D_1^0$
2631.88		30h		37984.34	+0.05		$fp^3G_5 - f\cdot d^3G_5^0$
2629.773		4		38014.77	−0.08		$fd^3F_3^0 - d^2\,{}^3F_4$
2624.86		3		38085.92	+0.17		$fp^3F_3 - f\cdot d^3F_2^0$
2623.83		4h		38100.87	+0.19		$fp^3D_2 - f\cdot d^3G_3^0$
2622.753		4s		38116.52	−0.05		$fd^3F_2^0 - d^2\,{}^3F_3$
2621.151		15		38139.81	+0.24		$fd^3D_3^0 - fp^3G_3$
2620.68		2h		38146.66	−0.09		$fp^1D_2 - f\cdot d^3P_2^0$
2615.93		60h		38215.93	+0.09		$fp^3G_4 - f\cdot d^3H_5^0$
2614.58		3h		38235.66	+0.16		$ds^3D_2 - 10_1^0$
2611	78		[2]	38276.6		−0.8	$fd^3D_3^0 - fp^3F_2$?
2610.91		4h		38289.40	+0.36		$fp^3D_1 - f\cdot d^3D_2^0$
2608.114		150h		38330.44	0.00		$fp^3G_5 - f\cdot d^3H_6^0$
2605.3		2h		38371.8	+1.2		$fp^3F_4 - f\cdot d^3F_3^0$?
2604.078		4s		38389.85	+0.20		$fd^3H_4^0 - d^2\,{}^3F_4$
2603.646		400		38396.22	−0.16		$fd^1H_5^0 - fp^1G_4$
2601.32		4s		38430.55	−0.20		$fd^3P_1^0 - d^2\,{}^3P_2$
2600.408		20h		38444.02	+0.07		$fp^3D_2 - f\cdot d^3G_4^0$ [4]
2599.18		30h		38462.19	−0.15		$fp^3D_3 - f\cdot d^3D_3^0$
2596	42		2	38503.1		−0.4	$fd^3D_2^0 - fp^3F_2$
2591.19		15h		38580.78	+0.11		$fp^3D_2 - f\cdot d^3D_2^0$
2588.58		2		38619.68	−0.01		$fd^3P_2^0 - fp^3F_3$
2584.87		70h		38675.10	+0.10		$fp^1G_4 - f\cdot d^1H_5^0$
2579.17		6		38760.57	+0.07		$fd^1F_3^0 - fp^3F_3$
2578.34		30s		38773.04	−0.25		$fd^3D_2^0 - d^2\,{}^3P_1$
2577.828		80h		38780.75	−0.25		$fp^3F_3 - f\cdot d^3H_4^0$
2575.06		20h		38822.43	−0.04		$fp^3F_3 - f\cdot d^3G_4^0$
2569.21		4		38910.82	−0.20		$ds^3D_1 - 10_1^0$
2567.02		4h		38944.02	−0.14		$fp^3D_1 - f\cdot d^3P_1^0$
2566.02		2h		38959.19	0.00		$fp^3F_3 - f\cdot d^3D_2^0$
2563.450		6		38998.24	+0.03		$fd^3P_2^0 - fp^3D_2$
2557.628	76	30h	12	39087.01	+0.01	−2.0	$fp^3D_3 - f\cdot d^3P_2^0$
2554.3	22	1	[3]	39137.9	−1.1	+0.2	$fd^1F_3^0 - fp^3D_2$
2553.28	28	12s	3	39153.57	0.00	0.0	$fd^3D_1^0 - d^2\,{}^3P_0$

[4] Either this is a coincidence or the level $f\cdot d^3G_4^0$ is wrongly identified.

TABLE IV—(*Continued*).

λ King	λ Lang	Intensity King	Intensity Lang	Wave Number Vac.	Wave Number $o-c$ King	Wave Number $o-c$ Lang	Multiplet Designation
2547.92	90	5*h*	1	39235.93	+0.14	+0.4	$fp^3D_2 - f\cdot d^3P_1^0$
2544.39	37	3*h*	[8]	39290.36	+0.52	+0.9	$fd^3P_2^0 - fp^3D_1$
2539.43	42	20*h*	10	39367.10	−0.19	−0.1	$fp^3F_4 - f\cdot d^3H_5^0$
2537.6	70	2*h*	[3]	39395.5	−1.0	−2.6	$fp^3G_4 - f\cdot d^3F_4^0$
2532.040	02	100	18	39481.98	+0.13	+0.5	$fd^3D_1^0 - fp^3F_2$
2522.11	06	4*h*	0	39637.42	−0.04	+0.7	$fp^3G_4 - f\cdot d^3D_3^0$
2517.6		1*h*		39708.4	−1.2		$fp^1F_3 - f\cdot d^3G_4^0$
2515.77	72	4*h*	[5]	39737.30	+0.13	+0.9	$fp^3G_4 - f\cdot d^3G_5^0$
2514.864	85	4*s*	[12]	39751.62	−0.04	+0.1	$fd^3D_1^0 - d^2\ ^3P_1$
2504.454	45	6*s*	4	39916.84	+0.05	+0.1	$fd^3D_3^0 - d^2\ ^3P_2$
2503.605	60	10	5	39930.37	−0.09	0.0	$fd^3D_3^0 - d^2\ ^1G_4$
2497.56	53	60	20	40027.01	−0.09	+0.4	$fd^3P_1^0 - fp^3D_2$
2490.35	32	3*s*		40142.89	+0.01	+0.5	$fd^3D_2^0 - d^2\ ^3P_2$
2484.31	30	5*s*	0	40240.48	+0.03	+0.2	$fd^1G_4^0 - d^2\ ^3F_4$
2483.88	85	60	20	40247.44	−0.07	+0.4	$fd^3D_3^0 - fp^1F_3$
2479.50	50	50	15	40318.53	{+0.28 −0.20	+0.3 −0.2	$fd^1D_2^0 - d^2\ ^1D_2$ $fd^3P_1^0 - fp^3D_1$
2477.31	30	40	12	40354.17	0.00	+0.1	$fd^3P_0^0 - fp^3D_1$
2472.71	68	4	[15]	40429.24	−0.03	+0.4	$fd^3G_4^0 - fp^3G_3$
2471.81	85	15*h*	5	40443.96	−0.19	−0.9	$fp^3F_4 - 1^0$
2470.00	96	150	20	40473.59	−0.01	+0.6	$fd^3D_2^0 - fp^1F_3$
2465.49		4*h*		40547.62	−0.32		$fp^3F_4 - f\cdot d^3F_4^0$
2460.86	83	2*s*	[8]	40623.91	−0.33	+0.2	$fd^3G_3^0 - d^2\ ^1D_2$
2454.37	35	50*s*	15	40731.32	−0.01	+0.3	$fd^3G_5^0 - d^2\ ^1G_4$
2444.93	88	10*h*	5	40888.57	−0.05	+0.8	$fp^3F_4 - f\cdot d^3G_5^0$
2441.69	62	20*h*	7	40942.82	−0.16	+1.0	$fp^3F_2 - f\cdot d^3F_2^0$
2439.87	82	250	30	40973.36	−0.33	+0.5	$fd^3P_2^0 - fp^3D_3$
2431.51	45	300	35	41114.22	−0.28	+0.7	$fd^1F_3^0 - fp^3D_3$
2430.31	25	60	15	41134.52	−0.10	+0.9	$fd^3D_3^0 - fp^3F_3$
2428.68	63	15*s*	10	41162.13	+0.08	+1.0	$fd^3D_3^0 - fp^3F_4$
2423.20	10	10*h*	12	41255.21	−0.03	+1.6	$fp^3F_2 - f\cdot d^3F_3^0$
2418.44	37	10*h*	9	41336.40	−0.03	+1.2	$fp^3F_2 - f\cdot d^3G_3^0$
2417.11	09	30*h*	10*d*	41359.14	{+0.45 −1.57	+0.8 −1.2	$fp^1F_3 - 1^0$ $fd^3D_2^0 - fp^3F_3$
2415.74	67	60*h*	15	41382.60	−0.28	+0.9	$fp^1F_3 - f\cdot d^1G_4^0$
2411.06	00	6*h*	10	41462.92	+0.44	+1.4	$fp^1F_3 - f\cdot d^3F_4^0$
2410.41	32	30*h*	12	41474.10	−0.15	+1.4	$fp^3G_3 - f\cdot d^3G_3^0$
2408.15	05	30*s*	12	41513.02	−0.12	+1.6	$fd^3D_3^0 - fp^3D_2$
2406.31	32	20*h*	10	41544.76	−0.27	−0.4	$fp^1F_3 - f\cdot d^1F_3^0$
2404.44	40	6*h*	7	41577.06	−0.12	+0.6	$fp^1F_3 - 2_3^0$
2400.72	71	10*h*	8	41641.48	−0.18	0.0	$fp^1F_3 - f\cdot d^1D_2^0$
2398.76	79	8*h*	8	41675.51	−0.23	−0.7	$d^2\ ^1G_4 - 1^0$
2397.66		3*s*		41694.62	−0.19		$fd^1D_2^0 - fp^3G_3$
2395.10	06	60	25	41739.18	−0.05	+0.7	$fd^3D_2^0 - fp^3D_2$
2393.00	88	2*h*	3	41775.81	−0.24	+1.9	$fp^3G_3 - f\cdot d^3H_4^0$
2390.7	51	1	2	41816.0	{−1.5 −0.4	+1.8 +2.9	$fp^3G_3 - f\cdot d^3G_4^0$? $fp^3F_2 - f\cdot d^3D_2^0$
2386.23	11	3*h*	5	41894.32	+0.09	+2.2	$d^2\ ^1G_4 - 2_3^0$
2385.11	08	15	10	41913.99	+0.05	+0.6	$fd^3P_2^0 - fp^1D_2$
2382.33	30	30	12	41962.90	−0.02	+0.5	$fd^3G_5^0 - fp^3F_4$
2380.18	14	200	30	42000.80	0.00	+0.7	$fd^3G_3^0 - fp^3G_3$
2378.48	43	6	10	42030.82	−0.04	+0.7	$fd^3D_2^0 - fp^3D_1$
2377.53	48	40	18	42047.61	−0.14	+0.7	$fd^1F_3^0 - fp^1G_4$
2377.13	06	50	18	42054.68	−0.07	+1.1	$fd^1F_3^0 - fp^1D_2$
2373.44	29	6*h*	7	42120.06	−0.15	+2.5	$d^2\ ^1G_4 - f\cdot d^3G_5^0$
2372.39	35	300	35	42138.70	+0.08	+0.8	$fd^3G_3^0 - fp^3F_2$
2371.15	13	4*s*	[3]	42160.74	−0.04	+0.3	$fs^1F_3^0 - ds^3D_2$
2367.81	79	30*s*	15	42220.20	+0.04	+0.4	$fd^3G_4^0 - d^2\ ^1G_4$
2362.58	52	40	20	42313.66	+0.16	+1.2	$fd^3D_3^0 - fp^3G_4$
2350.16	10	200	35	42537.26	+0.05	+1.1	$fd^3G_4^0 - fp^1F_3$
2337.71	66	25	12	42763.77	+0.07	+1.0	$fd^3F_3^0 - fp^3G_3$
2330.19	15	4	6	42901.77	+0.25	+1.0	$fd^3F_3^0 - fp^3F_2$
2329.92	87	6*s*	6	42906.74	+0.10	+1.1	$fd^3F_4^0 - d^2\ ^1G_4$
2327.95	91	3	4	42943.05	+0.20	+1.0	$fd^3P_1^0 - fp^1D_2$
2324.37	32	50	15	43009.18	−0.05	+0.9	$fd^3D_1^0 - fp^3D_1$
2318.70	68	200	30	43114.34	−0.03	+0.3	$fd^3G_5^0 - fp^3G_4$

Table IV—(*Continued*).

λ King	λ Lang	Intensity		Wave Number Vac.	Wave Number $o-c$		Multiplet Designation
		King	Lang		King	Lang	
2317.40	33	100	20	43138.53	+0.03	+1.3	$fd^3H_4^0 - fp^3G_3$
2315.91	73	8	7	43166.28	−0.13	+3.2	$d^2\,^1G_4 - f\cdot d^1H_5^0$
2312.83	73	8	7	43223.76	+0.07	+1.9	$fd^3F_4^0 - fp^1F_3$
2302.14	06	100	25	43424.45	+0.13	+1.7	$fd^3G_4^0 - fp^3F_3$
2300.70	61	80	20	43451.62	−0.13	+1.6	$fd^3G_4^0 - fp^3F_4$
2298.75	66	20	10	43488.48	−0.14	+1.6	$fd^3D_3^0 - fp^3D_3$
2287.85	77	30*s*	12	43695.65	−0.04	+1.5	$fd^3H_5^0 - d^2\,^1G_4$
2282.25	18	6	8	43802.86	+0.11	+1.4	$fd^1D_2^0 - fp^1F_3$
2277	52		3	43893.8		−0.1	$fp^3D_1 - 4_2^0$
2272	81		2	43984.8		+0.1	$fs^1F_3^0 - ds^1D_2$
2268.22	15	25	20	44073.77	0.00	+1.3	$fs^3F_4^0 - ds^3D_3$
2266.95	87	10*s*	15	44098.46	0.00	+1.5	$fs^3F_2^0 - ds^3D_1$
2266	22		2	44112.7		+1.9	$fd^3F_4^0 - fp^3F_3$
2264.91	80	50	20	44138.18	−0.05	+2.1	$fd^3F_4^0 - fp^3F_4$
2250	02		3	44430.2		+1.3	$fd^3D_3^0 - fp^1D_2$
2249.31	20	15*s*	18	44444.26	+0.02	+2.2	$fd^3F_2^0 - fp^3G_3$
2244.18	11	8*s*	15	44545.85	+0.12	+1.5	$fs^3F_3^0 - ds^3D_2$
2243	67		4	44556.0		+1.4	$fd^3F_3^0 - d^2\,^1G_4$
2242.35	25	80	25	44582.20	+0.14	+2.1	$fd^3F_2^0 - fp^3F_2$
2241.30	18	10	15	44603.08	−0.12	+2.3	$fd^3G_4^0 - fp^3G_4$
2238.69	58	8	15	44655.08	+0.12	+2.3	$fd^3D_2^0 - fp^1D_2$
2236.95	84	4	10	44689.81	−0.05	+2.1	$fd^1D_2^0 - fp^3F_3$
2234	74		3	44734.0		+1.5	$fp^3F_4 - 5_3^0$
2232	69		4	44775.1		+1.1	$fs^3F_2^0 - ds^3D_2$
2228.10	05	50	[135]	44867.30	+0.05	+1.1	$fd^3G_5^0 - fp^3G_5$
2227.88	76	40	20	44871.73	+0.09	+2.5	$fd^3F_3^0 - fp^1F_3$
2225.12	00	125	40	44927.38	+0.10	+2.5	$fd^3H_5^0 - fp^3F_4$
2222.06	97	100	40	44989.24	−0.06	+1.8	$fd^1G_4^0 - fp^3G_3$
2218.16	07	12*s*	20	45068.34	−0.04	+1.8	$fd^1D_2^0 - fp^3D_2$
2215	91		1	45114.1		+1.3	$fp^3F_3 - 6_2^0$
2210.7	50	2	15	45220.4	−2.3	+1.8	$fd^3G_5^0 - fp^1G_4$
2209	34		12	45248.2		+1.8	$fd^3H_4^0 - fp^1F_3$
2207.30	22	8	20	45290.05	+0.37	+2.0	$fd^3F_4^0 - fp^3G_4$
2203	82		12	45361.6		+1.6	$fd^1D_2^0 - fp^3D_1$
2203.22	10	6	20	45373.91	−0.46	+2.0	$fd^3G_3^0 - fp^3D_2$
2199	40		4	45452.7		+1.5	$fp^1F_3 - 4_2^0$
2195	98		4	45523.5		+1.4	$d^2\,^3P_2 - 3_1^0$
2190	56		[3]	45636.1		+2.8	$fd^3D_1^0 - fp^1D_2$
2184	61		15	45760.4		+1.6	$fd^3F_3^0 - fp^3F_3$
2183.8	70	1	15	45777.4	−0.9	+1.2	$fd^3G_4^0 - fp^3D_3$
2183	32		12	45787.4		+1.2	$fd^3F_3^0 - fp^3F_4$
2180.70	60	100	100	45842.43	−0.01	+2.1	$fd^3H_6^0 - fp^3G_5$
2169.55	44	6	75	46078.00	−0.73	+1.6	$fd^3H_5^0 - fp^3G_4$
2166.95	85	20	100	46133.28	−0.27	+1.8	$fd^3H_4^0 - fp^3F_3$
2166	71		20	46138.4		+1.1	$fd^3F_3^0 - fp^3D_2$
2165	59		5	46162.3		+1.3	$fd^3H_4^0 - fp^3F_4$
2164	94		2	46176.1		+1.4	$fd^3G_3^0 - fp^3G_4$
2162	83		2*d*	46221.2		−0.3	$fd^3F_2^0 - d^2\,^3P_2$
2156	46		2	46357.7		+1.6	$fd^3G_4^0 - fp^3G_5$
2151	43		30	46466.0		+1.2	$fd^3F_4^0 - fp^3D_3$
2145	34		2	46597.9		0.0	$fs^3F_2^0 - ds^1D_2$
2140	09		3	46712.2		+0.6	$fd^3G_4^0 - fp^1G_4$
2136	94		30	46781.1		+0.9	$fd^1G_4^0 - d^2\,^1G_4$
2124	98		15	47044.3		{+1.7 {+0.4	$fd^3F_4^0 - fp^3G_5$ $fd^1D_2^0 - fp^3D_3$
2122	55		12	47098.2		+1.0	$fd^1G_4^0 - fp^1F_3$
2112	89		2	47313.5		+1.1	$fd^3H_4^0 - fp^3G_4$
2111	19		5	47351.6		{+1.8 {+0.3	$fd^3G_3^0 - fp^3D_3$ $fp^3D_3 - 9_2^0$
2109	49		2	47389.7		0.0	$fd^1P_1^0 - ds^1D_2$
2109	08		25	47398.9		+0.9	$fd^3F_4^0 - fp^1G_4$
2107	25		3	47440.1		+0.8	$fd^3F_2^0 - fp^3F_3$
2095	73		1	47700.9		+0.7	$d^2\,^3P_1 - 6_2^0$
2090	54		8	47819.3		+1.5	$fd^3F_2^0 - fp^3D_2$
2089	99		9	47831.8		+0.2	$fd^3H_5^0 - fp^3G_5$
2086	16		2	47919.6		−0.2	$d^2\,^3P_2 - 7_3^0$

TABLE IV—(*Continued*).

λ King	λ Lang	Intensity		Wave Number Vac.	Wave Number $o-c$		Multiplet Designation
		King	Lang		King	Lang	
2083	34		35	47984.5		+0.1 +0.4	$fd^1G_4^0 - fp^3F_3$ $fd^1D_2^0 - fp^1D_2$
2082	16		7	48011.7		−0.1	$fd^1G_4^0 - fp^3F_4$
2077	89		15	48110.3		+0.9	$fd^3F_2^0 - fp^3D_1$
2074	59		4	48186.9		−0.2	$fd^3H_5^0 - fp^1G_4$
2070	41		2	48284.1		+1.0	$fd^3G_3^0 - fp^1G_4$
2061	71		15	48487.8		+0.2	$fd^3H_4^0 - fp^3D_3$
2042	82		18	48936.2		+0.5	$d^2\,{}^1D_2 - 4_2^0$
2037	96		18	49052.8		−0.2	$fd^3F_3^0 - fp^1D_2$
2037	43		5	49065.6		+0.3	$fd^3H_4^0 - fp^3G_5$
2033	39		25	49163.1		−0.1	$fd^1G_4^0 - fp^3G_4$
2022	77		10	49421.2		+0.4	$fd^3H_4^0 - fp^1G_4$
λ Vac							
1986	55		15	50338.5		+0.1	$fd^1G_4^0 - fp^3D_3$
1963	74		14	50923.2		+0.1	$d^2\,{}^3P_2 - 9_2^0$
1950	39		30	51271.8		+0.2	$fd^1G_4^0 - fp^1G_4$
1946	72		2	51368.5		+0.9	$fd^3P_2^0 - ds^3D_2$
1933	41		3	51722.1		+1.1	$fd^3P_1^0 - ds^3D_1$
1932	08		6	51757.7		+1.3	$fd^3P_0^0 - ds^3D_1$
1912	30		5	52293.1		+0.4	$d^2\,{}^3P_1 - 9_2^0$
1908	48		10	52397.7		+1.2	$fd^3P_1^0 - ds^3D_2$
1904	60		1	52504.5		+0.7	$d^2\,{}^3F_4 - 5_3^0$
1890	04		10	52908.9		+1.2	$fd^3P_2^0 - ds^3D_3$
1885	01		8	53050.1		+1.6	$fd^1F_3^0 - ds^3D_3$
1875	03		1	53332.5		+0.1	$fd^1F_3^0 - ds^1D_2$
1871	46		5	53434.2		+1.1	$fd^3D_2^0 - ds^3D_1$
1855	81		3	53884.8		+2.3	$fd^3D_3^0 - ds^3D_2$
1855	68		1	53888.6		+1.8	$d^2\,{}^3F_3 - 4_2^0$
1848	97		18	54084.2		+1.6	$d^2\,{}^3F_3 - 5_3^0$
1848	07		9	54110.5		+1.9	$fd^3D_2^0 - ds^3D_2$
1844	30		(6)	54221.1		+0.7	$fd^3P_1^0 - ds^1D_2$
1837	78		8	54413.5		+2.0	$fd^3D_1^0 - ds^3D_1$
1836	99		20	54436.9		+1.4	$d^2\,{}^3F_3 - 6_2^0$
1836	64		20	54447.3		+1.5	$d^2\,{}^3F_4 - 7_3^0$
1815	18		7*d*	55091.0		+4.0	$fd^3D_1^0 - ds^3D_2$?
1813	98		4	55127.4		+2.1	$d^2\,{}^3F_2 - 3_1^0$
1805	46		9	55387.6		+2.5	$d^2\,{}^3F_2 - 4_2^0$
1804	25		10	55424.7		+2.1	$fd^3D_3^0 - ds^3D_3$
1799	11		2	55583.0		+2.1	$d^2\,{}^3F_2 - 5_3^0$
1796	89		18	55651.7		+1.6 +3.0	$d^2\,{}^3F_4 - 8_4^0$ $fd^3D_2^0 - ds^3D_3$
1747	31		3	57230.9		+2.0	$d^2\,{}^3F_3 - 8_4^0$
1712	32		8	58400.3		+1.5	$fd^3F_4^0 - ds^3D_3$
1709	17		8	58507.9		+1.3	$fd^3F_3^0 - ds^3D_2$
1680	30		4	59513.2		+1.5	$fd^3F_2^0 - ds^3D_1$

from King's data when available, otherwise from Lang's; then the residual $o-c$ from the value computed from the terms of Table I; and finally the multiplet designation.

There is a small systematic difference between King's and Lang's wave-lengths. For convenience King's have been adopted as a standard for the present purpose, and the term values derived from these when possible (for all levels except ds^1D_2).

The differences in wave number are summarized in Table V in the sense Lang *minus*

TABLE V. *Summary of wave number differences.*

Wave Number	No.	Mean cm⁻¹	Av. Resid.
39000–40000	13	+0.1	±0.6
40000–41000	14	+0.4	0.3
41000–42000	20	+1.0	0.5
42000–43000	14	+1.0	0.4
43000–44000	11	+1.4	0.6
44000–45000	18	+1.8	0.4
45000–46000	14	+1.7	0.3
46000–48000	17	+1.1	0.4
48000–50000	10	+0.3	0.4
50000–54000	14	+1.0	0.5
54000–59000	13	+1.8	0.3

TABLE VI. *Zeeman effects in Ce III.*

λ	Obs. Z E	Calc. Z E	λ	Obs. Z E	Calc. Z E
3543	(0) 1.11	(0) 1.10	2927	(w_2) 0.98w_2	(0.44) 1.16
3504	(0.34) 1.15w_2	(0.32) 1.10	2925	(w_3) 0.98	(0) 0.83*
3497	(0.70) 1.31w_4	(0.70) 1.16	2923	(0) 1.17	(0) 1.10*
3470	(0.55) 0.99w_3	(0.51) 0.97	2907	(w_1) 1.18	(0) 1.00*
3459	(w_1) 1.50	(0) 1.44	2873	(w_2) 1.31w_2	(0) 1.50*
3454	(w_2) 1.47w_2	(0) 1.32	2861	(w_4?) 1.27w_2	(0) 1.50*
3443	(w_2) 1.19w_1	(0) 1.07	2849	(0) 1.17w_1	(0) 1.02
3427	(w_3) 0.76w_1	(0.28) 0.74	2802	(?) 1.23w_2	(0.86) 0.92*
3398	(0) 1.04w_1	(0.22) 0.99	2801	(?) 1.41w_2	(0.67) 1.15*
3395	(0) 1.27w_2	(0) 1.17	2774	(?) 1.54	(0) 1.50*
3353	(0.57) 1.15w_2	(0.60) 1.18	2768	(w_2) 1.16	(0) 1.12†
3228	(0.44) 1.23w_2	(0.45) 1.20	2754	(w_1) 0.83w_1	(0) 0.73†
3147	(0.48) 1.16w_3	(0.53) 1.14	2748	(0) 1.35	(0) 1.25*
3143	(0.27) 1.07w_1	(0.31) 1.01	2743	(0) 1.18	(0) 1.08*
3141	(0) 1.18	(0) 1.12	2730	(w_1) 0.79	(0) 0.67*
3121	(w_2) 1.35w_2	(0) 1.24	2719	(0) 1.50	(0) 1.68*
3110	(0) 1.36	(0) 1.32	2672	(?) 1.43	(0) 1.50*
3106	(0) 1.20	(0) 1.15	2662	(w_2) 0.75w_4	(0) 0.50*
3085	(0.62) 0.88w_4	(0.58) 0.82	2649	(w_2) 0.86w_4	(0) 0.82†
3057.5	(0) 0.80	(0) 0.80	2603	(w_2) 1.06	(0) 0.90†
3057.2	(0) 1.18	(0) 1.07	2578	(w_2) 1.24w_2	(0) 1.00*
3056	(0) 1.06	(0) 0.94	2532	(w_1) 1.09w_2	(0) 0.98†
3055	(0) 1.16	(0) 1.09	2483	(?) 1.25w_1	(0.44) 1.25†
3031	(0) 1.31	(0) 1.23	2470	(?) 1.13w_3	(0) 1.15†
3022	(?) 1.35	(0.73) 1.16	2454	(?) 1.67	(0) 1.48†
2931	(0) 1.08	(0) 1.00*	2431	(?) 1.69w_4	(0.62) 1.12†

* Theoretical blended pattern.
† Theoretical value used for one g; other g observed.

King. The values computed from the adopted terms (being on King's scale) have been used to extend the comparison into the vacuum region. The maximum difference corresponds to 0.09A near λ2300. The last column gives the average deviation, without regard to sign, of an individual difference from the group mean. The general average of these residuals is ± 0.44 cm^{-1}, which corresponds to ± 0.027A at λ2500, and ± 0.014A at λ1800.

A considerable series of measures of the Zeeman effect, made at Pasadena by one of us (R.B.K.), is summarized in Table VI. The first column gives the wave-length (for identification in Table IV); the second, the observed Zeeman pattern; and the third, the computed patterns for blends, according to the formulae of Shenstone and Blair.[9,10] These have been derived from de Bruin's g values when available. For many other lines the data do not suffice to determine separate g values for both the terms involved, and the theoretical positions derived from Lande's formulae are tabulated (and marked with an asterisk). These suffice to show that no very serious deviations from normal g values occur.

We are indebted to Miss Moore for valuable aid in preparing and checking the tables.

[9] Shenstone and Blair, Phil. Mag. **8**, 765 (1929).
[10] Russell, Phys. Rev. **36**, 1590 (1930).