NBS MONOGRAPH 32 SUPPLEMENT

Revision of the NBS Tables of Spectral-Line Intensities Below 2450 Å

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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National Bureau of Standards
Washington, D.C. 20234

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Contents

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Charles H. Corliss

A calibration is applied to the intensity measurements of the 1400 lines below 2450 Å in the NBS Tables of Spectral-Line Intensities. Tables of the new values are presented with the lines arranged by elements and by wavelengths.

Key Words: Atomic spectra, intensities, spectral lines, ultraviolet.

1. The Problem and Its Solution

The calibration of the intensity scale in the NBS Tables of Spectral-Line Intensities by Meggers, Corliss, and Scribner (1961) was made by comparison with the radiation from a standard tungsten ribbon filament lamp in the region between 3300 and 9000 Å. The intensity of the lamp at 5500 Å is 40 times its intensity at 3300 Å and 300 times its intensity at 2800 A. This fact introduced a progressively increasing error from scattered light of the intense visible radiation as the work proceeded toward short wavelengths, below 3300 Å.

Since the ribbon filament lamp was too faint in the region below 3300 Å to serve as a standard, we took recourse to a hydrogen arc lamp. Output from this lamp was compared by R. Stair in the Radiometry Section of the Bureau with a standard tungsten-in-quartz lamp and a standard mercury arc in the region from 2500 to 3800 Å: this provided an independent overlapping calibration which carried us down to 2500 Å.

At that time there was no practicable method available for making an intensity calibration at wavelengths short of 2500 Å. As the authors then stated, "Lacking any reliable energy calibration for shorter waves, the intensity estimates from 2500 to 2000 Å were necessarily adjusted by judicious extrapolation, guided by the declining densities of background in the spectrograms, caused by the increasing absorption in the apparatus and in the air at shorter wavelengths."

Soon after the appearance of the Intensity Tables, Penkin and Slavenas [1963] published absolute oscillator strengths for lines of tin and lead that extend down to 2170 Å. They made their measurements with the hook method, which does not require an intensity calibration of any sort. This being the case, there should be no wavelength-dependent error in their results. Now, Corliss and Bozman [1962] had already derived absolute oscillator strengths for these spectra from the relative intensities of Meggers, Corliss and Scribner. A plot of the ratio of the oscillator strengths of Corliss and Bozman to those of Penkin and Slavenas is shown in figure 1. The figure shows that the ratio is not wavelength dependent between 2900 and 2450 Å but that Corliss and Bozman's scale declines by a factor of 30 between 2450 and 2150 Å. Since oscillator strengths are proportional to intensities, this plot can be used to calibrate the intensity scale at the short wavelength end of the Intensity Tables.

There are additional data available below 2500 Å that support the calibration derived from Penkin and Slavenas' work on Sn I and Pb I. For example, Penkin and Shabonova [1963a] have measured by the hook method oscillator strengths for Al I, Ga I and In I and the same authors [1963b] for Tl I, which give results more or less parallel to those for Sn I and Pb I, but the data do not extend much below 2300 Å. Gruzdev [1962b] has calculated relative oscillator strengths for the transition $3d^7(^4F)4s - 3d^7(^4F)4p$ in Co II using intermediate coupling. A plot of the ratio of Corliss and Bozman's values to those of Gruzdev is given in figure 2, which exhibits a wavelength dependence in substantial agreement with that of figure 1. There seems little possibility of a wavelength dependent error in theoretically determined oscillator strengths. Gruzdev [1962a] has also calculated oscillator strengths for Fe II which are in agreement with values measured in Fe II by Morosova and Startsev [1965]. Both of these sets of values yield curves in qualitative agreement with the calibration based on Sn I and Pb I, although the slope is somewhat steeper. Similar curves are also obtained using the oscillator strengths measured for Ni II by Bell, Paquette, and Wiese [1966], although we have only four lines of Ni II in our data.

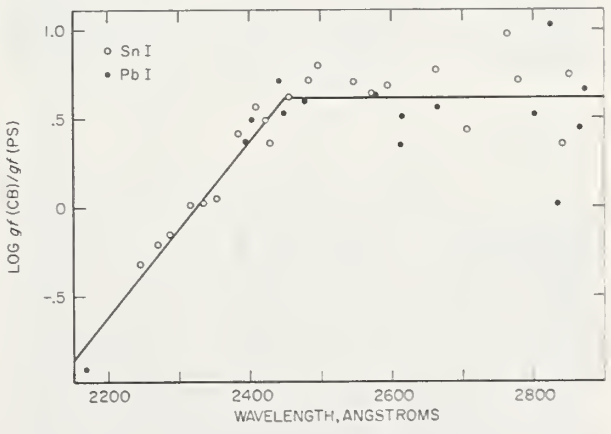

FIGURE 1. *Ratio of the gf-values of Corliss and Bozman (1960) to those of Penkin and Slavenas (1963) between 2150 and 2900 Å.*

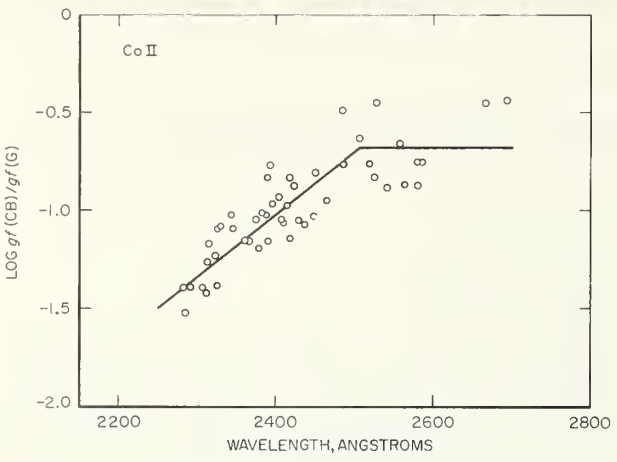

FIGURE 2. *Ratio of the gf-values of Corliss and Bozman (1960) to those of Gruzdev (1962b) between 2280 and 2700 Å.*

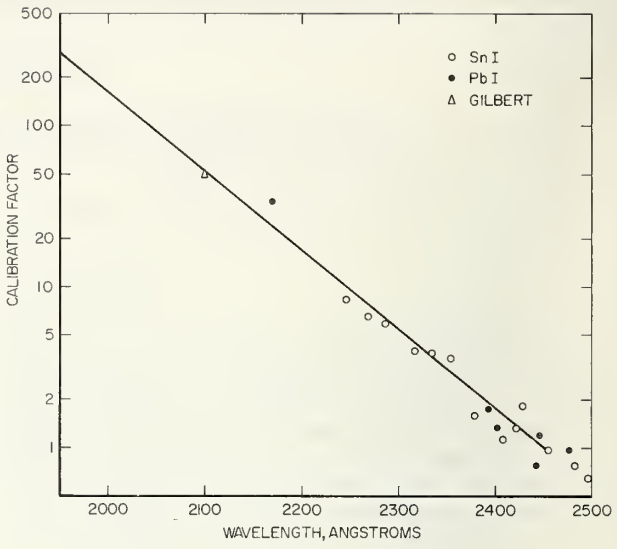

FIGURE 3. *Calibration curve for the NBS Tables of Spectral-Line Intensities below 2450 Å.*

We have preferred to base our calibration on experimental values obtained by the hook method, because of its presumed freedom from wavelength-dependent error, and in particular on those for Sn I and Pb I. They provide a calibration extending nearly to 2150 Å, over 100 Å farther into the ultraviolet than any of the other present sets of data.

Although the qualitative nature of the calibration to be applied to the intensity scale for the lines below 2500 Å in the NBS Intensity Tables is clearly established in the above discussion, the annoying fact remains that the ratio of the absolute values of the oscillator strengths for Sn I and Pb I above 2500 Å shown in figure 1, is not unity, as one might expect, but that Corliss and Bozman's absolute scale is too large by a factor of four. This probably arises from the method of uniform reduction of intensity numbers to oscillator strengths which they adopted for all the data in the intensity tables. Comparisons made with the many reliable absolute values published in the four years since the appearance of Corliss and Bozman's tables indicate that while the absolute scale of their oscillator strengths for complex spectra of neutral atoms is about right, the absolute scale for some of the simple spectra is too large. The origin of this discrepancy is not presently understood.

There is no reason to suppose, however, that this systematic error in the absolute scale for simple spectra implies any related error in the *relative* values of oscillator strengths for those spectra. We can, then, establish our calibration factors by setting the mean value of the ratios in the flat part of figure 1 equal to unity. This gives us the calibration curve in figure 3 which we have used to revise the intensities of the 1400 lines below 2450 Å. There is an additional point on this curve at 2100 Å, which arises from measurements of intensities of Sn I lines in chemiluminescent flames by Gilbert [1963] who concluded that our intensity scale declined by a factor of 50 from 2500 to 2100 Å. This agrees with our adopted calibration. The fact that the calibration factor is very large compared to the disagreement of the absolute scales makes that disagreement of little moment.

2. Results

The newly calibrated intensities are presented in three tables, corresponding to the method of presentation in Parts I and II of Monograph 32. Table 1 is a selected list by element and in order of strength of 145 lines below 2450 Å which are comparable in intensity to the strong lines given in the lists abstracted from the main tables of Part I. In this table are listed the revised intensity, character, wavelength, spectrum, energy levels and term combinations. All wavelengths are for normal air, even those below 2000 Å. The energy levels are rounded off to the nearest kayser. Under the heading "Term combination," the configurations of the active electrons and the term types (when known) are given for each energy level. In table 2 are listed by element all of the 1400 lines below 2450 Å. (Above 2450 Å the remaining 37,000 intensity numbers of Monograph 32 are unchanged.) The column headings are the same as those in table 1, except for the omission of the term combinations. New energy levels published since 1961 have been added. Table 3 is a consolidated list of all 1400 lines below 2450 Å in order of wavelength. As in Part II, the energy levels are omitted from the table.

3. Discussion

At first glance, the magnitude of the new intensity numbers in the region below 2100 Å seems rather large. Further consideration brings to mind that these are lines which have been observed through a path length of about ten meters of air, with optical elements declining in transmission and reflectance and recorded on photographic emulsions of diminished sensitivity. Although the product of these various factors has not been calculated accurately, it is perhaps not strange to find that some of these lines are very intense indeed. There are ample theoretical considerations which support these large values.

In 1941, Meggers published two papers giving the strongest lines in the first and second spectra of 92 chemical elements insofar as experimental data permitted, i.e., first spectra of 74 elements and second spectra of 72. At that time, excepting photometric measurements of relative intensities of components of selected multiplets (to test the sum rule), no systematic quantitative determinations of line strengths in extended ranges of spectra existed. However, extensive experience in subjective estimates of relative intensities, combined with elementary quantum principles, resulted in the formulation of simple rules for selecting the strongest line in any given spectrum. These rules are given in Meggers' papers cited above.

In discussing the new intensity scale, let us first compare our data with Meggers' predictions of the strongest lines of *neutral* atoms in this region. In the region from 1960 to 2350 Å Meggers lists six lines for elements which concern us here.

(1) The Be I line at 2348 Å, $2s^2\ {}^1S_0 - 2s2p\ {}^1P^\circ_1$, is the strongest Be I line in our earlier list, but we now increase the intensity number from 300 to 950; more in keeping with a value expected for the strongest line.

(2) The Se I line at 1960 Å, $4p^4\ {}^3{}_{P_2} - 4p^3 5s\ {}^3S^\circ_1$, formerly listed as the second strongest line with an intensity of 34, now has an assigned intensity of 9000 and is twice as strong as the next strongest line of the multiplet at 2039 Å, $4p^4\ {}^3P_1 - 4p^3 5s\ {}^3S^\circ_1$, as would be expected from the *LS* coupling multiplet ratios.

(3) The Sb I line at 2068 Å, $5p^3\ {}^4S^\circ_{1\frac{1}{2}} - 5p^2 6s\ {}^4P_{2\frac{1}{2}}$, formerly given as the fifth Sb I line in order of intensity at 55, is now increased to 4200, a value appropriate to its position as the leading line of the principal multiplet of Sb I.

(4) The Te I line at 2142 Å, $5p^4\ {}^3P_2 - 5p^3 6s\ {}^3S^\circ_1$, is now increased from 55 to 1800, and displaces a subordinate member of that multiplet that had previously been listed as the strongest line. However, an even stronger intensity now appears in our table, in disagreement with Meggers prediction. This line, at 2002 Å, is now given an intensity of 2600. The classification of this line is in dispute. It is given by Bartelt [1934] as $5p^4\ {}^3P_1 - 5p^3 5d\ {}^3D^\circ_1$ but this classification has not been accepted by Moore [1958] in her compilation of Atomic Energy Levels.

(5 and 6) The intensity numbers for the $ns^2\ {}^1S_0 - ns\ np\ {}^1P^\circ_1$ resonance transitions of Zn I and Cd I at 2138 and 2288 Å have not been changed because the lines were self-reversed in the original observations and the intensities were perforce calculated from the known transition probabilities. They were therefore not dependent on the original extrapolation and they retain the largest intensity numbers for their respective spectra, as predicted.

In his predictions of strongest lines of *singly ionized* atoms, Meggers lists ten lines of interest to us here.

(1) The Fe II line at 2382 Å, $4s\ {}^6D_{4\frac{1}{2}} - 4p\ {}^6F^\circ_{5\frac{1}{2}}$, is the second strongest line in our list, with an intensity of 130. The strongest line is still $4s\ {}^6D_{4\frac{1}{2}} - 4p\ {}^6D^\circ_{4\frac{1}{2}}$, at 2599 Å, intensity 200.

(2) The Co II line at 2286 Å, $4s\ {}^5F_5 - 4p\ {}^5G^\circ_6$, is now the strongest line in our list, in conformity with Meggers' prediction, with an intensity of 170.

(3) The Ni II line at 2216 Å, $4s\ {}^4F_{4\frac{1}{2}} - 4p\ {}^4G^\circ_{5\frac{1}{2}}$, does not appear in our list. This is probably due to the general weakness of Ni II in our spectra because of the relatively high ionization potential of Ni. We observe only four lines of Ni II, of which the strongest is the line at 2316 Å, $4s\ {}^4F_{4\frac{1}{2}} - 4p\ {}^4D^\circ_{3\frac{1}{2}}$.

(4) The Cu II line at 2135 Å, $4s\ {}^3D_3 - 4p\ {}^3F^\circ_4$, which we formerly gave as our strongest line, intensity 6, is now displaced by the line at 1999 Å, $4s\ {}^3D_3 - 4p\ {}^1F^\circ_3$, an intersystem line, intensity 550. Our second line at 2043 Å, $4s\ {}^3D_3 - 4p\ {}^3D^\circ_3$, intensity 380, should be the stronger line according to Meggers' rule.

(5) The Zn II line at 2025 Å, $4s\ {}^2S_{\frac{1}{2}} - 4p\ {}^2P^\circ_{1\frac{1}{2}}$, should be the stronger member of the doublet but both our previous and our present numbers indicate that the other member of the doublet at 2061 Å is the stronger.

(6) Moving on to the next long period of the periodic table, Meggers predicts the strongest line of Ru II to be the line at 2402 Å, $5s\ {}^6D_{4\frac{1}{2}} - 5p\ {}^6F^\circ_{5\frac{1}{2}}$, which is in accordance with our observations, where an intensity of 85 is assigned.

(7) The Rh II line at 2334 Å, $5s\ {}^5F_5 - 5p\ {}^5G^\circ_6$, is now assigned the largest intensity number in Rh II at a value of 14. Previously the line at 2520 Å bore the largest intensity number.

(8) and (9) The Pd II line at 2296 Å and the Ag II line at 2246 Å do not appear in our lists, probably because of the general weakness of these spectra in our copper arc, caused by the high ionization potentials of these atoms. We do observe a line of Ag II at 2413 Å, $5s\ {}^3D_2 - 5p\ {}^3F^\circ_3$, which is the second member of the multiplet whose leading line is listed by Meggers. This is our strongest Ag II line with a newly assigned intensity number of 15. Our apparatus was probably too insensitive at 2246 Å to record the ultimate line.

(10) The Cd II line at 2144 Å, $5s\ {}^2S_{\frac{1}{2}} - 5p\ {}^2P^\circ_{1\frac{1}{2}}$.

is the strongest line in our new list, with an intensity of 1900. The second member of the multiplet at 2265 Å has an intensity of 900, in agreement with the relative value predicted from *LS* multiplet intensities.

The apparent disagreements between experiment and theory may arise from inadequacies in the observations, or in the cases of the heavier elements, from inapplicability of the simple theory.

The author acknowledges his indebtedness to W. F. Meggers for his interest and helpful discussions concerning this problem.

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TABLE 1. *Strong lines below 2450 Å*

Intensity and character	Wavelength in Å	Spectrum	Energy levels in K	Term combination		
Antimony						
4200	2068.33	I	0–48332	$5p^3\ ^4S^\circ_{1\frac{1}{2}}$	$-5p^26s$	$^4P_{2\frac{1}{2}}$
1300	2049.57	I	8512–57287	$5p^3\ ^2D^\circ_{1\frac{1}{2}}$	$-$ 57287	
850	2175.81	I	0–45945	$5p^3\ ^4S^\circ_{1\frac{1}{2}}$	$-5p^26s$	$^4P_{1\frac{1}{2}}$
Arsenic						
6500	1971.97	I	0–50694	$4p^3\ ^4S^\circ_{1\frac{1}{2}}$	$-4p^25s$	$^4P_{2\frac{1}{2}}$
5500	1936.96	I	0–51610	$4p^3\ ^4S^\circ_{1\frac{1}{2}}$	$-4p^25s$	$^4P_{1\frac{1}{2}}$
4400	2003.34	I	10915–60815	$4p^3\ ^2D^\circ_{2\frac{1}{2}}$	$-4p^25s$	$^2D_{2\frac{1}{2}}$
Beryllium						
950	2348.61	I	0–42565	$2s^2\ ^1S_0$	$-2s2p$	$^1P^\circ_1$
Bismuth						
4800	1953.89	I	0–51158	$6p^3\ ^4S^\circ_{1\frac{1}{2}}$	$-6p^27d$	$^2D_{2\frac{1}{2}}$
4400	2061.70	I	0–48489	$6p^3\ ^4S^\circ_{1\frac{1}{2}}$	$-6p^27s$	$^4P_{2\frac{1}{2}}$
1000	2021.21	I	0–49461	$6p^3\ ^4S^\circ_{1\frac{1}{2}}$	$-$ 49461	$_{1\frac{1}{2}}$
Boron						
650	2089.59	I	16–47857	$2s^22p\ ^2P^\circ_{1\frac{1}{2}}$	$-2s2p^2\ ^2D_{1\frac{1}{2},2\frac{1}{2}}$	
Cadmium						
1900	2144.38	II	0–46619	$5s\ ^2S_{\frac{1}{2}}$	$-5p$	$^2P^\circ_{1\frac{1}{2}}$
1500	2288.02	I	0–43692	$5s^2\ ^1S_0$	$-5s5p$	$^1P^\circ_1$
900	2265.02	II	0–44136	$5s\ ^2S_{\frac{1}{2}}$	$-5s5p$	$^2P^\circ_{\frac{1}{2}}$
Chromium						
1900	2055.52	II	0–48632	$3d^5\ ^6S_{2\frac{1}{2}}$	$-3d^44p$	$^6P^\circ_{3\frac{1}{2}}$
1400	2061.49	II	0–48491	$3d^5\ ^6S_{2\frac{1}{2}}$	$-3d^44p$	$^6P^\circ_{2\frac{1}{2}}$
900	2065.42	II	0–48399	$3d^5\ ^6S_{2\frac{1}{2}}$	$-3d^44p$	$^6P^\circ_{1\frac{1}{2}}$
Germanium						
4200	1998.24	I	1410–51437	$4p^2\ ^3P_2$	$-4p4d$	$^3P^\circ_2$
3200	1970.23	I	1410–52148	$4p^2\ ^3P_2$	$-4p6s$	$^3P^\circ_1$
3000	1954.47	I	557–51705	$4p^2\ ^3P_1$	$-4p4d$	$^3P^\circ_1$
2600	2068.66	I	557–48882	$4p^2\ ^3P_1$	$-4p4d$	$^3D^\circ_2$
Gold						
1100	2012.00	I	9161–58845	$6s^2\ ^2D_{2\frac{1}{2}}$	$-6s6p$	$^2P^\circ_{1\frac{1}{2}}$
260	2021.38	I	9161–58616	$6s^2\ ^2D_{2\frac{1}{2}}$	$-6s6p$	$^2F^\circ_{2\frac{1}{2}}$
260	2427.95	I	0–41174	$6s\ ^2S_{\frac{1}{2}}$	$-6s6p$	$^2P^\circ_{1\frac{1}{2}}$
Hafnium						
950	2028.18	II	13486–62775	$5d^26s\ ^4P_{2\frac{1}{2}}$	$-5d^26p$	$^2F^\circ_{2\frac{1}{2}}$
700	2012.78	II	3051–52717	$5d6s^2\ ^2D_{2\frac{1}{2}}$	$-5d^26p$	$^4D^\circ_{1\frac{1}{2}}$
140	2096.18	II	15084–62775	$5d^26s\ ^2F_{3\frac{1}{2}}$	$-5d^26p$	$^2F^\circ_{2\frac{1}{2}}$
Iridium						
800	2088.82	I	0–47858	$5d^76s^2\ a^4F_{4\frac{1}{2}}$	$-$ 47858	$^\circ_{5\frac{1}{2}}$
750	2033.57	I	0–49159	$5d^76s^2\ a^4F_{4\frac{1}{2}}$	$-$ 49159	$^\circ_{4\frac{1}{2}}$
700	2092.63	I	2835–50606	$5d^86s\ b^4F_{4\frac{1}{2}}$	$-$ 50606	$^\circ_{5\frac{1}{2}}$
480	2010.63	I	0–49719	$5d^76s^2\ a^4F_{4\frac{1}{2}}$	$-$ 49719	$^\circ_{5\frac{1}{2}}$
420	2022.35	I	2835–52266	$5d^86s\ b^4F_{4\frac{1}{2}}$	$-$ 52266	$^\circ_{5\frac{1}{2}}$
380	2158.05	I	2835–49159	$5d^86s\ b^4F_{4\frac{1}{2}}$	$-$ 49159	$^\circ_{4\frac{1}{2}}$
300	2052.22	I	6324–55036	$5d^76s^2\ a^4F_{3\frac{1}{2}}$	$-$ 55036	$^\circ_{4\frac{1}{2}}$

TABLE 1. *Strong lines below 2450 Å*—Continued

Intensity and character	Wavelength in Å	Spectrum	Energy levels in K	Term combination
			Iridium—Continued	
280	2169.42	II		
240	2060.64	I	7107–55619	$5d^6 6s\ b^4F_{3/2}$ – $55619^\circ_{3/2}$
220	2126.81	II		
220	2127.94	I	0–46979	$5d^7 6s^2\ a^4F_{4/2}$ – $46979^\circ_{3/2}$
			Iron	
360	2166.77	I	0–46137	$3d^6 4s^2\ ^5D_4$ – $3d^5 4s^2 4p\ ^5P^\circ_3$
300	2084.12	I	0–47967	$3d^6 4s^2\ ^5D_4$ – $3d^7 4p\ ^5P^\circ_3$
			Manganese	
1900	2003.85	I	0–49888	$3d^5 4s^2\ ^6S_{2/2}$ – $3d^5 4s 4p\ ^6P^\circ_{3/2}$
1400	1998.86	I	0–50013	$3d^5 4s^2\ ^6S_{2/2}$ – $3d^5 4s 4p\ ^6P^\circ_{2/2}$
1000	1995.41	I	0–50099	$3d^5 4s^2\ ^6S_{2/2}$ – $3d^5 4s 4p\ ^6P^\circ_{1/2}$
			Molyhdenum	
5000	2020.30	II	0–49481	$4d^5\ ^6S_{2/2}$ – $4d^4 5p\ ^6P^\circ_{3/2}$
2600	2038.44	II	0–49041	$4d^5\ ^6S_{2/2}$ – $4d^4 5p\ ^6P^\circ_{1/2}$
2400	2015.11	II	0–49609	$4d^5\ ^6S_{2/2}$ – $4d^4 5p\ ^6P^\circ_{2/2}$
2200	2045.98	II	0–48861	$4d^5\ ^6S_{2/2}$ – $4d^4 5p\ ^4P^\circ_{2/2}$
600	2081.68	II	0–48022	$4d^5\ ^6S_{2/2}$ – $4d^4 5p\ ^4P^\circ_{1/2}$
500	2093.11	II	15447–63207	$4d^5\ ^4G_{5/2}$ – $4d^4 5p\ ^4G^\circ_{5/2}$
340	2100.84	II	15428–63012	$4d^5\ ^4G_{4/2}$ – $2^\circ_{3/2}$
300	2089.52	II	15199–63041	$4d^5\ ^4G_{2/2}$ – $4d^4 5p\ ^4G^\circ_{2/2}$
280	2092.50	II	15331–63105	$4d^5\ ^4G_{3/2}$ – $4d^4 5p\ ^4F^\circ_{3/2}$
190	2104.29	II	15447–62954	$4d^5\ ^4G_{5/2}$ – $4d^4 5p\ ^4G^\circ_{4/2}$
170	2108.02	II	23248–70670	$4d^5\ ^2I_{6/2}$ – $4d^4 5p\ ^2H^\circ_{5/2}$
			Niobium	
600	2029.32	II		
550	2032.99	II	3542–52715	$4d^4 5s\ ^5F_4$ – $5d^2 5s 5p\ 527^\circ_3$
360	2109.42	II		
300	2125.21	II	3030–50069	$4d^4 5s\ ^5F_3$ – $4d^2 5s 5p\ 500^\circ_3$
280	2131.18	II	2629–49537	$4d^4 5s\ ^5F_2$ – $4d^2 5s 5p\ 495^\circ_2$
190	2126.54	II	3542–50552	$4d^4 5s\ ^5F_4$ – $4d^4 5p\ ^3F^\circ_4$
			Osmium	
2400	2018.14	I	0–49534	$5d^6 6s^2\ ^5D_4$ – 49534°_5
2400	2020.26			
2200	2045.36			
1500	2034.44	I	0–49138	$5d^6 6s^2\ ^5D_4$ – 49138°_3
1400	2010.15	I	0–49731	$5d^6 6s^2\ ^5D_4$ – 49731°_4
1200	2022.76	I	2740–52162	$5d^6 6s^2\ ^5D_2$ – 52162°_2
1200	2028.23	I	4159–53447	$5d^6 6s^2\ ^5D_3$ – 53447°_4
1200	2079.97	I	0–48062	$5d^6 6s^2\ ^5D_4$ – 48062°_5
1100	2003.73	I	4159–54050	$5d^6 6s^2\ ^5D_3$ – 54050°_3
1100	2061.69	I	2740–51229	$5d^6 6s^2\ ^5D_2$ – 51229°_3
800	2001.45	I	0–49947	$5d^6 6s^2\ ^5D_4$ – 49947°_4
750	2004.78			
720	2058.69	I	0–48559	$5d^6 6s^2\ ^5D_4$ – 48559°_3
	2058.78	I	4159–52716	$5d^6 6s^2\ ^5D_3$ – 52716°_4
650	2048.28	I	2740–51546	$5d^6 6s^2\ ^5D_2$ – 51546°_2
650	2049.42	I	4159–52938	$5d^6 6s^2\ ^5D_3$ – 52938°_3
650	2067.21	II	3593–51952	$5d^6 6s\ ^6D_{3/2}$ – $51952^\circ_{4/2}$
600	2076.95	I	0–48132	$5d^6 6s^2\ ^5D_4$ – 48132°_4
600	2078.09			
550	2119.79			
500	2097.60	I	5144–52802	$5d^7 6s\ ^5F_5$ – 52802°_5
			Phosphorus	
340	2136.18	I	11376–58174	$3p^3\ ^2D^\circ_{2/2}$ – $3p^2 4s\ ^2P_{1/2}$
260	2149.14	I	11362–57877	$3p^3\ ^2D^\circ_{1/2}$ – $3p^2 4s\ ^2P_{1/2}$
			Platinum	
550	2049.37	I	0–48779	$5d^9 6s\ ^3D_3$ – $5d^9 6s 6p\ 32^\circ_3$
440	2032.41	I		
320	2030.63	I		
300	2084.59	I	824–48779	$5d^9 6s^2\ ^3F_4$ – $5d^9 6s 6p\ 32^\circ_3$
190	2144.23	I	0–46622	$5d^9 6s\ ^3D_3$ – $5d^9 6p\ 27^\circ_3$
			Rhenium	
2200	2049.08	I	0–48786	$5d^6 6s^2\ ^6S_{2/2}$ – $48786^\circ_{3/2}$
2000	2003.53	I	0–49895	$5d^6 6s^2\ ^6S_{2/2}$ – $49895^\circ_{1/2}$
1300	2017.87	I	0–49541	$5d^6 6s^2\ ^6S_{2/2}$ – $49541^\circ_{2/2}$
850	2085.59	I	0–47932	$5d^6 6s^2\ ^6S_{2/2}$ – $47932^\circ_{3/2}$
800	2097.12	I	0–47669	$5d^6 6s^2\ ^6S_{2/2}$ – $47669^\circ_{3/2}$
420c	2275.25	II	0–43938	$5d^5 6s\ ^7S_3$ – $5d^4 6s 6p\ ^7P^\circ_2$
400	2167.94	I	0–46112	$5d^6 6s^2\ ^6S_{2/2}$ – $46112^\circ_{2/2}$
380	2092.41	II		
340	2074.70	I	0–48184	$5d^6 6s^2\ ^6S_{2/2}$ – $48184^\circ_{3/2}$
340c	2214.26	II	0–45148	$5d^5 6s\ ^7S_3$ – $5d^4 6s 6p\ ^7P^\circ_3$
300	2083.92	I	0–47971	$5d^6 6s^2\ ^6S_{2/2}$ – $47971^\circ_{2/2}$
300	2156.67	I	0–46353	$5d^6 6s^2\ ^6S_{2/2}$ – $46353^\circ_{3/2}$
280	2139.04	II		
280	2176.21	I	0–45937	$5d^6 6s^2\ ^6S_{2/2}$ – $45937^\circ_{3/2}$
240	2287.51	I	0–43702	$5d^6 6s^2\ ^6S_{2/2}$ – $5d^6 6s 6p\ ^6P^\circ_{1/2}$
			Ruthenium	
300	2083.77	I	1191–49165	$4d^7 5s\ ^5F_4$ – 47°_4
280	2076.43	I	0–48144	$4d^7 5s\ ^5F_4$ – 31°_4
275	2090.89	I		
			Selenium	
9000	1960.26	I	0–50997	$4p^4\ ^3P_2$ – $4p^3 5s\ ^3S^\circ_1$
4000	2039.85	I	1989–50997	$4p^4\ ^3P_1$ – $4p^3 5s\ ^3S^\circ_1$

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TABLE 1. *Strong lines below 2450 Å*—Continued

Intensity and character	Wavelength in Å	Spectrum	Energy levels in K	Term combination
			Tantalum	
240	2400.63	II	6187–47830	$5d^3 6s\ {}^5F_5 - 47830^\circ_6$
150	2146.87	II	1031–47596	$5d^3 6s\ {}^5F_2 - 47596^\circ_1$
150	2196.03	II	4416–49938	$5d^3 6s\ {}^5F_4 - 49938^\circ_4$
150	2199.67	II	0–45447	$5d^3 6s\ {}^5F_1 - 45447^\circ_2$
140d	2210.03	II	0–45234	$5d^3 6s\ {}^5F_1 - {}^5D^\circ_1$
	2210.19	II	4416–49647	$5d^2 6s\ {}^5F_4 - 49647^\circ_3$
140	2239.48	II	2642–47281	$5d^3 6s\ {}^5F_3 - 47281^\circ_4$
140	2387.06	II	4416–46295	$5d^3 6s\ {}^5F_4 - 46295^\circ_5$
120	2182.71	II	1031–46831	$5d^3 6s\ {}^5F_2 - 46831^\circ_3$
120	2250.76	II	1031–45447	$5d^3 6s\ {}^5F_2 - 45447^\circ_2$
			Tellurium	
2600	2002.0	I	4751–54685	$5p^4\ {}^3P_1 - 5p^3 5d\ {}^3D^\circ_1$
1800	2142.75	I	0–46653	$5p^4\ {}^3P_2 - 5p^3 6s\ {}^3S^\circ_1$
			Tin	
2600	1970.80	I	1692–52416	$5p^2\ {}^3P_1 - 5p7s\ {}^3P^\circ_2$
1500h	1983.55	I	3428–53826	$5p^2\ {}^3P_2 - 5p7d\ {}^3D^\circ_3$
			Tungsten	
1200	2029.98	II	6147–55392	$5d^4 6s\ {}^6D_{4\frac{1}{2}} - 55392^\circ_{4\frac{1}{2}}$
1100	2008.07	II	4716–54499	$5d^4 6s\ {}^6D_{3\frac{1}{2}} - 55499^\circ_{3\frac{1}{2}}$
800	2079.11	II	6147–54229	$5d^4 6s\ {}^6D_{4\frac{1}{2}} - 54229^\circ_{5\frac{1}{2}}$
600	2026.08	II	4716–54057	$5d^4 6s\ {}^6D_{3\frac{1}{2}} - 54057^\circ_{4\frac{1}{2}}$
500	2094.75	II	1519–49242	$5d^4 6s\ {}^6D_{1\frac{1}{2}} - 49242^\circ_{2\frac{1}{2}}$
480	2001.71	II	3173–53114	$5d^4 6s\ {}^6D_{2\frac{1}{2}} - 53114^\circ_{2\frac{1}{2}}$
440	2049.63	II	1519–50292	$5d^4 6s\ {}^6D_{1\frac{1}{2}} - 50292^\circ_{2\frac{1}{2}}$
420	2009.98	II	1519–51254	$5d^4 6s\ {}^6D_{1\frac{1}{2}} - 51254^\circ_{1\frac{1}{2}}$
340	2010.23	II	3173–52902	$5d^4 6s\ {}^6D_{2\frac{1}{2}} - 52902^\circ_{3\frac{1}{2}}$
340	2014.23	II	3173–52803	$5d^4 6s\ {}^6D_{2\frac{1}{2}} - 52803^\circ_{1\frac{1}{2}}$
300	2088.19	II	3173–51045	$5d^4 6s\ {}^6D_{2\frac{1}{2}} - 51045^\circ_{3\frac{1}{2}}$
280	2071.21	II	3173–51438	$5d^4 6s\ {}^6D_{2\frac{1}{2}} - 51438^\circ_{1\frac{1}{2}}$
220	2035.03	II	7420–56544	$5d^5\ {}^6S_{2\frac{1}{2}} - 56544^\circ_{2\frac{1}{2}}$
200	2098.60	II	1519–49154	$5d^4 6s\ {}^6D_{1\frac{1}{2}} - 49154^\circ_{1\frac{1}{2}}$
200	2121.59	II	3173–50292	$5d^4 6s\ {}^6D_{2\frac{1}{2}} - 50292^\circ_{2\frac{1}{2}}$
			Vanadium	
280	2092.44	I	553–48329	$3d^3 4s^2\ {}^4F_{4\frac{1}{2}} - {}^4F^\circ_{4\frac{1}{2}}$
			Ytterbium	
420	2126.72	II	0–47006	$6s\ {}^2S_{\frac{1}{2}} - 47006^\circ_{\frac{1}{2}}$
350	2116.65	II	0–47229	$6s\ {}^2S_{\frac{1}{2}} - 47229^\circ_{\frac{1}{2}}$
120	2185.70	II	0–45737	$6s\ {}^2S_{\frac{1}{2}} - 45737^\circ_{1\frac{1}{2}}$
90	2224.45	II	0–44941	$6s\ {}^2S_{\frac{1}{2}} - 44941^\circ_{1\frac{1}{2}}$
			Zinc	
1000	2061.91	II	0–48481	$4s\ {}^2S_{\frac{1}{2}} - 4p\ {}^2P^\circ_{\frac{1}{2}}$
1000	2138.56	I	0–46745	$4s^2\ {}^1S_0 - 4s4p\ {}^1P^\circ_1$
300	2025.51	II	0–49354	$4s\ {}^2S_{\frac{1}{2}} - 4p\ {}^2P^\circ_{1\frac{1}{2}}$

TABLE 2. *Lines arranged by elements*

Intensity and character	Wavelength in Å	Spectrum	Energy levels in K
Aluminum			
50	2269.09	I	112–44169
	2269.21	I	112–44166
46	2367.06	I	0–42234
85	2373.13	I	112–42238
17	2373.36	I	112–42234
4	2378.41	I	112–42144
Antimony			
300	2029.49	I	16396–65653
500	2039.77	I	9854–58863
1300	2049.57	I	8512–57287
4200	2068.33	I	0–48332
500	2098.41	I	8512–56152
100	2118.48	I	18464–65653
190	2127.39	I	0–46991
320	2139.69	I	8512–55233
160	2141.83	I	
320	2144.86	I	8512–55121
850	2175.81	I	0–45945
150	2179.19	I	9854–55728
40	2201.32	I	16396–61809
100	2208.45	I	9854–55121
65	2220.73	I	8512–53528
32	2224.93	I	8512–53443
55	2262.51	I	16396–60581
12	2288.98	I	9854–53528
38	2293.44	I	9854–53443
20	2306.46	I	16396–59738
220	2311.47	I	0–43249
5	2360.50	I	16396–58747
10	2373.67	I	18464–60581
8	2383.64	I	18464–60404
6	2422.13	I	18464–59738
8	2426.35	I	16396–57597
19	2445.51	I	8512–49391
Arsenic			
5500	1936.96	I	0–51610
6500	1971.97	I	0–50694
3600	1989.70	I	10592–60835
1100	1990.48	I	10592–60815
500	1994.78	I	18186–68301
4400	2003.34	I	10915–60815
550	2009.19	I	18648–68403
420	2013.32	I	18648–68301
48	2165.52	I	18648–64812
260	2288.12	I	10915–54605
16	2344.03	I	18186–60835
260	2349.84	I	10592–53136
50	2369.67	I	18648–60825
40	2370.77	I	18648–60815
40	2381.18	I	10915–52898
11	2437.23	I	10592–51610
Barium			
140	2304.24	II	4874–48259
200	2335.27	II	5675–48484
19	2347.58	II	5675–48259

Intensity and character	Wavelength in Å	Spectrum	Energy levels in K
Beryllium			
110 h	2174.94	I	21980–67944
	2175.07	I	21982–67944
950	2348.61	I	0–42565
Bismuth			
4800	1953.89	I	0–51158
900	1959.48	I	0–51019
1000	2021.21	I	0–49461
4400	2061.70	I	0–48489
460	2110.26	I	0–47371
250	2133.63	I	11418–58272
36	2228.25	I	0–44865
170	2230.61	I	0–44817
34	2276.58	I	0–43912
19	2400.88	I	15437–57075
Boron			
420	2088.93	I	0–47857
650	2089.59	I	16–47857
Cadmium			
1900	2144.38	II	0–46619
900	2265.02	II	0–44136
15	2267.47	I	30656–74745
1500	2288.02	I	0–43692
40	2306.61	I	30656–73996
19	2312.84	II	46619–89844
30 h	2329.28	I	31827–74745
Calcium			
7	2398.56	I	0–41679
Chromium			
1900	2055.52	II	0–48632
1400	2061.49	II	0–48491
900	2065.42	II	0–48399
8 h	2364.71	I	0–42275
13	2383.33	I	8308–50253
14	2408.62	I	8308–49812
Cobalt			
44	2174.60	I	0–45971
30	2245.13	II	4029–48556
12	2268.17	I	4143–48217
11	2274.49	I	0–43952
34	2276.53	I	
10	2283.52	II	4029–47807
11	2284.85	I	816–44568
170	2286.16	II	3350–47078
30	2287.81	I	4143–47839
10	2291.46	I	4690–48317
12	2292.00	II	17772–61388
11	2293.39	II	4561–48151
11	2295.23	I	0–43555
9	2296.05	I	5076–48616
19	2296.71	I	4690–48217
8	2303.97	I	3483–46873

TABLE 2. *Lines arranged by elements*—Continued

Intensity and character	Wavelength in Å	Spectrum	Energy levels in K
Cobalt—Continued			
12	2304.18	I	816–44202
15	2305.18	I	816–44183
120	2307.86	II	4029–47346
110	2309.02	I	0–43295
75	2311.60	II	4561–47807
75	2314.05	II	4950–48151
60	2314.98	II	5204–48388
18	2316.16	I	1407–44568
22	2316.86	I	1407–44556
100	2323.14	I	816–43848
34	2324.32	II	4029–47039
24	2325.55	I	1407–44394
32	2326.14	II	4561–47537
32	2326.48	II	3350–46321
6	2329.10	II	18338–61260
22	2330.35	II	4950–47848
60	2335.99	I	1407–44202
28	2337.94	II	
68	2338.67	I	1809–44556
20	2339.05	I	816–43555
26	2344.26	II	5204–47848
26	2346.16	I	816–43426
38	2347.39	II	4950–47537
8	2350.28	I	4690–47225
6	2351.39	I	1407–43922
66	2352.85	I	3483–45971
85	2353.42	I	816–43295
		II	4561–47039
26	2355.48	I	1407–43848
22	2358.18	I	1809–44202
4	2361.53	II	5204–47537
80	2363.79	II	4029–46321
40	2365.07	I	0–42269
15	2369.68	I	4143–46330
10	2370.51	I	816–42988
7 h	2371.44	I	17234–59389
14	2371.86	I	1407–43555
4	2372.83	I	1407–43538
6	2373.38	I	
7	2375.18	II	4950–47039
9	2377.22	I	5076–47129
85	2378.62	II	3350–45379
60	2380.48	I	816–42811
7	2381.75	II	
75	2383.46	II	4029–45972
60	2384.86	I	0–41918
42	2386.36	II	4561–46453
6	2387.46	I	4690–46563
140	2388.92	II	3350–45198
28	2389.54	II	4950–46786
7	2391.37	I	
10	2392.60	II	
10	2393.90	II	4561–46321
5 h	2397.03	I	
26	2397.39	II	9813–51512
2.5	2400.84	I	4690–46330
48 d	2402.06	I	816–42434
	2402.17	I	1809–43426
17	2404.17	II	5204–46786
5	2406.27	I	4143–45688
220	2407.25	I	0–41529
11	2407.67	II	10708–52230
13	2408.75	II	4950–46453
10	2410.51	I	14036–55509
220	2411.62	I	816–42269
65	2412.76	I	1809–43243
4	2413.19	I	5076–46502
4	2413.58	I	14399–55819
20	2414.06	II	4561–45972
200	2414.46	I	1407–42811
200	2415.30	I	1809–43200
6	2416.90	II	11322–52684
6	2417.05	I	
42	2417.65	II	4029–45379
28	2419.12	I	
5	2420.73	II	
8	2422.56	I	13796–55061
5	2423.62	II	5204–46453
170	2424.93	I	0–41226
2.5	2425.59	I	4690–45905
6	2427.00	I	
5	2428.29	II	4029–45198
17	2428.60	I	
5	2429.23	I	816–41969
140	2432.21	I	816–41918
32	2435.09	I	
30	2435.83	I	0–41041
120	2436.66	I	1407–42434
3.0	2436.98	II	4950–45972
100	2439.05	I	1809–42797
22	2441.05	I	17234–58187
2.5	2449.16	II	4561–45379
Copper			
550	1999.69	II	21929–71920
240	2024.34	I	0–49383
160	2035.84	II	23998–73102
220	2037.12	II	22847–71920
380	2043.79	II	21929–70842
65	2112.09	II	26265–73596
200	2135.98	II	21929–68731
70	2138.53	I	11203–57949
140	2165.09	I	0–46173
180	2178.94	I	0–45879
120	2181.72	I	0–45821
36	2192.26	II	22847–68448
170 d	2199.58	I	11203–56651
	2199.75	I	13245–58691
55	2214.58	I	11203–56344
46	2225.70	I	0–44916
95	2227.78	I	13245–58119
120	2230.08	I	11203–56030
40	2247.00	II	21929–66419
28	2293.84	I	11203–54784
5	2369.89	II	26265–68448
7	2441.64	I	0–40944

Intensity and character	Wavelength in Å	Spectrum	Energy levels in K
Dysprosium			
14	2356.91	II	
3.5	2381.95		
7	2387.36	II	
8	2392.15		
10	2402.29	II	
13	2410.01	II	
8	2422.75	II	
14	2439.82	II	
Erbium			
8	2341.82	II	
11	2358.51	II	0–42387
8	2377.83	II	
8	2383.28	II	440–42387
10	2386.58	II	
12	2387.17	II	
11	2396.38	III	
9	2397.30	II	
4	2400.30	II	
3.5	2404.41	II	
4	2410.53	II	
7	2420.28	II	
6	2425.23	II	
9	2427.28	II	
4	2439.45	II	
14	2446.39	II	0–40864
Gallium			
3.5	2294.20	I	0–43574
7	2338.28	I	826–43578
4	2371.32	I	0–42158
11	2418.70	I	826–42158
Germanium			
3000	1954.47	I	557–51705
2000	1961.36	I	7125–58091
3200	1970.23	I	1410–52148
1400	1987.62	I	1410–51705
4200	1998.24	I	1410–51437
1700	2019.07	I	557–50069
2400	2041.71	I	0–48962
1600	2043.77	I	1410–50323
420	2054.46	I	1410–50069
220	2057.24	I	7125–55718
750	2065.21	I	557–48962
2600	2068.66	I	557–48882
420	2086.02	I	557–48480
2000	2094.26	I	1410–49144
240	2105.82	I	1410–48882
95	2124.74	I	7125–54175
340	2198.71	I	7125–52592
18	2256.00	I	7125–51437
18	2314.20	I	7125–50323
24	2327.92	I	7125–50069
20	2379.14	I	7125–49144
130	2417.37	I	7125–48480
Gold			
1100	2012.00	I	9161–58845
260	2021.38	I	9161–58616
18	2352.65	I	9161–51654
12	2387.75	I	9161–51029
260	2427.95	I	0–41174
Hafnium			
700	2012.78	II	3051–52717
950	2028.18	II	13486–62775
140	2096.18	II	15084–62775
60	2210.82	II	36883–82101
36	2254.01	II	3645–47996
18	2255.15	II	3645–47973
28	2266.83	II	4905–49006
70	2277.16	II	0–43901
26	2321.14	II	4905–47973
65	2322.47	II	0–43044
34	2323.25	II	3645–46675
13	2324.50	II	12071–55077
34	2324.89	II	4905–47904
22	2332.97	II	3645–46495
22	2337.33	II	0–42771
26	2343.32	II	6344–49006
36	2347.44	II	6344–48931
60	2351.22	II	0–42518
12	2353.02	I	0–42485
10	2365.98	II	4905–47158
28	2380.30	II	3645–45643
11	2381.00	II	14360–56346
19	2393.18	II	12921–54693
50	2393.36	II	4905–46675
75	2393.83	II	0–41761
15	2400.78	II	3051–44691
8	2404.56	II	13486–55060
60	2405.42	II	6344–47904
14	2406.44	II	11952–53494
42	2410.14	II	8362–49841
10	2413.33	II	12071–53494
6	2415.96	II	11952–53331
36	2417.69	II	3051–44400
13	2425.98	II	13486–54693
5	2428.75	I	2357–43518
13	2428.99	II	12071–53227
14	2433.57	II	17369–58448
5	2434.74	II	17389–58448
4	2444.99	I	4568–45455
44	2447.25	II	3051–43901
16	2449.44	II	6344–47158

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Intensity and character	Wavelength in Å	Spectrum	Energy levels in K
Indium			
18	2306.06	II	0–43349
4	2389.54	I	0–41836
Iridium			
480	2010.65	I	0–49719
420	2022.35	I	2835–52266
750	2033.57	I	0–49159
300	2052.22	I	6324–55036
240	2060.64	I	7107–55619
180	2083.22	I	5785–53772
150	2085.74	I	7107–55036
800	2088.82	1	0–47858
700	2092.63	I	2835–50606
130	2112.68	I	6324–53642
85	2119.54	I	0–47165
95	2125.44	I	7107–54141
220	2126.81	II	
95	2127.52	I	2835–49824
220	2127.94	I	0–46979
180	2148.22	I	7107–53642
120	2150.54	I	4079–50564
170	2152.68	II	
140	2155.81	I	0–46372
380	2158.05	I	2835–49159
100	2162.88	I	0–46220
280	2169.42	II	
220	2175.24	I	0–45957
130	2178.17	I	0–45896
75	2187.43	II	
55	2190.38	II	
36	2191.64	I	2835–48449
44	2208.09	II	
65	2220.37	I	2835–47858
38	2221.07	II	
120	2242.68	II	
30	2245.76	II	
100	2253.38	I	7107–51471
	2253.49	I	4079–48441
100	2255.10	I	2835–47165
70	2255.81	I	5785–50101
17	2258.51	I	9878–54141
70	2258.86	I	6324–50580
40	2264.61	I	2835–46979
55	2266.33	I	6324–50434
50	2268.90	1	10579–54639
32	2280.00	I	6324–50170
46	2281.02	II	
32	2281.91	I	9878–53687
16	2284.60	I	13940–57698
16	2295.08	I	5785–49342
38	2298.05	I	11831–55333
	2298.16	I	6324–49824
22	2299.53	I	7107–50580
44	2300.50	I	6324–49779
130	2304.22	I	2835–46220
20	2305.47	I	5785–49146
10	2307.27	I	7107–50434
44	2308.93	I	6324–49621
22	2315.38	I	0–43176
20	2321.45	I	7107–50170
20	2321.58	I	2835–45896
10	2327.98	I	12218–55161
26	2333.30	I	5785–48629
36	2333.84	I	6324–49159
28	2334.50	I	6324–49146
75	2343.18	I	5785–48449
36	2343.61	I	5785–48441
5	2352.62	I	12218–54711
28	2355.00	I	9878–52327
11	2357.53	II	
20	2358.16	I	4079–46472
24	2360.73	I	9878–52224
120	2363.04	I	6324–48629
18	2368.04	II	
170	2372.77	I	0–42132
14	2375.09	II	
12	2377.28	I	7107–49159
12	2377.98	I	7107–49146
24	2379.38	I	4079–46094
26	2381.62	I	6324–48299
10	2383.17	I	13088–55036
4	2383.79	I	9878–51815
6	2386.58	II	
65	2386.89	I	6324–48207
120	2390.62	I	2835–44652
130	2391.18	I	2835–44643
4	2401.77	I	13088–54711
11	2407.59	I	7107–48629
14	2409.37	I	4079–45571
14	2410.17	I	13088–54566
14	2410.73	I	12218–53687
26	2413.31	I	4079–45503
18	2415.86	I	5785–47165
30	2418.11	I	7107–48449
6	2424.32	I	10579–51815
6	2424.66	I	9878–51108
10	2424.89	I	5785–47011
18	2424.99	I	6324–47549
14	2425.66	I	6324–47537
8	2426.53	II	
2.5	2426.78	I	5785–46979
26	2427.61	I	4079–45259
26	2431.24	I	0–41119
65	2431.94	I	4079–45186
8	2432.36	I	7107–48207
5	2432.58	I	13940–55036
13	2435.14	I	13088–54141
4	2436.42	I	13088–54119
12	2445.34	I	6324–47206
2.0	2447.49	I	17779–58625
12	2447.76	I	6324–47165
9	2448.23	I	5785–46618
2.0	2449.02	I	12952–53772

Intensity and character	Wavelength in Å	Spectrum	Energy levels in K
Iron			
300	2084.12	I	0–47967
360	2166.77	I	0–46137
150	2178.09	I	416–46314
63	2191.84	I	704–46314
60	2196.04	I	888–46410
22	2297.79	I	416–43923
26	2332.80	II	385–43239
14	2338.00	II	863–43621
36	2343.49	II	0–42658
12	2348.10	II	1873–44447
12	2348.30	II	668–43239
11	2359.10	II	863–43239
11	2360.00	II	1873–44233
9	2360.29	II	2430–44785
20	2364.83	II	385–42658
10	2368.60	II	2838–45044
26	2373.73	II	0–42115
7	2375.19	II	3118–45207
15	2379.28	II	2430–44447
15	2380.76	II	668–42658
130	2382.04	II	0–41968
8	2383.24	II	2838–44785
6	2384.39	II	3118–45044
32	2388.63	II	385–42237
110	2395.62	II	385–42115
36	2399.24	II	668–42335
7	2404.43	II	863–42440
100	2404.88	II	668–42237
30	2406.66	II	863–42401
30	2410.52	II	863–42335
22	2411.07	II	977–42440
22	2413.31	II	977–42401
5	2424.14	II	22637–63876
3.5	2430.07	II	22810–63949
8	2439.74	I	19390–60366
6	2440.11	I	19788–60758
11	2442.57	I	19621–60549
5	2443.87	I	6928–47835
4	2444.51	II	20831–61726
3.0	2445.56	II	21812–62690
7	2447.71	I	0–40842
Lanthanum			
22	2187.87	II	0–45692
70	2256.76	II	1394–45692
100	2297.78	III	1603–45111
8	2317.82	II	18895–62026
18	2319.44	II	2592–45692
7	2328.75	II	16599–59528
90	2379.38	III	0–42015
1.8	2438.01	II	18895–59900
Lead			
600	2022.02	I	0–49440
700	2053.27	I	0–48687
550	2169.99	I	0–46069
140	2203.53	II	14081–59448
20	2246.88	I	7819–52312
7	2332.44	I	10650–53511
3.5	2388.80	I	10650–52500
170	2393.79	I	10650–52412
3.0	2399.60	I	10650–52312
60	2401.95	I	7819–49440
13	2411.73	I	10650–52102
2.0 h	2428.63	I	21458–62621
38	2443.84	I	7819–48726
70	2446.19	I	7819–48687
Lutetium			
130 h	2195.54	II	0–45532
44	2236.17	III	0–44705
7	2276.94	II	27264–71169
14	2297.41	II	28503–72017
100	2392.19	II	17332–59122
9	2399.14	II	32453–74122
6	2419.21	II	38223–79547
4	2430.26	II	32453–73588
Manganese			
1000	1995.41	I	0–50099
1400	1998.86	I	0–50013
1900	2003.85	I	0–49888
160	2092.16	I	0–47782
180	2109.58	I	0–47388
30	2208.81	I	0–45259
56	2213.85	I	0–45156
80	2221.84	I	0–44994
Molybdenum			
2400	2015.11	II	0–49609
5000	2020.30	II	0–49481
2600	2038.44	II	0–49041
2200	2045.98	II	0–48861
600	2081.68	II	0–48022
300	2089.52	II	15199–63041
280	2092.50	II	15331–63105
500	2093.11	II	15447–63207
340	2100.84	II	15428–63012
190	2104.29	II	15447–62954
170	2108.02	II	23248–70670
50	2269.69	II	15447–59492
20	2304.25	II	27627–71011
20	2306.97	II	15427–58761
16	2325.94	I	12346–55328
30	2330.46	I	
14	2332.12	II	15330–58197
24	2340.47	I	
24	2341.59	II	15199–57892

TABLE 2. *Lines arranged by elements*—Continued

Intensity and character	Wavelength in Å	Spectrum	Energy levels in K
Molybdenum—Continued			
10	2352.61	I	12346–54839
10	2355.22	I	11143–53589
10	2355.42	II	15699–58141
9	2364.37	I	11454–53736
6	2366.09	II	15890–58141
17	2372.27	I	11454–53595
13	2380.41	I	11859–53855
19	2383.52	I	11859–53800
14	2389.20	II	23853–65695
17	2403.61	II	23833–65425
10	2404.66	II	24509–66082
17	2405.86	I	
5	2408.39	I	12346–53855
5	2412.84	II	22444–63877
15	2413.01	II	15890–57320
9	2415.33	I	12346–53736
10	2417.96	II	16796–58141
8	2419.01	II	23934–65261
10	2420.18	II	24138–65444
9	2424.00	II	23833–65075
8	2430.43	I	12346–53479
8	2435.96	II	22864–63904
8	2440.28	II	17174–58141
Nickel			
110	2289.98	I	0–43655
44	2300.78	I	205–43655
140	2310.96	I	0–43259
120	2312.34	I	1332–44565
100	2313.66	I	
100	2313.98	I	2217–45419
30	2316.04	II	8394–51558
95	2317.16	I	1332–44475
180	2320.03	I	0–43090
130	2321.38	I	2217–45281
17	2322.68	I	
100	2325.79	I	1332–44315
65	2329.96	I	2217–45122
32	2337.49	I	0–42768
11	2337.82	I	1713–44475
85	2345.54	I	0–42621
13	2346.63	I	1332–43933
28	2347.52	I	0–42585
11	2360.63	I	2217–44565
14	2362.06	I	1332–43655
17	2386.58	I	880–42768
22	2394.52	II	13550–55300
15	2416.14	II	14995–56371
17	2419.31	I	1332–42654
6	2421.23	I	1332–42621
5	2423.33	I	1332–42585
5	2423.66	I	2217–43464
5	2424.03	I	1713–42954
7	2437.89	II	13550–54557

Intensity and character	Wavelength in Å	Spectrum	Energy levels in K
Niobium			
600	2029.32	II	
550	2032.99	II	3542–52715
360	2109.42	II	
300	2125.21	II	3030–50069
190	2126.54	II	3542–50552
280	2131.18	II	2629–49537
66	2295.68	II	1225–44771
50	2302.08	II	801–44227
30	2376.40	II	801–42869
20	2387.09	II	10836–52715
26	2387.52	II	7901–49772
8	2388.27	II	7901–49759
28	2398.48	II	10247–51927
10	2405.34	II	10653–52215
10	2405.85	II	10836–52389
26	2412.46	II	8320–49759
28	2416.99	II	10919–52280
26	2418.69	II	10604–51936
14	2433.80	II	9510–50585
7	2435.95	II	9813–50852
6	2436.33	I	2154–43187
8	2437.42	II	7506–48520
7	2442.14	II	10247–51182
5	2442.68	II	16219–57145
Osmium			
800	2001.45	I	0–49947
1100	2003.73	I	4159–54050
750	2004.78		
1400	2010.15	I	0–49731
2400	2018.14	I	0–49534
2400	2020.26		
1200	2022.76	I	2740–52162
1200	2028.23	I	4159–53447
1500	2034.44	I	0–49138
2200	2045.36		
650	2048.28	I	2740–51546
650	2049.42	I	4159–52938
720	2058.69	I	0–48559
	2058.78	I	4159–52716
1100	2061.69	I	2740–51229
650	2067.21	II	3593–51952
350	2070.67	II	3929–52206
600	2076.95	I	0–48132
600	2078.09		
1200	2079.97	I	0–48062
240	2082.54	I	4159–52162
240	2089.03	I	0–47854
240	2089.21	I	2740–50589
500	2097.60	I	5144–52802
440	2100.63	I	2740–50330
180	2117.66	I	2740–49947
400	2117.96	I	0–47200
550	2119.79		
160	2123.84	I	4159–51229
440	2137.11	I	4159–50937

TABLE 2. *Lines arranged by elements* – Continued

Intensity and character	Wavelength in Å	Spectrum	Energy levels in K
Osmium – Continued			
200	2149.97		
220	2154.59	I	2740–49138
110	2157.84	I	0–46328
100	2158.53	I	2740–49054
200	2161.00		
260	2166.90	I	4159–50294
95	2167.75	I	0–46117
180	2171.65	I	2740–48773
80	2184.68	I	0–45759
70	2194.39	II	3593–49149
64	2202.49	I	0–45389
50	2227.98	I	0–44870
90	2234.61	I	2740–47477
110	2252.15	I	8743–53131
170	2255.85	I	2740–47052
		II	0–44315
120	2264.60	I	4159–48303
30	2268.28	I	2740–46813
80	2270.17	I	2740–46776
120	2282.26	II	0–43802
70	2283.67	I	4159–47935
48	2289.32	I	4159–47828
32	2297.31	I	0–43516
55	2308.31	I	5144–48452
16	2313.75	II	5592–48799
46	2320.18	I	
26	2323.98	I	
55	2324.24	I	0–43011
14	2325.51	I	5144–48132
28	2326.99	I	6093–49054
26	2334.56	I	2740–45562
60	2336.80	II	3593–46374
36	2338.63	I	0–42747
24	2340.69	I	5144–47854
36	2343.74	I	4159–46813
22	2345.75	I	4159–46776
36	2347.38	I	8743–51329
19	2350.23	II	5592–48128
5	2351.55	I	10166–52678
5	2351.72	I	11378–53887
30	2352.99	I	8743–51229
10	2355.28	II	3929–46374
20	2356.92	I	
20	2357.25	I	8743–51152
26	2362.41	I	0–42317
75	2362.77	I	0–42310
16	2363.33	I	8743–51043
42	2367.35	II	3929–46157
24	2369.24	I	8743–50937
42	2370.70	I	4159–46328
40	2371.18	I	8743–50903
7	2374.33	I	4159–46264
8	2374.51	I	11031–53131
8	2375.06	II	
220	2377.03	I	5144–47200
22	2377.61	I	11378–53424
8	2378.14	I	5766–47802
8	2378.74	I	12774–54800
75	2379.39	I	5144–47158
15	2379.64	I	4159–46170
15	2379.84		
8	2380.82	I	2740–44730
15	2382.46	I	11378–53338
20	2384.62	I	2740–44663
140	2387.29	I	0–41876
28	2394.29	I	11378–53131
24	2395.39	I	2740–44475
90	2395.88	I	0–41726
18	2396.78	I	12774–54484
5	2397.61	I	11378–53073
9	2398.18	I	11031–52716
80	2401.13	I	8743–50377
22	2402.23	I	4159–45775
17	2403.54	I	10166–51759
28	2403.85	I	8743–50330
8	2405.08	II	
24	2405.45	I	11378–52938
17	2405.96	I	8743–50294
30	2408.67	I	11031–52535
20	2410.98	I	13020–54484
8	2411.90		
8	2414.10	I	8743–50154
24	2414.52	I	2740–44144
15	2415.32	I	14091–55481
44	2417.99	I	4159–45503
7	2418.35	I	11378–52716
44	2418.53	I	2740–44075
4	2419.63		
8	2420.02	II	13137–54445
4	2421.15	I	12774–54064
7	2421.86	I	14091–55369
7	2421.94		
17	2423.07	II	7892–49149
6	2424.02	II	13204–54445
4	2424.19	I	12774–54013
42	2424.56	I	0–41232
120	2424.97	I	0–41225
5	2426.19	I	8743–49947
20	2426.81	I	11031–52224
6	2427.90	II	13204–54379
4	2429.67	I	10166–51311
32	2431.19	I	5144–46264
32	2431.61	I	11378–52491
12	2435.51	I	5766–46813
12	2435.65	I	13020–54064
2.5	2436.51	I	13020–54050
6	2437.73		
3.5	2440.68	I	11378–52338
7	2442.00	I	13365–54302
6	2445.88	I	12774–53647
30	2446.02	I	2740–43611
3.0	2449.88		

TABLE 2. *Lines arranged by elements*—Continued

Intensity and character	Wavelength in Å	Spectrum	Energy levels in K
	Palladium		
68	2447.91	I	0–40839
	Phosphorus		
34	2135.47	I	11362–58174
340	2136.18	I	11376–58174
260	2149.14	I	11362–57877
28	2152.94	I	18722–65157
55	2154.08	I	18748–65157
	Platinum		
320	2030.63	I	
440	2032.41	I	
550	2049.37	I	0–48779
150	2067.50	I	0–48352
300	2084.59	I	824–48779
100	2103.33	I	824–48352
95	2128.61	I	776–47741
190	2144.23	I	0–46622
		II	4787–51408
60	2165.17	I	0–46170
150	2174.67	I	
40	2202.22	I	776–46170
32	2222.61	I	6568–51546
15	2249.30	I	0–44444
19	2268.84	I	
28	2274.38	I	776–44730
15	2289.27	I	776–44444
15	2292.40	I	824–44433
24	2308.04	I	6568–49881
9	2315.50	I	
22	2318.29	I	824–43946
10	2326.10	I	6568–49545
17	2340.18	I	6568–49286
28	2357.10	I	776–43188
18	2368.28	I	6568–48779
13	2383.64	I	10132–52072
4	2386.81	I	776–42660
12	2389.53	I	824–42660
3.5	2396.17	I	13496–55217
7	2401.87	I	10132–51752
20	2403.09	I	6140–47741
10	2418.06	I	13496–54839
8	2428.04	I	6568–47741
5	2428.20	I	10117–51287
2.5	2429.10	I	10132–51287
18	2436.69	I	776–41803
65	2440.06	I	0–40970
	Rhenium		
2000	2003.53	I	0–49895
1300	2017.87	I	0–49541
2200	2049.08	I	0–48786
340	2074.70	I	0–48184
300	2083.92	I	0–47971
850	2085.59	I	0–47932
380	2092.41	II	
800	2097.12	I	0–47669
220	2109.22	I	
280	2139.04	II	
130	2142.74	II	
	2142.97	I	0–46649
300	2156.67	I	0–46353
400	2167.94	I	0–46112
280	2176.21	I	0–45937
340 c	2214.26	II	0–45148
180	2214.58	I	
140	2226.42	I	0–44901
75	2235.44	I	0–44720
36	2255.73	I	11584–55902
70	2256.19	I	0–44309
160	2264.39	I	0–44148
170	2274.62	I	0–43950
420 c	2275.25	II	0–43938
130	2281.62	I	0–43815
240	2287.51	I	0–43702
220	2294.49	I	0–43569
32	2298.09	II	27628–71128
32	2299.77	I	11755–55224
50	2302.99	I	0–43408
55	2306.54	I	0–43342
19	2312.97	I	15058–58280
18	2313.34	I	
18	2319.19	I	16307–59412
30	2320.16	I	16307–59394
65	2322.49	I	0–43044
24	2328.66	I	11584–54514
22	2334.33	I	11584–54410
22	2335.73	I	11754–54554
18	2336.10	I	16619–59412
22	2337.95	I	11754–54514
70	2344.78	I	
11	2345.28	I	13826–56452
11	2347.06	I	11584–54177
19	2349.39	I	14621–57173
18 d	2350.46	I	
55	2352.07	I	11584–54087
17 d	2353.95	I	
	2354.08	I	11754–54221
20	2356.50	I	11754–54177
16	2365.32	I	
95	2365.90	I	0–42254
46	2367.68	I	15058–57281
15	2368.53	II	14930–57139
42	2369.27	I	11755–53949
18	2370.76	II	14883–57050
17	2371.52	I	11584–53738
12	2373.48	II	14930–57050
26	2375.07	I	14217–56308
12	2375.82	I	11584–53662

Intensity and character	Wavelength in Å	Spectrum	Energy levels in K
Rhenium—Continued			
8	2377.33	I	
6	2378.53	II	27746–69776
30	2379.77	I	
15	2380.22	I	16619–58619
6	2380.89	I	16307–58295
15	2381.14	I	11754–53738
15	2383.46	I	14217–56160
15	2386.90	II	20976–62859
7	2387.46	I	16307–58180
28	2388.57	I	
14	2389.11	I	0–41844
14	2390.43	I	
7	2391.28	I	11584–53390
19	2393.65	I	13826–55590
26	2394.37	I	11584–53336
26	2396.79	I	11584–53294
16	2397.31	I	15166–56866
6	2398.71	I	16619–58295
6	2398.89	I	
17 d	2400.72	I	15058–56699
	2400.89	I	
17	2401.68	I	11754–53379
12	2402.60	I	
6	2403.04	II	23341–64942
12	2404.34	I	
120	2405.06	I	11754–53321
60	2405.60	I	0–41557
26	2406.70	I	
22	2410.37	I	11584–53059
10	2410.99	I	
15	2413.22	I	
10	2414.59	I	15770–57173
10	2416.30	I	
10	2416.44	I	11584–52954
10	2417.66	I	16307–57657
5	2418.20	II	25988–67328
14	2419.40	I	15770–57090
100	2419.81	I	0–41313
14	2421.38	I	15166–56452
24	2421.73	I	14621–55901
24	2421.88	I	
5	2423.50	I	15058–56308
5	2423.84	II	
5	2425.38	I	
8	2426.64	I	16328–57524
200	2428.58	I	0–41164
9	2429.65	I	16307–57453
40	2431.54	I	
34	2432.18	I	11754–52857
12	2432.70	I	15166–56260
14	2433.28	I	16307–57391
8	2433.61	I	
8	2436.05	I	16619–57657
15	2438.46	I	13826–54823
11	2439.06	I	11754–52741
6	2440.41	I	
6	2440.58	I	
28 c	2441.47	I	0–40946
19	2442.51	I	15770–56699
7	2444.09	I	
20	2444.94	I	11584–52472
50	2446.98	I	15058–55912
10	2448.20	I	
7	2449.03	II	18846–59666
7	2449.52	II	26237–67049
50	2449.71	I	0–40809
Rhodium			
11	2276.21	I	28835–71359
10	2288.57	I	2598–46280
8	2309.82	I	3473–46753
4	2318.36	I	5691–48811
7	2319.10	I	5691–48798
7	2321.73	I	1530–44588
26	2322.58	I	0–43042
10	2326.47	I	3310–46280
6	2328.64	I	7791–50721
14	2334.77	II	16885–59702
4	2345.41		
4	2352.47	I	0–42495
4	2359.18	I	1530–43905
22	2361.92	I	0–42325
8	2368.34	I	3473–45683
20	2382.89	I	0–41953
17	2383.40		
3.0	2384.65	I	7791–49713
20	2386.14		
6	2407.88	I	1530–43048
2.0	2408.19	I	1530–43042
2.0	2410.25	I	3310–44787
6	2415.84	II	19793–61173
4	2418.64		
3.5	2419.75	I	3473–44787
3.5	2420.18	II	33845–75152
5	2420.98	II	20647–61940
6	2423.94		
5	2427.11	II	18540–59729
10	2427.68	I	2598–43777
18	2429.52	I	3473–44621
3.0	2431.85	II	21180–62288
3.0	2432.66	I	5658–46753
1.4	2437.08	I	7791–48811
9	2437.80		
26	2440.34	I	1530–42495
4 h	2444.27		
5	2448.84	I	2598–43421
4	2449.04	I	5691–46511
Ruthenium			
280	2076.43	I	0–48144
300	2083.77	I	1191–49165
275	2090.89	I	
80	2255.52	I	0–44322
34	2259.53	I	0–44243

Intensity and character	Wavelength in Å	Spectrum	Energy levels in K
Ruthenium—Continued			
90	2272.09	I	0–43999
28	2278.19	I	1191–45071
90	2279.57	I	
20	2285.38	I	0–43743
34	2302.54	I	1191–44608
55	2317.80	I	1191–44322
17	2322.01	I	1191–44243
14	2334.96	II	10151–52964
28	2340.69	I	2092–44801
22 h	2342.85	II	10151–52820
22	2349.34	I	1191–43743
36	2351.33	I	2092–44608
20	2357.91	II	9152–51549
16	2360.56	I	2092–44442
20	2370.17	I	2713–44891
28	2375.27	I	2713–44801
9	2375.63	II	11604–53685
19	2392.42	I	3105–44891
11	2396.71	II	9152–50863
85	2402.72	II	9152–50758
16	2407.92	II	11304–52820
6	2410.89	I	
6	2414.82	II	10151–51549
14	2420.82	I	
6	2422.92	I	
5	2429.60	I	8575–49722
7	2432.93	I	6545–47635
3.5	2447.45	I	9492–50339
Scandium			
5	2429.16		
8	2438.62		
Selenium			
9000	1960.26	I	0–50997
4000	2039.85	I	1989–50997
1100	2062.79	I	2534–50997
200	2074.79	I	0–48182
Silicon			
220	2124.11	I	6299–53362
30	2207.97	I	0–45276
30	2210.88	I	77–45294
48	2216.67	I	223–45322
32	2435.16	I	6299–47352
Silver			
8	2331.37	II	40741–83621
15	2413.18	II	40741–82168
9	2437.79	II	39164–80172
3.0	2447.93	II	46046–86884

Intensity and character	Wavelength in Å	Spectrum	Energy levels in K
Strontium			
140	2152.84	II	14556–60992
140	2165.96	II	14836–60992
1.6	2428.10	I	0–41172
Tantalum			
110	2140.13	II	
150	2146.87	II	1031–47596
75	2150.62	II	1031–47515
60	2165.01	II	0–46175
75	2178.03	II	3180–49080
120	2182.71	II	1031–46831
54	2193.20	II	2642–48223
110	2193.88	II	6187–51754
150	2196.03	II	4416–49938
150	2199.67	II	0–45447
50	2207.14	II	
140 d	2210.03	II	0–45234
	2210.19	II	4416–49647
42	2215.60	II	4416–49536
140	2239.48	II	2642–47281
24	2248.48	II	9746–54207
48	2249.79	II	0–44435
120	2250.76	II	1031–45447
26	2254.86	II	3180–47515
44	2255.77	II	12436–56753
36	2256.51	II	9746–54048
50	2258.71	II	0–44259
85	2261.42	II	0–44206
26	2261.62	II	1031–45234
100	2262.30	II	2642–46831
22	2269.56	II	12705–56753
75	2271.85	II	2642–46646
100	2272.59	II	3180–47169
20	2279.85	I	
32	2282.19	II	1031–44835
13	2285.02	II	5331–49080
80	2285.25	II	2642–46387
60	2286.59	II	9746–53466
24	2287.27	II	12436–56142
100	2289.16	II	3180–46851
18	2292.54	II	0–43606
16	2295.18		
16	2301.47	II	12705–56142
44	2302.24	II	5658–49080
44	2302.93	II	4416–47825
30	2303.49	II	1031–44430
10	2308.46	II	5658–48963
44	2312.60	II	1031–44259
42	2315.46	II	1031–44206
26	2319.16	II	12436–55543
10	2331.29	II	11767–54649
70	2331.98	II	
55	2332.19	II	4416–47281
11	2334.13	II	
18	2334.88	II	6831–49647

Intensity and character	Wavelength in Å	Spectrum	Energy levels in K
Tantalum—Continued			
14	2335.75	II	12705–55505
30	2338.28	II	6988–49741
20	2340.94	II	6831–49536
20	2341.61	II	12436–55128
13	2343.64	II	
10	2346.42	II	
9	2351.99	II	
17	2353.86	II	5331–47801
12	2355.22	II	
17	2356.05	II	9690–52121
14	2356.90	II	4416–46831
25	2357.30	I	0–42408
17	2359.16	II	9746–52121
26	2361.09	I	2010–44350
16	2362.78	II	
13	2363.32	II	
60	2364.24	II	6187–48470
5	2367.24	II	4416–46646
15	2369.32	II	2642–44835
30	2370.76	II	5658–47825
32	2371.58	I	3964–46117
		II	0–42153
7	2372.80	II	6831–48963
10	2373.94	II	10713–52825
7	2375.91	I	
15	2378.31	II	1031–43065
44	2381.13	II	2642–44626
24	2381.52	II	0–41977
17	2383.72	II	5658–47596
24	2384.28	II	1031–42960
13	2385.73	I	
140	2387.06	II	4416–46295
8	2388.37	II	5658–47515
16	2389.11	II	9690–51534
7	2396.30	I	5621–47340
11	2399.15	I	
5	2399.92	II	3180–44835
240	2400.63	II	6187–47830
14	2402.13	II	2642–44259
10	2403.68	II	11875–53466
13	2406.55	I	2010–43551
4	2407.57	I	2010–43553
13	2408.26	II	5658–47169
4 d	2412.53	II	14581–56019
	2412.67	I	
12	2414.32	I	9253–50660
24	2415.21	II	6831–48223
32	2416.89	II	2642–44005
8	2417.33	II	0–41355
22	2417.86	II	
15	2418.77	II	
14	2421.03	I	3964–45256
15	2421.85	II	14581–55859
17	2423.48	II	3180–44430
13	2425.91	II	12436–53645
36	2427.64	I	0–41180
6	2428.00	II	5658–46831
36	2429.71	II	0–41145
17	2431.06	II	1031–42153
6	2431.66	I	
48	2432.70	II	6187–47281
13	2433.59	II	3180–44259
13	2436.51	II	12436–53466
11	2437.07	I	
9	2437.67	I	0–41010
11	2438.64	II	6831–47825
20	2439.91	I	2010–42983
13	2442.39	I	5621–46552
10	2444.13	II	2642–43544
9	2444.67	II	
5	2445.53	II	
10	2447.17	I	0–40852
8	2449.44	II	6988–47801
Tellurium			
1400	1994.2	I	4751–54877
2600	2002.0	I	4751–54685
650	2081.03	I	10559–58596
1800	2142.75	I	0–46653
320	2147.19	I	10559–57116
36	2159.79	I	10559–56845
50	2259.04	I	0–44253
120	2383.25	I	4707–46653
150	2385.76	I	4751–46653
Thallium			
14	2315.98	I	0–43166
90 h	2379.69	I	0–42011
Thorium			
12	2326.93	II	1860–44822
9	2354.02	II	
9	2356.75	II	0–42418
4	2366.04	II	
10	2366.98	II	
4	2368.05	II	4490–46706
14	2373.84	II	0–42113
9	2375.07	II	
20	2377.84	II	4113–46156
6	2384.36	II	
6	2388.14	II	1522–43383
6	2393.11	II	4490–46264
8	2404.17	II	
8	2404.51	II	4113–45689
4	2411.30	II	
9	2413.41	II	1522–42944
4	2423.00	II	
8	2423.68	II	
2.5	2431.15	II	4490–45611
5	2432.85	II	

TABLE 2. *Lines arranged by elements*—Continued

Intensity and character	Wavelength in Å	Spectrum	Energy levels in K
Thorium—Continued			
4	2437.54	II	
3.0	2443.96	II	
2.5	2444.46	II	1522–42418
Thulium			
40	2284.80	II	
13	2329.78	II	
26	2331.78	III	
24	2338.36	III	
8	2340.93	II	
34	2357.05	III	
13	2361.23	III	
13	2363.93	III	
5	2365.95	II	
18	2367.11	II	237–42470
17	2383.68	II	
12	2388.95	II	
6	2408.23	II	
50	2409.03	II	
12	2412.44	II	
7	2419.37	II	
3.5	2420.21	II	
13	2421.64	II	
2.5	2423.28	II	
50	2426.16	II	
6	2428.42	II	
3.5	2430.75	II	
6	2434.74	II	
5	2436.19	II	
7	2437.66	II	
10	2440.69	II	
15	2445.46	II	
4	2445.94	II	
7	2447.40	II	
Tin			
2600	1970.80	I	1692–52416
1500 h	1983.55	I	3428–53826
800	2040.66	I	3428–52416
480	2073.08	I	0–48222
550	2091.58	I	1692–49487
140 h	2096.39	I	8613–56299
150	2100.93	I	3428–51010
550	2113.93	I	1692–48982
60	2148.73	I	1692–48216
140	2151.43	I	3428–49894
160	2194.49	I	3428–48982
220	2199.34	I	1692–47146
320	2209.65	I	3428–48670
30	2211.05	I	8613–53826
48	2231.72	I	3428–48222
420	2246.05	I	0–44509
19	2251.17	I	8613–53021
48	2267.19	I	8613–52707
320	2268.91	I	3428–47488
65	2286.68	I	3428–47146
220	2317.23	I	8613–51754
140	2334.80	I	1692–44509
550	2354.84	I	1692–44145
6	2357.90	I	8613–51010
20	2380.72	I	1692–43683
26	2408.15	I	8613–50126
360	2421.70	I	8613–49894
550	2429.49	I	3428–44576
3.5	2433.47	I	3428–44509
Titanium			
15	2272.61	I	387–44376
19	2273.28	I	0–43976
14	2276.70	I	170–44079
20	2279.96	I	387–44233
16	2299.85	I	0–43468
15	2302.73	I	170–43583
20	2305.67	I	387–43745
7	2380.81	I	387–42377
3.5	2384.52	I	387–42311
6	2418.36	I	0–41337
8	2421.30	I	170–41458
10	2424.24	I	387–41624
4	2428.23	I	0–41170
3.5	2433.22	I	170–41255
2.0	2434.10	I	387–41458
3.5	2440.21	II	12629–53597
7	2440.98	I	387–41342
Tungsten			
480	2001.71	II	3173–53114
1100	2008.07	II	4716–54499
420	2009.98	II	1518–51254
340	2010.23	II	3173–52902
340	2014.23	II	3173–52803
600	2026.08	II	4716–54057
1200	2029.98	II	6147–55393
220	2035.03	II	7420–56544
440	2049.63	II	1519–50292
190	2065.57	II	4716–53114
280	2071.21	II	3173–51438
180	2075.59	II	8711–56875
800	2079.11	II	6147–54229
300	2088.19	II	3173–51045
180	2089.14	II	4716–52567
140	2090.48		
500	2094.75	II	1519–49242
200	2098.60	II	1519–49154
180	2100.67	II	0–47589
120	2101.54		

TABLE 2. *Lines arranged by elements*—Continued

Intensity and character	Wavelength in Å	Spectrum	Energy levels in K
Tungsten—Continued			
120	2106.18	II	1519–48983
110	2110.34	II	8711–56084
170	2118.87	II	0–47180
200	2121.59	II	3173–50292
70	2153.56	II	6147–52567
70	2157.80	II	4716–51045
120	2166.32	II	4716–50863
40	2182.90	I	6219–52015
36	2194.52	II	0–45554
110	2204.48	II	6147–51495
38	2248.75	II	0–44455
38	2249.84	I	1670–46105
15	2270.24	II	1519–45554
8	2271.37	I	3326–47338
42	2277.58	I	0–43893
13	2284.90	I	1670–45422
26	2285.17	I	6219–49966
44 d	2294.49	I	6219–49789
	2294.54	II	4716–48285
22	2298.28	I	4830–48326
20	2303.83	II	1519–44912
20	2306.60	I	2951–46292
28	2309.04	I	6219–49514
36	2313.19	I	0–43217
18	2314.18	I	6219–49418
16	2315.02	II	3173–46355
9	2318.94	I	15070–58179
38	2321.63	I	3326–46385
24	2326.09	II	6147–49125
32 d	2326.56	I	6219–49188
	2326.71	I	3326–46292
6	2328.31	II	1519–44455
15	2331.30	I	12162–55043
6	2331.92	I	
6	2332.76		
11	2333.77	II	1519–44355
17	2341.37	I	1670–44367
5	2343.13	I	17008–59673
6	2347.97	I	3326–45902
6	2349.26	II	20534–63088
	2349.32	I	13307–55859
10 d	2350.37	II	20456–62990
	2350.46	I	4830–47362
26	2354.61	I	6219–48676
5	2358.07	I	12162–54557
5	2358.81	II	3173–45554
48	2360.43	I	3326–45678
70	2363.06	I	1670–43975
5	2364.22	II	14968–57252
9	2365.45	I	0–42262
9	2365.85	I	17008–59264
9	2366.18	I	4830–47079
8	2366.95	I	9528–51763
12	2367.68	I	1670–43893
8	2370.88	I	2951–45117
3.0	2371.39	I	17107–59264
4	2374.14	I	6219–48326
42	2374.46	I	4830–46932
7	2374.76	I	3326–45422
8	2376.07	I	15070–57143
4	2376.56	I	17107–59172
4	2377.03	I	
17	2382.99	I	6219–48171
55	2384.82	I	6219–48138
7	2386.17	I	17008–58904
20	2389.07	I	1670–43515
10	2390.37	II	7421–49242
10	2392.93	II	4716–46493
10	2395.47	I	
60	2397.09	II	3173–44877
46	2397.72	I	3326–45019
46	2397.98	I	3326–45015
5	2399.04	I	17107–58778
2.5	2401.29	I	6219–47851
8	2402.44	I	13778–55389
6	2404.24	II	8711–50292
4	2405.26	I	13349–54912
140 d	2405.58	I	1670–43228
	2405.69	I	4830–46385
8	2409.03	I	4830–46328
5	2410.63	I	6219–47689
6	2411.54	II	17437–58892
26	2414.04	I	3326–44737
50	2415.68	I	1670–43054
4	2416.23	I	6219–47593
4	2419.34	II	20040–61361
5	2420.20	I	13778–55084
4	2421.01	II	13412–54705
11	2422.28	I	3326–44596
3.5	2422.66	I	6219–47484
90	2424.22	I	4830–46068
20 d	2425.98	I	13349–54557
	2426.07	I	19535–60741
13	2427.29	I	15070–56256
20	2427.49	II	3173–44355
18	2429.39	II	26929–68079
17	2429.84	I	6219–47362
12	2430.44	I	14976–56109
60	2431.08	I	3326–44447
65	2433.98	I	4830–45902
6	2435.01	II	20534–61590
190	2435.96	I	4830–45869
3.0	2436.26	I	2951–43985
26	2436.62	I	3326–44353
3.0	2437.96	I	9528–50534
6	2442.97	I	
2.5	2443.33	I	19826–60741
10	2443.62	I	17008–57919
60	2444.06	I	1670–42573
16	2446.39	II	7421–48285
28	2448.39	I	12162–52993

TABLE 2. *Lines arranged by elements*—Continued

Intensity and character	Wavelength in Å	Spectrum	Energy levels in K
Uranium			
8	2419.57	II	0–41317
4	2423.70		
5	2427.45		
3.0	2432.4		
4	2448.93		
Vanadium			
280	2092.44	I	553–48329
5	2384.00	II	8842–50775
5	2384.28	I	0–41928
8	2386.96	I	10892–52774
8	2388.92	I	11101–52948
10	2390.87	I	137–41950
10	2391.26	I	2220–44026
11	2392.90	I	2425–44203
9	2397.78	I	553–42245
9	2398.27	I	553–42237
9	2399.96	I	0–41655
16	2406.75	I	323–41861
14	2407.90	I	137–41655
12	2412.69	I	323–41758
9	2413.03	I	0–41429
16	2415.33	I	0–41389
16	2416.75	I	553–41918
12	2417.35	I	137–41492
13	2420.12	I	553–41861
13	2421.06	I	137–41429
13	2421.98	I	323–41599
5	2423.38	I	137–41389
14	2428.28	I	323–41492
10	2432.02	I	323–41429
14	2435.52	I	553–41599
7	2439.10	I	553–41539
4	2441.89	I	553–41492
Ytterbium			
350	2116.65	II	0–47229
420	2126.72	II	0–47006
52	2161.60	II	
120	2185.70	II	0–45737
90	2224.45	II	0–44941
20	2320.81	II	0–43075
7	2362.88	II	21418–63727
24	2390.73	II	21418–63234
2.5	2398.01	II	0–41688
4	2421.36	II	32371–73658
3.5	2447.25	II	28758–69608
Yttrium			
34	2243.06	II	0–44568
5	2354.20	I	530–42995
20	2367.25	III	725–42955
3	2373.83		
5	2385.24		
2.5	2413.93	II	23776–65189
24	2414.68	III	0–41401
55	2422.20	II	3296–44568
Zinc			
300	2025.51	II	0–49354
1000	2061.91	II	0–48481
1000	2138.56	I	0–46745
Zirconium			
4	2374.42	I	0–42103
4	2384.17	I	
3.5	2388.01	I	570–42434
3.5	2389.21	I	
3.0	2405.52	I	1241–42799
4	2419.41	II	4248–45568
10	2449.85	II	4248–45055

TABLE 3. *Lines arranged by wavelength*

Intensity and character	Wavelength in Å	Element and spectrum
5500	1936.96	As I
4800	1953.89	Bi I
3000	1954.47	Ge I
900	1959.48	Bi I
9000	1960.26	Se I
2000	1961.36	Ge I
3200	1970.23	Ge I
2600	1970.80	Sn I
6500	1971.97	As I
1500 h	1983.55	Sn I
1400	1987.62	Ge I
3600	1989.70	As I
1100	1990.48	As I
1400	1994.2	Te I
500	1994.78	As I
1000	1995.41	Mn I
4200	1998.24	Ge I
1400	1998.86	Mn I
550	1999.69	Cu II
800	2001.45	Os I
480	2001.71	W II
2600	2002.0	Te I
4400	2003.34	As I
2000	2003.53	Re I
1100	2003.73	Os I
1900	2003.85	Mn I
750	2004.78	Os
1100	2008.07	W II
550	2009.19	As I
420	2009.98	W II
1400	2010.15	Os I
340	2010.23	W II
480	2010.65	Ir I
1100	2012.00	Au I
700	2012.78	Hf II
420	2013.32	As I
340	2014.23	W II
2400	2015.11	Mo II
1300	2017.87	Re I
2400	2018.14	Os I
1700	2019.07	Ge I
2400	2020.26	Os
5000	2020.30	Mo II
1000	2021.21	Bi I
260	2021.38	Au I
600	2022.02	Pb I
420	2022.35	Ir I
1200	2022.76	Os I
240	2024.34	Cu I
300	2025.51	Zn II
600	2026.08	W II
950	2028.18	Hf II
1200	2028.23	Os I
600	2029.32	Nb II
300	2029.49	Sb I
1200	2029.98	W II
320	2030.63	Pt I
440	2032.41	Pt I
550	2032.99	Nb II
750	2033.57	Ir I
1500	2034.44	Os I
220	2035.03	W II
160	2035.84	Cu II
220	2037.12	Cu II
2600	2038.44	Mo II
500	2039.77	Sb I
4000	2039.85	Se I
800	2040.66	Sn I
2400	2041.71	Ge I
1600	2043.77	Ge I
380	2043.79	Cu II
2200	2045.36	Os
2200	2045.98	Mo II
650	2048.28	Os I
2200	2049.08	Re I
550	2049.37	Pt I
650	2049.42	Os I
1300	2049.57	Sb I
440	2049.63	W II
300	2052.22	Ir I
700	2053.27	Pb I
420	2054.46	Ge I
1900	2055.52	Cr II
220	2057.24	Ge I
720	2058.69	Os I
	2058.78	Os I
240	2060.64	Ir I
1400	2061.49	Cr II
1100	2061.69	Os I
4400	2061.70	Bi I
1000	2061.91	Zn II
1100	2062.79	Se I
750	2065.21	Ge I
900	2065.42	Cr II
190	2065.57	W II
650	2067.21	Os II
150	2067.50	Pt I
4200	2068.33	Sb I
2600	2068.66	Ge I
350	2070.67	Os II
280	2071.21	W II
480	2073.08	Sn I
340	2074.70	Re I
200	2074.79	Se I
180	2075.59	W II
280	2076.43	Ru I
600	2076.95	Os I
600	2078.09	Os
800	2079.11	W II
1200	2079.97	Os I
650	2081.03	Te I
600	2081.68	Mo II
240	2082.54	Os I
180	2083.22	Ir I
300	2083.77	Ru I
300	2083.92	Re I
300	2084.12	Fe I
300	2084.59	Pt I
850	2085.59	Re I

Intensity and character	Wavelength in Å	Element and spectrum
150	2085.74	Ir I
420	2086.02	Ge I
300	2088.19	W II
800	2088.82	Ir I
420	2088.93	B I
240	2089.03	Os I
180	2089.14	W II
240	2089.21	Os I
300	2089.52	Mo II
650	2089.59	B I
140	2090.48	W
275	2090.89	Ru I
550	2091.58	Sn I
160	2092.16	Mn I
380	2092.41	Re II
280	2092.44	V I
280	2092.50	Mo II
700	2092.63	Ir I
500	2093.11	Mo II
2000	2094.26	Ge I
500	2094.75	W II
140	2096.18	Hf II
140 h	2096.39	Sn I
800	2097.12	Re I
500	2097.60	Os I
500	2098.41	Sb I
200	2098.60	W II
440	2100.63	Os I
180	2100.67	W II
340	2100.84	Mo II
150	2100.93	Sn I
120	2101.54	W
100	2103.33	Pt I
190	2104.29	Mo II
240	2105.82	Ge I
120	2106.18	W II
170	2108.02	Mo II
220	2109.22	Re I
360	2109.42	Nb II
180	2109.58	Mn I
460	2110.26	Bi I
110	2110.34	W II
65	2112.09	Cu II
130	2112.68	Ir I
550	2113.93	Sn I
350	2116.65	Yb II
180	2117.66	Os I
400	2117.96	Os I
100	2118.48	Sb I
170	2118.87	W II
85	2119.54	Ir I
550	2119.79	Os
200	2121.59	W II
160	2123.84	Os I
220	2124.11	Si I
95	2124.74	Ge I
300	2125.21	Nb II
95	2125.44	Ir I
190	2126.54	Nb II
420	2126.72	Yb II
220	2126.81	Ir II
190	2127.39	Sb I
95	2127.52	Ir I
220	2127.94	Ir I
95	2128.61	Pt I
280	2131.18	Nb II
250	2133.63	Bi I
34	2135.47	P I
200	2135.98	Cu II
340	2136.18	P I
440	2137.11	Os I
70	2138.53	Cu I
1000	2138.56	Zn I
280	2139.04	Re II
320	2139.69	Sb I
110	2140.13	Ta II
160	2141.83	Sb I
130	2142.74	Re II
	2142.97	Re I
1800	2142.75	Te I
190	2144.23	Pt I
		Pt II
1900	2144.38	Cd II
320	2144.86	Sb I
150	2146.87	Ta II
320	2147.19	Te I
180	2148.22	Ir I
60	2148.73	Sn I
260	2149.14	P I
200	2149.97	Os
120	2150.54	Ir I
75	2150.62	Ta II
140	2151.43	Sn I
170	2152.68	Ir II
140	2152.84	Sr II
28	2152.94	P I
70	2153.56	W II
55	2154.08	P I
220	2154.59	Os I
140	2155.81	Ir I
300	2156.67	Re I
70	2157.80	W II
110	2157.84	Os I
380	2158.05	Ir I
100	2158.53	Os I
36	2159.79	Te I
200	2161.00	Os
52	2161.60	Yb II
100	2162.88	Ir I
60	2165.01	Ta II
140	2165.09	Cu I
60	2165.17	Pt I
48	2165.52	As I
140	2165.96	Sr II
120	2166.32	W II
360	2166.77	Fe I
260	2166.90	Os I

TABLE 3. *Lines arranged by wavelength* — Continued

Intensity and character	Wavelength in Å	Element and spectrum	Intensity and character	Wavelength in Å	Element and spectrum
95	2167.75	Os I	55	2214.58	Cu I
400	2167.94	Re I			
			180	2214.58	Re I
280	2169.42	Ir II	42	2215.60	Ta II
550	2169.99	Pb I	48	2216.67	Si I
180	2171.65	Os I	65	2220.37	Ir I
44	2174.60	Co I	65	2220.73	Sb I
150	2174.67	Pt I			
			38	2221.07	Ir II
110 h	2174.94	Be I	80	2221.84	Mn I
	2175.07	Be I	32	2222.61	Pt I
220	2175.24	Ir I	90	2224.45	Yb II
850	2175.81	Sb I	32	2224.93	Sb I
280	2176.21	Re I			
75	2178.03	Ta II	46	2225.70	Cu I
			140	2226.42	Re I
150	2178.09	Fe I	95	2227.78	Cu I
130	2178.17	Ir I	50	2227.98	Os I
180	2178.94	Cu I	36	2228.25	Bi I
150	2179.19	Sb I			
120	2181.72	Cu I	120	2230.08	Cu I
			170	2230.61	Bi I
120	2182.71	Ta II	48	2231.72	Sn I
40	2182.90	W I	90	2234.61	Os I
80	2184.68	Os I	75	2235.44	Re I
120	2185.70	Yb II			
75	2187.43	Ir II	44	2236.17	Lu III
			140	2239.48	Ta II
22	2187.87	La II	120	2242.68	Ir II
55	2190.38	Ir II	34	2243.06	Y II
36	2191.64	Ir I	30	2245.13	Co II
63	2191.84	Fe I			
36	2192.26	Cu II	30	2245.76	Ir II
			420	2246.05	Sn I
54	2193.20	Ta II	20	2246.88	Pb I
110	2193.88	Ta II	40	2247.00	Cu II
70	2194.39	Os II	24	2248.48	Ta II
160	2194.49	Sn I	38	2248.75	W II
36	2194.52	W II	15	2249.30	Pt I
			48	2249.79	Ta II
130 h	2195.54	Lu II	38	2249.84	W I
150	2196.03	Ta II	120	2250.76	Ta II
60	2196.04	Fe I			
340	2198.71	Ge I	19	2251.17	Sn I
220	2199.34	Sn I	110	2252.15	Os I
			100	2253.38	Ir I
170 d	2199.58	Cu I		2253.49	Ir I
	2199.75	Cu I	36	2254.01	Hf II
150	2199.67	Ta II	26	2254.86	Ta II
40	2201.32	Sb I			
40	2202.22	Pt I	100	2255.10	Ir I
64	2202.49	Os I	18	2255.15	Hf II
			80	2255.52	Ru I
140	2203.53	Pb II	36	2255.73	Re I
110	2204.48	W II	44	2255.77	Ta II
50	2207.14	Ta II			
30	2207.97	Si I	70	2255.81	Ir I
44	2208.09	Ir II	170	2255.85	Os I
					Os II
100	2208.45	Sb I	18	2256.00	Ge I
30	2208.81	Mn I	70	2256.19	Re I
320	2209.65	Sn I	36	2256.51	Ta II
140 d	2210.03	Ta II			
	2210.19	Ta II	70	2256.76	La II
60	2210.82	Hf II	17	2258.51	Ir I
			50	2258.71	Ta II
30	2210.88	Si I	70	2258.86	Ir I
30	2211.05	Sn I	50	2259.04	Te I
56	2213.85	Mn I			
340 c	2214.26	Re II	34	2259.53	Ru I

Intensity and character	Wavelength in Å	Element and spectrum	Intensity and character	Wavelength in Å	Element and spectrum
85	2261.42	Ta II	20	2285.38	Ru I
26	2261.62	Ta II			
100	2262.30	Ta II	170	2286.16	Co II
55	2262.51	Sb I	60	2286.59	Ta II
			65	2286.68	Sn I
160	2264.39	Re I	24	2287.27	Ta II
120	2264.60	Os I	240	2287.51	Re I
40	2264.61	Ir I			
900	2265.02	Cd II	30	2287.81	Co I
55	2266.33	Ir I	1500	2288.02	Cd I
			260	2288.12	As I
28	2266.83	Hf II	10	2288.57	Rh I
48	2267.19	Sn I	12	2288.98	Sb I
15	2267.47	Cd I			
12	2268.17	Co I	100	2289.16	Ta II
30	2268.28	Os I	15	2289.27	Pt I
			48	2289.32	Os I
19	2268.84	Pt I	110	2289.98	Ni I
50	2268.90	Ir I	10	2291.46	Co I
320	2268.91	Sn I			
50 d	2269.09	Al I	12	2292.00	Co II
	2269.21	Al I	15	2292.40	Pt I
22	2269.56	Ta II	18	2292.54	Ta II
			11	2293.39	Co II
50	2269.69	Mo II	38	2293.44	Sb I
80	2270.17	Os I			
15	2270.24	W II	28	2293.84	Cu I
8	2271.37	W I	3.5	2294.20	Ga I
75	2271.85	Ta II	220	2294.49	Re I
			44 d	2294.49	W I
90	2272.09	Ru I		2294.54	W II
100	2272.59	Ta II	16	2295.08	Ir I
15	2272.61	Ti I			
19	2273.28	Ti I	16	2295.18	Ta
28	2274.38	Pt I	11	2295.23	Co I
			66	2295.68	Nb II
11	2274.49	Co I	9	2296.05	Co I
170	2274.62	Re I	19	2296.71	Co I
420 c	2275.25	Re II			
11	2276.21	Rh II	32	2297.31	Os I
34	2276.53	Co I	14	2297.41	Lu II
			100	2297.78	La III
34	2276.58	Bi I	22	2297.79	Fe I
14	2276.70	Ti I	38	2298.05	Ir I
7	2276.94	Lu II		2298.16	Ir I
70	2277.16	Hf II			
42	2277.58	W I	32	2298.09	Re II
			22	2298.28	W I
28	2278.19	Ru I	22	2299.53	Ir I
90	2279.57	Ru I	32	2299.77	Re I
20	2279.85	Ta I	16	2299.85	Ti I
20	2279.96	Ti I			
32	2280.00	Ir I	44	2300.50	Ir I
			44	2300.78	Ni I
46	2281.02	Ir II	16	2301.47	Ta II
130	2281.62	Re I	50	2302.08	Nb II
32	2281.91	Ir I	44	2302.24	Ta II
32	2282.19	Ta II			
120	2282.26	Os II	34	2302.54	Ru I
			15	2302.73	Ti I
10	2283.52	Co II	44	2302.93	Ta II
70	2283.67	Os I	50	2302.99	Re I
16	2284.60	Ir I	30	2303.49	Ta II
40	2284.80	Tm II			
11	2284.85	Co I	20	2303.83	W II
			8	2303.97	Co I
13	2284.90	W I	12	2304.18	Co I
13	2285.02	Ta II	130	2304.22	Ir I
26	2285.17	W I	140	2304.24	Ba II
80	2285.25	Ta II			

TABLE 3. *Lines arranged by wavelength*—Continued

Intensity and character	Wavelength in Å	Element and spectrum	Intensity and character	Wavelength in Å	Element and spectrum
20	2304.25	Mo II	20	2321.45	Ir I
15	2305.18	Co I	20	2321.58	Ir I
20	2305.47	Ir I	38	2321.63	W I
20	2305.67	Ti I	7	2321.73	Rh I
18	2306.06	In II	17	2322.01	Ru I
20	2306.46	Sb I	65	2322.47	Hf II
55	2306.54	Re I	65	2322.49	Re I
20	2306.60	W I	26	2322.58	Rh I
40	2306.61	Cd I	17	2322.68	Ni I
20	2306.97	Mo II	100	2323.14	Co I
10	2307.27	Ir I	34	2323.25	Hf II
120	2307.86	Co II	26	2323.98	Os I
24	2308.04	Pt I	55	2324.24	Os I
55	2308.31	Os I	34	2324.32	Co II
10	2308.46	Ta II	13	2324.50	Hf II
44	2308.93	Ir I	34	2324.89	Hf II
110	2309.02	Co I	14	2325.51	Os I
28	2309.04	W I	24	2325.55	Co I
8	2309.82	Rh I	100	2325.79	Ni I
140	2310.96	Ni I	16	2325.94	Mo I
220	2311.47	Sb I	24	2326.09	W II
75	2311.60	Co II	10	2326.10	Pt I
120	2312.34	Ni I	32	2326.14	Co II
44	2312.60	Ta II	10	2326.47	Rh I
19	2312.84	Cd II	32	2326.48	Co II
19	2312.97	Re I			
36	2313.19	W I	32 d	2326.56	W I
18	2313.34	Re I		2326.71	W I
100	2313.66	Ni I	12	2326.93	Th II
16	2313.75	Os II	28	2326.99	Os I
100	2313.98	Ni I	24	2327.92	Ge I
75	2314.05	Co II	10	2327.98	Ir I
18	2314.18	W I	6	2328.31	W II
18	2314.20	Ge I	6	2328.64	Rh I
60	2314.98	Co II	24	2328.66	Re I
16	2315.02	W II	7	2328.75	La II
22	2315.38	Ir I	6	2329.10	Co II
42	2315.46	Ta II	30 h	2329.28	Cd I
9	2315.50	Pt I	13	2329.78	Tm II
14	2315.98	Tl I	65	2329.96	Ni I
30	2316.04	Ni II	22	2330.35	Co II
18	2316.16	Co I	30	2330.46	Mo I
22	2316.86	Co I	10	2331.29	Ta II
95	2317.16	Ni I	15	2331.30	W I
220	2317.23	Sn I	8	2331.37	Ag II
55	2317.80	Ru I	26	2331.78	Tm III
8	2317.82	La II	6	2331.92	W I
22	2318.29	Pt I	70	2331.98	Ta II
4	2318.36	Rh I	14	2332.12	Mo II
9	2318.94	W I	55	2332.19	Ta II
7	2319.10	Rh I	7	2332.44	Pb I
26	2319.16	Ta II	6	2332.76	W
18	2319.19	Re I	26	2332.80	Fe II
18	2319.44	La II	22	2332.97	Hf II
180	2320.03	Ni I	26	2333.30	Ir I
30	2320.16	Re I	11	2333.77	W II
46	2320.18	Os I	36	2333.84	Ir I
20	2320.81	Yb II	11	2334.13	Ta II
26	2321.14	Hf II	22	2334.33	Re I
130	2321.38	Ni I	28	2334.50	Ir I

TABLE 3. *Lines arranged by wavelength*—Continued

Intensity and character	Wavelength in Å	Element and spectrum	Intensity and character	Wavelength in Å	Element and spectrum
26	2334.56	Os I	12	2348.10	Fe II
14	2334.77	Rh II	12	2348.30	Fe II
			950	2348.61	Be I
140	2334.80	Sn I	6	2349.26	W II
18	2334.88	Ta II		2349.32	W I
14	2334.96	Ru II			
200	2335.27	Ba II	22	2349.34	Ru I
22	2335.73	Re I	19	2349.39	Re I
			260	2349.84	As I
14	2335.75	Ta II	19	2350.23	Os II
60	2335.99	Co I	8	2350.28	Co I
18	2336.10	Re I			
60	2336.80	Os II			
22	2337.33	Hf II	10 d	2350.37	W II
				2350.46	W I
			18 d	2350.46	Re I
32	2337.49	Ni I	60	2351.22	Hf II
11	2337.82	Ni I	36	2351.33	Ru I
28	2337.94	Co II	6	2351.39	Co I
22	2337.95	Re I			
14	2338.00	Fe II	5	2351.55	Os I
			5	2351.72	Os I
7	2338.28	Ga I	9	2351.99	Ta II
30	2338.28	Ta II	55	2352.07	Re I
24	2338.36	Tm III	4	2352.47	Rh I
36	2338.63	Os I			
68	2338.67	Co I	10	2352.61	Mo I
			5	2352.62	Ir I
20	2339.05	Co I	18	2352.65	Au I
17	2340.18	Pt I	66	2352.85	Co I
24	2340.47	Mo I	30	2352.99	Os I
24	2340.69	Os I			
28	2340.69	Ru I	12	2353.02	Hf I
			85	2353.42	Co I
8	2340.93	Tm II			Co II
20	2340.94	Ta II	17	2353.86	Ta II
17	2341.37	W I	17 d	2353.95	Re I
24	2341.59	Mo II		2354.08	Re I
20	2341.61	Ta II			
			9	2354.02	Th II
8	2341.82	Er II	5	2354.20	Y I
22 h	2342.85	Ru II	26	2354.61	W I
5	2343.13	W I	550	2354.84	Sn I
75	2343.18	Ir I	28	2355.00	Ir I
26	2343.32	Hf II	10	2355.22	Mo I
36	2343.49	Fe II	12	2355.22	Ta II
36	2343.61	Ir I	10	2355.28	Os II
13	2343.64	Ta II	10	2355.42	Mo II
36	2343.74	Os I	26	2355.48	Co I
16	2344.03	As I	17	2356.05	Ta II
26	2344.26	Co II	20	2356.50	Re I
70	2344.78	Re I	9	2356.75	Th II
11	2345.28	Re I	14	2356.90	Ta II
4	2345.41	Rh	14	2356.91	Dy II
85	2345.54	Ni I	20	2356.92	Os I
22	2345.75	Os I	34	2357.05	Tm III
26	2346.16	Co I	28	2357.10	Pt I
10	2346.42	Ta II	20	2357.25	Os I
13	2346.63	Ni I	25	2357.30	Ta I
11	2347.06	Re I	11	2357.53	Ir II
36	2347.38	Os I	6	2357.90	Sn I
38	2347.39	Co II	20	2357.91	Ru II
36	2347.44	Hf II	5	2358.07	W I
28	2347.52	Ni I	20	2358.16	Ir I
19	2347.58	Ba II	22	2358.18	Co I
6	2347.97	W I	11	2358.51	Er II

TABLE 3. *Lines arranged by wavelength*—Continued

Intensity and character	Wavelength in Å	Element and spectrum	Intensity and character	Wavelength in Å	Element and spectrum
5	2358.81	W II	50	2369.67	As I
11	2359.10	Fe II	15	2369.68	Co I
17	2359.16	Ta II	5	2369.89	Cu II
4	2359.18	Rh I	20	2370.17	Ru I
			10	2370.51	Co I
11	2360.00	Fe II			
9	2360.29	Fe II	42	2370.70	Os I
48	2360.43	W I	18	2370.76	Re II
5	2360.50	Sb I	30	2370.76	Ta II
16	2360.56	Ru I	40	2370.77	As I
			8	2370.88	W I
11	2360.63	Ni I			
24	2360.73	Ir I	40	2371.18	Os I
26	2361.09	Ta I	4	2371.32	Ga I
13	2361.23	Tm III	3.0	2371.39	W I
4	2361.53	Co II	7 h	2371.44	Co I
			17	2371.52	Re I
22	2361.92	Rh I			
14	2362.06	Ni I	32	2371.58	Ta I, Ta II
26	2362.41	Os I			
75	2362.77	Os I	14	2371.86	Co I
16	2362.78	Ta II	17	2372.27	Mo I
			170	2372.77	Ir I
7	2362.88	Yb II	7	2372.80	Ta II
120	2363.04	Ir I			
70	2363.06	W I	4	2372.83	Co I
13	2363.32	Ta II	85	2373.13	Al I
16	2363.33	Os I	17	2373.36	Al I
			6	2373.38	Co I
80	2363.79	Co II	12	2373.48	Re II
13	2363.93	Tm III			
5	2364.22	W II	10	2373.67	Sb I
60	2364.24	Ta II	26	2373.73	Fe II
9	2364.37	Mo I	3	2373.83	Y
			14	2373.84	Th II
8 h	2364.71	Cr I	10	2373.94	Ta II
20	2364.83	Fe II			
40	2365.07	Co I	4	2374.14	W I
16	2365.32	Re I	7	2374.33	Os I
9	2365.45	W I	4	2374.42	Zr I
			42	2374.46	W I
9	2365.85	W I	8	2374.51	Os I
95	2365.90	Re I			
5	2365.95	Tm II	7	2374.76	W I
10	2365.98	Hf II	8	2375.06	Os II
4	2366.04	Th II	26	2375.07	Re I
			9	2375.07	Th II
6	2366.09	Mo II	14	2375.09	Ir II
9	2366.18	W I			
8	2366.95	W I	7	2375.18	Co II
10	2366.98	Th II	7	2375.19	Fe II
46	2367.06	Al I	28	2375.27	Ru I
			9	2375.63	Ru II
18	2367.11	Tm II	12	2375.82	Re I
5	2367.24	Ta II			
20	2367.25	Y III	7	2375.91	Ta I
42	2367.35	Os II	8	2376.07	W I
46	2367.68	Re I	30	2376.40	Nb II
			4	2376.56	W I
12	2367.68	W I	220	2377.03	Os I
18	2368.04	Ir II			
4	2368.05	Th II	4	2377.03	W I
18	2368.28	Pt I	9	2377.22	Co I
8	2368.34	Rh I	12	2377.28	Ir I
			8	2377.33	Re I
15	2368.53	Re II	22	2377.61	Os I
10	2368.60	Fe II			
24	2369.24	Os I	8	2377.83	Er II
42	2369.27	Re I	20	2377.84	Th II
15	2369.32	Ta II	12	2377.98	Ir I

TABLE 3. *Lines arranged by wavelength*—Continued

Intensity and character	Wavelength in Å	Element and spectrum	Intensity and character	Wavelength in Å	Element and spectrum
8	2378.14	Os I	3.0	2384.65	Rh I
15	2378.31	Ta II	55	2384.82	W I
			60	2384.86	Co I
4	2378.41	Al I	5	2385.24	Y
6	2378.53	Re II			
85	2378.62	Co II	13	2385.73	Ta I
8	2378.74	Os I	150	2385.76	Te I
20	2379.14	Ge I	20	2386.14	Rh
			7	2386.17	W I
15	2379.28	Fe II	42	2386.36	Co II
24	2379.38	Ir I			
90	2379.38	La III	10	2386.58	Er II
75	2379.39	Os I	6	2386.58	Ir II
15	2379.64	Os I	17	2386.58	Ni I
			4	2386.81	Pt I
90 h	2379.69	Tl I	65	2386.89	Ir I
30	2379.77	Re I			
15	2379.84	Os	15	2386.90	Re II
15	2380.22	Re I	8	2386.96	V I
28	2380.30	Hf II	140	2387.06	Ta II
			20	2387.09	Nb II
13	2380.41	Mo I	12	2387.17	Er II
60	2380.48	Co I			
20	2380.72	Sn I	140	2387.29	Os I
15	2380.76	Fe II	7	2387.36	Dy II
7	2380.81	Ti I	6	2387.46	Co I
			7	2387.46	Re I
8	2380.82	Os I	26	2387.52	Nb II
6	2380.89	Re I			
11	2381.00	Hf II	12	2387.75	Au I
44	2381.13	Ta II	3.5	2388.01	Zr I
15	2381.14	Re I	6	2388.14	Th II
			8	2388.27	Nb II
40	2381.18	As I	8	2388.37	Ta II
24	2381.52	Ta II			
26	2381.62	Ir I	28	2388.57	Re I
7	2381.75	Co II	32	2388.63	Fe II
3.5	2381.95	Dy	3.5	2388.80	Pb I
			140	2388.92	Co II
130	2382.04	Fe II	8	2388.92	V I
15	2382.46	Os I			
20	2382.89	Rh I	12	2388.95	Tm II
17	2382.99	W I	20	2389.07	W I
10	2383.17	Ir I	14	2389.11	Re I
			16	2389.11	Ta II
8	2383.24	Fe II	14	2389.20	Mo II
120	2383.25	Te I			
8	2383.28	Er II	3.5	2389.21	Zr I
13	2383.33	Cr I	12	2389.53	Pt I
17	2383.40	Rh	28	2389.54	Co II
			4	2389.54	In I
75	2383.46	Co II	10	2390.37	W II
15	2383.46	Re I			
19	2383.52	Mo I	14	2390.43	Re I
13	2383.64	Pt I	120	2390.62	Ir I
8	2383.64	Sb I	24	2390.73	Yb II
			10	2390.87	V I
17	2383.68	Tm II	130	2391.18	Ir I
17	2383.72	Ta II			
4	2383.79	Ir I	10	2391.26	V I
5	2384.00	V II	7	2391.28	Re I
4	2384.17	Zr I	7	2391.37	Co I
			8	2392.15	Dy
24	2384.28	Ta II	100	2392.19	Lu II
5	2384.28	V I			
6	2384.36	Th II	19	2392.42	Ru I
6	2384.39	Fe II	10	2392.60	Co II
3.5	2384.52	Ti I	11	2392.90	V I
			10	2392.93	W II
20	2384.62	Os I	6	2393.11	Th II

TABLE 3. *Lines arranged by wavelength*—Continued

Intensity and character	Wavelength in Å	Element and spectrum
19	2393.18	Hf II
50	2393.36	Hf II
19	2393.65	Re I
170	2393.79	Pb I
75	2393.83	Hf II
10	2393.90	Co II
28	2394.29	Os I
26	2394.37	Re I
22	2394.52	Ni II
24	2395.39	Os I
10	2395.47	W I
110	2395.62	Fe II
90	2395.88	Os I
3.5	2396.17	Pt I
7	2396.30	Ta I
11	2396.38	Er III
11	2396.71	Ru II
18	2396.78	Os I
26	2396.79	Re I
5 h	2397.03	Co I
60	2397.09	W II
9	2397.30	Er II
16	2397.31	Re I
26	2397.39	Co II
5	2397.61	Os I
46	2397.72	W I
9	2397.78	V I
46	2397.98	W I
2.5	2398.01	Yb II
9	2398.18	Os I
9	2398.27	V I
28	2398.48	Nb II
7	2398.56	Ca I
6	2398.71	Re I
6	2398.89	Re I
5	2399.04	W I
9	2399.14	Lu II
11	2399.15	Ta I
36	2399.24	Fe II
3.0	2399.60	Pb I
5	2399.92	Ta II
9	2399.96	V I
4	2400.30	Er II
240	2400.63	Ta II
17 d	2400.72	Re I
	2400.89	Re I
15	2400.78	Hf II
2.5	2400.84	Co I
19	2400.88	Bi I
80	2401.13	Os I
2.5	2401.29	W I
17	2401.68	Re I
4	2401.77	Ir I
7	2401.87	Pt I
60	2401.95	Pb I
48 d	2402.06	Co I
	2402.17	Co I
14	2402.13	Ta II
22	2402.23	Os I
10	2402.29	Dy II
8	2402.44	W I
12	2402.60	Re I
85	2402.72	Ru II
6	2403.04	Re II
20	2403.09	Pt I
17	2403.54	Os I
17	2403.61	Mo II
10	2403.68	Ta II
28	2403.85	Os I
17	2404.17	Co II
8	2404.17	Th II
6	2404.24	W II
12	2404.34	Re I
3.5	2404.41	Er II
7	2404.43	Fe II
8	2404.51	Th II
8	2404.56	Hf II
10	2404.66	Mo II
100	2404.88	Fe II
120	2405.06	Re I
8	2405.08	Os II
4	2405.26	W I
10	2405.34	Nb II
60	2405.42	Hf II
24	2405.45	Os I
3.0	2405.52	Zr I
140 d	2405.58	W I
	2405.69	W I
60	2405.60	Re I
10	2405.85	Nb II
17	2405.86	Mo I
17	2405.96	Os I
5	2406.27	Co I
14	2406.44	Hf II
13	2406.55	Ta I
30	2406.66	Fe II
26	2406.70	Re I
16	2406.75	V I
220	2407.25	Co I
4	2407.57	Ta I
11	2407.59	Ir I
11	2407.67	Co II
6	2407.88	Rh I
14	2407.90	V I
16	2407.92	Ru II
26	2408.15	Sn I
2.0	2408.19	Rh I
6	2408.23	Tm II
13	2408.26	Ta II
5	2408.39	Mo I
14	2408.62	Cr I
30	2408.67	Os I
13	2408.75	Co II
50	2409.03	Tm II
8	2409.03	W I
14	2409.37	Ir I
13	2410.01	Dy II
42	2410.14	Hf II

TABLE 3. *Lines arranged by wavelength*—Continued

Intensity and character	Wavelength in Å	Element and spectrum	Intensity and character	Wavelength in Å	Element and spectrum
14	2410.17	Ir I	6	2416.90	Co II
2.0	2410.25	Rh I	28	2416.99	Nb II
22	2410.37	Re I			
10	2410.51	Co I	6	2417.05	Co I
30	2410.52	Fe II	8	2417.33	Ta II
			12	2417.35	V I
4	2410.53	Er II	130	2417.37	Ge I
5	2410.63	W I	42	2417.65	Co II
14	2410.73	Ir I			
6	2410.89	Ru I	10	2417.66	Re I
20	2410.98	Os I	36	2417.69	Hf II
			22	2417.86	Ta II
10	2410.99	Re I	10	2417.96	Mo II
22	2411.07	Fe II	44	2417.99	Os I
4	2411.30	Th II			
6	2411.54	W II	10	2418.06	Pt I
220	2411.62	Co I	30	2418.11	Ir I
			5	2418.20	Re II
13	2411.73	Pb I	7	2418.35	Os I
8	2411.90	Os	6	2418.36	Ti I
12	2412.44	Tm II			
26	2412.46	Nb II	44	2418.53	Os I
4 d	2412.53	Ta II	4	2418.64	Rh
	2412.67	Ta I	26	2418.69	Nb II
			11	2418.70	Ga I
12	2412.69	V I	15	2418.77	Ta II
65	2412.76	Co I			
5	2412.84	Mo II	8	2419.01	Mo II
15	2413.01	Mo II	28	2419.12	Co I
9	2413.03	V I	6	2419.21	Lu II
			17	2419.31	Ni I
15	2413.18	Ag II	4	2419.34	W II
4	2413.19	Co I			
15	2413.22	Re I	7	2419.37	Tm II
22	2413.31	Fe II	14	2419.40	Re I
26	2413.31	Ir I	4	2419.41	Zr II
			8	2419.57	U II
10	2413.33	Hf II	4	2419.63	Os
9	2413.41	Th II			
4	2413.58	Co I	3.5	2419.75	Rh I
2.5	2413.93	Y II	100	2419.81	Re I
26	2414.04	W I	8	2420.02	Os II
			13	2420.12	V I
20	2414.06	Co II	10	2420.18	Mo II
8	2414.10	Os I			
12	2414.32	Ta I	3.5	2420.18	Rh II
200	2414.46	Co I	5	2420.20	W I
24	2414.52	Os I	3.5	2420.21	Tm II
			7	2420.28	Er II
10	2414.59	Re I	5	2420.73	Co II
24	2414.68	Y III			
6	2414.82	Ru II	14	2420.82	Ru I
24	2415.21	Ta II	5	2420.98	Rh II
200	2415.30	Co I	4	2421.01	W II
			14	2421.03	Ta I
15	2415.32	Os I	13	2421.06	V I
9	2415.33	Mo I			
16	2415.33	V I	4	2421.15	Os I
50	2415.68	W I	6	2421.23	Ni I
6	2415.84	Rh II	8	2421.30	Ti I
			4	2421.36	Yb II
18	2415.86	Ir I	14	2421.38	Re I
6	2415.96	Hf II			
15	2416.14	Ni II	13	2421.64	Tm II
4	2416.23	W I	360	2421.70	Sn I
10	2416.30	Re I	24	2421.73	Re I
			15	2421.85	Ta II
10	2416.44	Re I	7	2421.86	Os I
16	2416.75	V I			
32	2416.89	Ta II	24	2421.88	Re I

TABLE 3. *Lines arranged by wavelength* — Continued

Intensity and character	Wavelength in Å	Element and spectrum	Intensity and character	Wavelength in Å	Element and spectrum
7	2421.94	Os	10	2427.68	Rh I
13	2421.98	V I			
6	2422.13	Sb I	6	2427.90	Os II
55	2422.20	Y II	260	2427.95	Au I
			6	2428.00	Ta II
11	2422.28	W I	8	2428.04	Pt I
8	2422.56	Co I	1.6	2428.10	Sr I
3.5	2422.66	W I			
8	2422.75	Dy II	5	2428.20	Pt I
6	2422.92	Ru I	4	2428.23	Ti I
			14	2428.28	V I
4	2423.00	Th II	5	2428.29	Co II
17	2423.07	Os II	6	2428.42	Tm II
2.5	2423.28	Tm II			
5	2423.33	Ni I	200	2428.58	Re I
5	2423.38	V I	17	2428.60	Co I
			2.0 h	2428.63	Pb I
17	2423.48	Ta II	5	2428.75	Hf I
5	2423.50	Re I	13	2428.99	Hf II
5	2423.62	Co II			
5	2423.66	Ni I	2.5	2429.10	Pt I
8	2423.68	Th II	5	2429.16	Sc
			5	2429.23	Co I
4	2423.70	U	18	2429.39	W II
5	2423.84	Re II	550	2429.49	Sn I
6	2423.94	Rh			
9	2424.00	Mo II	18	2429.52	Rh I
6	2424.02	Os II	5	2429.60	Ru I
			9	2429.65	Re I
5	2424.03	Ni I	4	2429.67	Os I
5	2424.14	Fe II	36	2429.71	Ta II
4	2424.19	Os I			
90	2424.22	W I	17	2429.84	W I
10	2424.24	Ti I	3.5	2430.07	Fe II
			4	2430.26	Lu II
6	2424.32	Ir I	8	2430.43	Mo I
42	2424.56	Os I	12	2430.44	W I
6	2424.66	Ir I			
10	2424.89	Ir I	3.5	2430.75	Tm II
170	2424.93	Co I	17	2431.06	Ta II
			60	2431.08	W I
120	2424.97	Os I	2.5	2431.15	Th II
18	2424.99	Ir I	32	2431.19	Os I
6	2425.23	Er II			
5	2425.38	Re I	26	2431.24	Ir I
2.5	2425.59	Co I	40	2431.54	Re I
			32	2431.61	Os I
14	2425.66	Ir I	6	2431.66	Ta I
13	2425.91	Ta II	3.0	2431.85	Rh II
13	2425.98	Hf II			
20 d	2425.98	W I	65	2431.94	Ir I
	2426.07	W I	10	2432.02	V I
50	2426.16	Tm II	34	2432.18	Re I
			140	2432.21	Co I
5	2426.19	Os I	8	2432.36	Ir I
8	2426.35	Sb I			
8	2426.53	Ir II	3.0	2432.4	U
8	2426.64	Re I	5	2432.58	Ir I
2.5	2426.78	Ir I	3.0	2432.66	Rh I
			12	2432.70	Re I
20	2426.81	Os I	48	2432.70	Ta II
6	2427.00	Co I			
5	2427.11	Rh II	5	2432.85	Th II
9	2427.28	Er II	7	2432.93	Ru I
13	2427.29	W I	3.5	2433.22	Ti I
			14	2433.28	Re I
5	2427.45	U	3.5	2433.47	Sn I
20	2427.49	W II			
26	2427.61	Ir I	14	2433.57	Hf II
36	2427.64	Ta I	13	2433.59	Ta II

Intensity and character	Wavelength in Å	Element and spectrum	Intensity and character	Wavelength in Å	Element and spectrum
8	2433.61	Re I	3.5	2440.68	Os I
14	2433.80	Nb II	10	2440.69	Tm II
65	2433.98	W I	7	2440.98	Ti I
			22	2441.05	Co I
2.0	2434.10	Ti I	28 c	2441.47	Re I
5	2434.74	Hf II			
6	2434.74	Tm II	7	2441.64	Cu I
6	2435.01	W II	4	2441.89	V I
32	2435.09	Co I	7	2442.00	Os I
			7	2442.14	Nb II
13	2435.14	Ir I	13	2442.39	Ta I
32	2435.16	Si I			
12	2435.51	Os I	19	2442.51	Re I
14	2435.52	V I	11	2442.57	Fe I
12	2435.65	Os I	5	2442.68	Nb II
			6	2442.97	W I
30	2435.83	Co I	2.5	2443.33	W I
7	2435.95	Nb II			
8	2435.96	Mo II	10	2443.62	W I
190	2435.96	W I	38	2443.84	Pb I
8	2436.05	Re I	5	2443.87	Fe I
			3.0	2443.96	Th II
5	2436.19	Tm II	60	2444.06	W I
3.0	2436.26	W I			
6	2436.33	Nb I	7	2444.09	Re I
4	2436.42	Ir I	10	2444.13	Ta II
2.5	2436.51	Os I	4 h	2444.27	Rh
			2.5	2444.46	Th II
13	2436.51	Ta II	4	2444.51	Fe II
26	2436.62	W I			
120	2436.66	Co I	9	2444.67	Ta II
18	2436.69	Pt I	20	2444.94	Re I
3.0	2436.98	Co II	4	2444.99	Hf I
			12	2445.34	Ir I
11	2437.07	Ta I	15	2445.46	Tm II
1.4	2437.08	Rh I			
11	2437.23	As I	19	2445.51	Sb I
8	2437.42	Nb II	5	2445.53	Ta II
4	2437.54	Th II	3.0	2445.56	Fe II
			6	2445.88	Os I
7	2437.66	Tm II	4	2445.94	Tm II
9	2437.67	Ta I			
6	2437.73	Os	30	2446.02	Os I
9	2437.79	Ag II	70	2446.19	Pb I
9	2437.80	Rh	14	2446.39	Er II
			16	2446.39	W II
7	2437.89	Ni II	50	2446.98	Re I
3.0	2437.96	W I			
1.8	2438.01	La II	10	2447.17	Ta I
15	2438.46	Re I	44	2447.25	Hf II
8	2438.62	Sc	3.5	2447.25	Yb II
			7	2447.40	Tm II
11	2438.64	Ta II	3.5	2447.45	Ru I
100	2439.05	Co I			
11	2439.06	Re I	2.0	2447.49	Ir I
7	2439.10	V I	7	2447.71	Fe I
4	2439.45	Er II	12	2447.76	Ir I
			68	2447.91	Pd I
8	2439.74	Fe I	3.0	2447.93	Ag II
14	2439.82	Dy II			
20	2439.91	Ta I	10	2448.20	Re I
65	2440.06	Pt I	9	2448.23	Ir I
6	2440.11	Fe I	28	2448.39	W I
			5	2448.84	Rh I
3.5	2440.21	Ti II	4	2448.93	U
8	2440.28	Mo II			
26	2440.34	Rh I	2.0	2449.02	Ir I
6	2440.41	Re I	7	2449.03	Re II
6	2440.58	Re I	4	2449.04	Rh I
			2.5	2449.16	Co II

TABLE 3. *Lines arranged by wavelength*—Continued

Intensity and character	Wavelength in Å	Element and spectrum	Intensity and character	Wavelength in Å	Element and spectrum
16	2449.44	Hf II	50	2449.71	Re I
			10	2449.85	Zr II
8	2449.44	Ta II			
7	2449.52	Re II	3.0	2449.88	Os

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