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Oscillator Strengths for Lines of Ni I

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Relative intensities and oscillator strengths for 888 lines of Ni I between 2800 and 9900 Å from several investigations have been reduced to the absolute scale of Corliss and Bozman and critically compared. New observations of faint lines in the visible and infrared portions of the spectrum are included.

1. Introduction

Since nickel is more abundant in the solar system than any other element having a complex spectrum except iron, it is important to have a good description of the wavelengths and line strengths in the nickel spectrum. Accurate wavelengths of the Ni I lines are available in the work of Burns and Sullivan [1947, 1948]. They were able to classify most of the observed lines by use of the energy levels found earlier by Russell [1929]. Although hundreds of additional lines could be observed with modern light sources, few of them would be of practical interest in the laboratory or in astrophysics.

The situation with regard to the measurement of line strengths is not as satisfactory as with wavelengths. Numerous investigations have been published, especially for the near ultraviolet, but the various results need to be reduced to the same entity, adjusted to a uniform scale, and critically compared. By the process of intercomparing results, obvious errors can be discovered, and the defective values can be rejected or in some cases corrections can be applied. Furthermore, new measurements need to be made in regions of the spectrum not yet adequately studied. In this paper I have assembled the published data for Ni I in the manner suggested above and have added to them new measurements that I have made in the visible and infrared.

Measurements of oscillator strengths in Ni I are beset with difficulties arising from the peculiar distribution of lines in the spectrum. The circumstances can best be appreciated by examining the table of nickel lines in the NBS Tables of Spectral-Line Intensities by Meggers, Corliss, and Scribner [1961]. The strong lines arising from the low levels lie in the near ultraviolet between 2900 and 4000 Å. Then there is a gap in the spectrum, occupied by only the faintest lines. Finally there is a group of lines of moderate intensity in the region from 4400 to 8000 Å which arise from high levels. It is difficult to put the measurements from different groups onto the same scale because the observations require different techniques and there are usually no lines in common between sets of observations of the different groups.

2. Published Data

A summary of the previously published data on the strength of spectrum lines in Ni I is given in table 1. Because of the different entities reported and the different scales adopted, it is in most cases impossible to make direct comparisons of the results. The entities reported are either intensities or oscillator strengths. The intensities are usually observed at different effective temperatures and must be reduced to a common temperature if they are to be compared. Apart from a factor λ^3, the oscillator strength is proportional to the intensity from a source at an infinite temperature. I have chosen to convert all reported quantities to log *gf*, which is widely used in astrophysical work.

Most of the scales on which the data are reported are arbitrary and different from one another.

TABLE 1. *Previously published data on intensities and oscillator strengths in the first spectrum of nickel*

Reference	Date	Wavelength range	No. of lines	No. accepted	Method of observation	Entity reported	Temperature	Reference symbol
		Å					°K	
Ornstein and Bouma	(1930)	2419–3858	140	106	Spark emission	Intensity	6400	OBS
Ornstein and Bouma	(1930)	2798–4201	304	190	Arc emission	Intensity	4300	OBA
van Driel	(1935)	3232–3858	52	48	Arc emission	Intensity	6400	vD
King	(1948)	3012–3912	134	132	Furnace absorption	*gf*	1600–2700	K
Heid and Dieke	(1954)	3359–5893	478	244	Arc emission	Intensity	5000	HD
Parchevsky and Penkin	(1954)	3050–3807	47	46	Furnace hooks	*f*	2300–2800	PP
Allen and Asaad	(1957)	3315–3973	40	40	Arc emission	log *gf*	4300	AA
Mitrofanova	(1960)	3722–5155	77	----------	Arc emission	log *gf*	5160	M
Corliss and Bozman	(1962)	2289–8862	242	216	Arc emission	log *gf*	5100	CB

Parchevsky and Penkin [1954], however, have reported their f-values on King's arbitrary scale. But the time is past when it can be considered satisfactory to report oscillator strengths on arbitrary relative scales. There is enough knowledge now for most common spectra for us to adopt a reasonably accurate absolute scale for reporting relative measurements. Allen and Asaad [1957] and also Corliss and Bozman [1962] have attempted to report their measurements on absolute scales but the scales differ by a factor of two. The values of log gf are derived here on the basis of the absolute scale of Corliss and Bozman. Their scale is especially convenient for this purpose since their measurements cover the entire range of wavelengths of the published data. The accuracy of the scale is discussed in section 2.1.

To convert the data from arc sources that have been reported as intensitites (I), to oscillator strengths, I have generally compared them with I_{NBS}, the intensities reported by Meggers, Corliss, and Scribner [1961], as follows:

1. Plot log I versus log I_{NBS} for lines of about the same excitation potential.
2. If the points above a certain value of I fall below a 45° straight line, all lines with values of I above this critical value are self-absorbed and should be rejected (or corrected).
3. Plot I/I_{NBS} versus wavelength for lines of about the same excitation potential to find out if the intensity scale has been properly calibrated as a function of wavelength. Introduce a correction if there is significant variation.
4. Plot log I/I_{NBS} versus E, the upper energy level in kaysers, and determine the temperature of the light source from the equation

$$\frac{1}{T}=\frac{1}{T_{\mathrm{NBS}}}-\frac{1}{0.625}\left(\frac{\Delta \log I/I_{\mathrm{NBS}}}{\Delta E}\right) \tag{1}$$

where T_{NBS} is 5100 °K, the temperature of the NBS copper arc, and the factor in parentheses is the slope of the plot.

5. Calculate a preliminary value of log gf, by assuming a Boltzmann distribution, from the equation

$$\log gf=\log I+3 \log \lambda+\frac{0.625E}{T}. \tag{2}$$

6. Plot log gf/gf_{CB} versus E to determine the departure from a Boltzmann distribution at high levels.
7. Add the function determined in 6 to the preliminary log gf to obtain the final absolute scale.

By this process I have tried to select the most reliable parts of each set of intensity data, introduce corrections where they are obviously necessary, and derive oscillator strengths which lie as closely as possible on the absolute scale.

The data reported as oscillator strengths were compared with CB for evidence of variation with wavelength and then adjusted to the CB scale by adding the mean difference between the scales to the reported values.

2.1. Data of Corliss and Bozman [1962]

The "Experimental Transition Probabilities for Spectral Lines of Seventy Elements" by Corliss and Bozman [1962] is based on "Tables of Spectral-Line Intensities" by Meggers, Corliss, and Scribner [1961]. Corliss and Bozman have derived values of log gf on an absolute scale for 242 lines of Ni I between 2300 and 8900 Å. The intensities of the 26 lines below 2500 Å grow progressively too weak at short wavelengths because the calibration made by Meggers, Corliss, and Scribner was applicable only at longer wavelengths and, for lack of a better method, was extrapolated from 2500 to 2000 Å. These lines have therefore been omitted from the present list. The remaining values are entered in column 6 of table 2.

A test of the intensity calibration between 3000 and 4000 Å can be made by comparing CB with K. The method of total absorption used by King does not depend on a calibration of intensity versus wavelength. This does not, of course, preclude other wavelength dependent sources of error from affecting the observations. In figure 1, where we plot the ratio K/CB against wavelength, we find no systematic variation.

The accuracy of Corliss and Bozman's values of log gf is discussed at length in section 8 of the introduction to their tables. From a study of the internal consistency of the data they found that the standard deviation of an individual determination taken as a relative value of log gf within a spectrum increased from 0.13 for lines with upper levels at 15000 K to 0.17 for lines with upper levels at 50000 K. Taken as absolute values, they found that the corresponding values of standard deviation were 0.24 and 0.29. Comparisons of the relative values of K and PP with CB are shown in figures 2 and 3. Allen and Corliss [1963] compared the CB scale with a scale determined by Allen [1960] based on the f-sum rule. They found in the case of Ni I that the f-sum scale values of log gf were larger than those of the CB scale by 0.05.

2.2. Data of Allen and Asaad [1957]

Allen and Asaad at the University of London Observatory measured the intensities of 40 nickel lines between 3315 and 3974 Å. The spectrum was excited in a 3 amp d-c arc between electrodes of copper containing 0.05 percent and less of nickel, a concentration which assures freedom from self-absorption. From measurements in similar arcs of copper containing Fe, Co, Ni, Cr, and Mn, they deduced an effective arc temperature of 4300 °K, based on King's temperature scale. They reported their values of log gf on an absolute scale determined by comparing their relative scale with experimental and theoretical absolute values for seven spectra from the group that they studied. Although their absolute scale was determined in the same way as that of Corliss and Bozman, it is based on less than a third as many determinations, and is probably

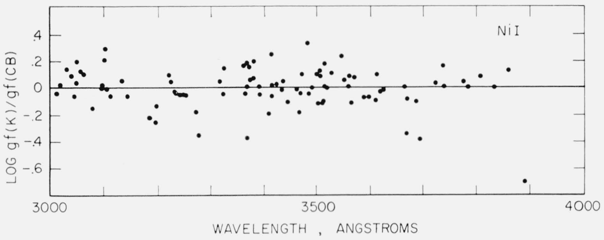

Figure 1. *Log ratio of* gf-*values from King (1948) to those of Corliss and Bozman (1962) as a function of wavelength.*

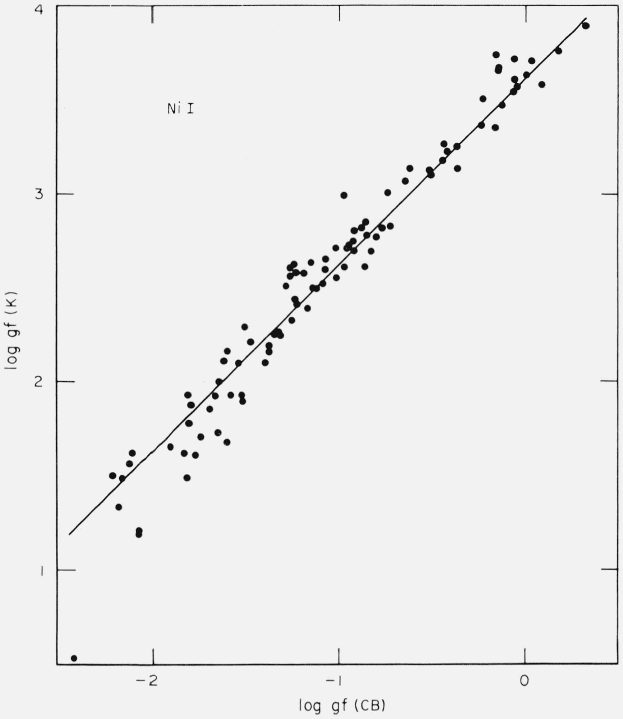

Figure 2. *Comparison of log* gf-*values from King (1948) with those from Corliss and Bozman (1962).*

not as accurate. Their absolute scale for Ni I has therefore been adjusted to that of CB by adding 0.30 to their log *gf*. The results are given in column 9 of table 2. A graphical comparison of AA with K is given by Goldberg, Müller, and Aller [1960, p. 104].

2.3. Data of Ornstein and Bouma [1930]

Ornstein and Bouma [1930] at Utrecht published relative intensities for about 300 lines of Ni I observed between 2800 and 4200 Å in the spectrum from a 0.45 ampere arc between nickel electrodes. About 20 percent of the values, those of intensity 40 or more on the OBA scale, are affected by self-absorption. These lines have all been measured subsequently by others and no attempt is made here to derive oscillator strengths from them. The OBA intensity scale declines progressively from 2800 to 3800 Å by about a factor of three and it has been adjusted to conform to the NBS scale. The values of log *gf* were derived by using a temperature of 4300 °K. Earlier, King [1948] attempted to derive *gf*-values from the OBA measurements. He noticed the self-absorption, but was unable to determine an arc temperature for the remaining lines because of the small range of excitation potential (less than one volt) for lines observed in his furnace spectra and the large random errors in the OBA data. In the present work a range of more than four volts was available for the temperature determination.

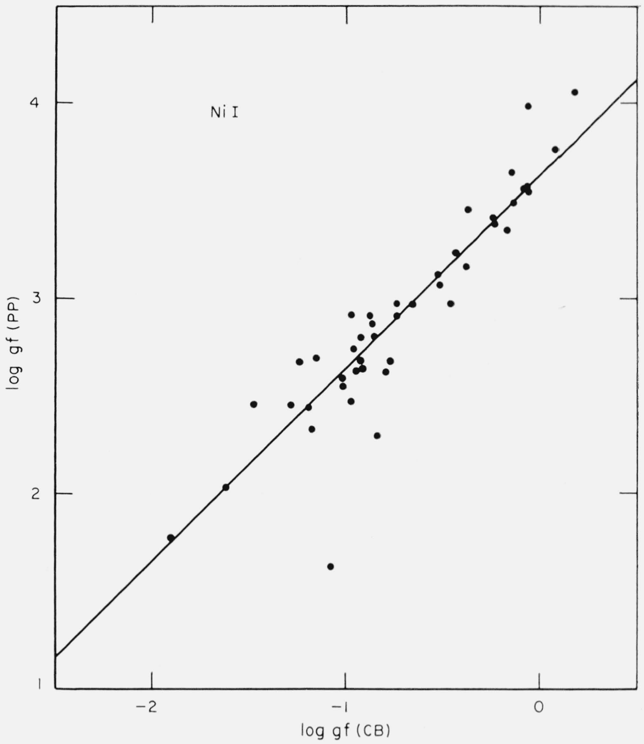

Figure 3. *Comparison of log* gf-*values from Parchevsky and Penkin (1954) with those from Corliss and Bozman (1962).*

Ornstein and Bouma also published intensities for about 230 lines observed in a condensed spark between nickel electrodes. About 140 of these lines are classified in Ni I. About 120 of these lines, with intensities less than 15, appear to be free from self-absorption. Their intensity scale is correctly calibrated below 3400 Å but declines gradually at longer wavelengths.

The population distribution over the energy levels of atoms in an arc departs from a Boltzmann distribution at high levels in a particular way which is illustrated in figure 5 of the introduction to Corliss and Bozman. Since that normalization curve is not likely to apply to sparks, it did not seem appropriate to determine the spark temperature by comparison of the spark intensities with the NBS arc intensities, the method outlined earlier in this section for determination of arc temperatures. Instead a plot of log $I\lambda^3/gf_{\mathrm{CB}}$ against energy of upper levels was made and an effective spark temperature of 6400 °K was derived from the slope. The linearity of the plot indicated the existence of a nearly exponential decline in the population of the upper energy levels in the range between 30 and 60 kK. The departure from a Boltzmann distribution in a spark apparently takes place only at much higher levels than in the arc. For this reason, the oscillator strengths for the lines observed in Ornstein and Bouma's spark were calculated directly from a Boltzmann distribution at 6400 °K and adjusted to the absolute scale of CB with a constant factor independent of excitation potential.

The values of log *gf* derived from Ornstein and Bouma's arc observations (OBA) are entered in table 2 in column 10; those from their spark observations (OBS) are entered in column 11.

2.4. Data of van Driel [1935]

In 1935 H. van Driel completed a Thesis at the University of Utrecht in which he measured relative intensities for 50 lines of Ni I between 3230 and 3860 Å. He made his observations in 2.0–2.4 amp arcs between various alloys of nickel and at pressures between 18 and 77 mm Hg. Van Driel studied the question of self-absorption carefully and his intensities, when plotted against the NBS intensities show no trace of self-absorption. He finally adopted a carbon arc with a hollow carbon electrode containing a mixture of carbon powder and nickel sulfate. The arc was operated at 2.4 amperes and at an ambient pressure of 32 mm Hg. He measured an effective temperature of 6400 °K for this arc from the intensity distribution in the CN band at 3883 Å. His intensities are here reduced to log *gf* by using his temperature and the resulting relative values are normalized to the absolute scale of Corliss and Bozman. The results are entered in column 8 of table 2 for wavelengths less than 3800 Å. For longer wavelengths this column is used for a different set of measurements.

2.5. Data of King [1948]

In 1948 R. B. King at the California Institute of Technology measured relative *gf*-values for 134 lines of Ni I between 3012 and 3912 Å. The observations were made by the method of total absorption in a tube furnace operated at temperatures between 1600 and 2700 °K. A comparison of his values with those of CB is shown in figure 2. King's values (K) were adjusted to the CB scale by adding −3.63 to his log *gf* and are tabulated in column 7 of table 2. Figure 1 shows that, within the range of King's observations, there is no wavelength-dependent variation between K and CB.

2.6. Data of Heid and Dieke [1954]

Heid and Dieke at Johns Hopkins University measured the relative intensities of 478 lines of Ni I between 3359 and 5893 Å. The light source was a 2 amp d-c arc 3 mm long struck between nickel rods in air. Light was taken from a section about 0.5 mm long at the center of the arc and measured with a photomultiplier tube at the focal curve of a 21-foot Wadsworth spectrograph. Lines closer than about 0.6 Å were not resolved. Corrections were made for background intensity and for self-reversal. When the values corrected for self-reversal are plotted against the NBS intensities of Meggers, Corliss, and Scribner, it is evident that some self-absorption remains. All lines with background-corrected intensities greater than 450 which lie shortward of 4700 Å are self-absorbed and have been omitted from our tabulation. All the lines lying longward of 4700 are free of self-absorption. I have also omitted the blended lines. There remain about 350 lines whose intensities seem to be suitable for reduction to oscillator strengths.

When the ratio of Heid and Dieke's intensities to the NBS intensities is plotted against wavelength, a sudden rise by nearly a factor of two is noted at 4700 Å.

The temperature of Heid and Dieke's arc was determined to be 5000 °K. Separate determinations were made for the two wavelength regions above and below 4700 Å to avoid any systematic error. The values obtained were 4950 °K below 4700 Å and 5020 °K at longer wavelengths. Finally, a separate normalization function was determined and applied to each of the two wavelength regions.

The values of log gf calculated as described above are entered in column 12 and have been averaged into the "Best" value only at wavelengths longer than 4200 Å. At shorter wavelengths they do not agree well with the other determinations.

2.7. Data of Parchevsky and Penkin [1954]

In 1954 Parchevsky and Penkin at the University of Leningrad measured relative oscillator strengths for 47 lines of Ni I by means of the hook method. These lines lie between 3050 and 3807 Å. A comparison of their values with those of CB is shown in figure 3. In a recent paper reviewing all of his work, Penkin [1964] has made very slight revisions to 16 of his values for Ni I. The recent values are used here and are reduced to the scale of Corliss and Bozman by adding −3.66 to Penkin's log *gf*. The results are entered in column 13 of table 2. It will be seen in the table that his value for 3612.74 Å is too small by a factor of ten and it has not been used in making the reduction to the common scale or in taking the best value.

2.8. Data of Mitrofanova [1960]

Mitrofanova at the Pulkovo Observatory reported oscillator strengths for 77 lines of Ni I between 3722 and 5155 Å. They were measured in the spectrum emitted from a 2.3 ampere a-c arc. Her data show insufficient correlation with the other data and have not been listed here.

3. New Observations

Reference to table 1 indicates that although a considerable amount of work has been done in the near ultraviolet, much remains to be done in the visible and especially in the infrared. To help fill this need, I have made three sets of observations; at Imperial College, London (IC), at University of London Observatory (ULO) and at the National Bureau of Standards (CHC).

3.1. Data From Imperial College [1963]

The work at Imperial College was carried out in connection with the measurement of oscillator strengths in Fe I in the region from 4000 to 10000 Å. These observations are reported by Corliss and Warner [1964]. While making the plates for iron, I made a similar set for nickel, using the methods of observation and reduction described in detail in the paper by Corliss and Warner.

The plates were made on the Eagle spectrographs at Imperial College with a 4 amp d-c arc between nickel rods as the source. Intensity calibration was provided by a rotating step-sector placed at the horizontal focus of the spectrograph. The intensity measurements were made using the ratio of the step openings to determine intensity ratios of lines visually matched in different steps of the sectored spectrograms. The wavelength response of the observing equipment was determined as outlined in section 2. In the region from 4000 to 4400 Å, where the nickel spectrum is deficient in lines, the response curve was determined from the iron spectrum. The temperature, obtained as described in section 2, was 4480 °K, which is substantially the same as that determined earlier for the iron arc. The derived values of log *gf*, adjusted to the CB scale, are entered in column 14 of table 2 under the symbol IC.

3.2. Data From ULO [1963]

During the academic year 1962–1963, I obtained at the University of London Observatory a set of spectrograms of the nickel arc with their ten foot Eagle spectrograph. This instrument is equipped with a 600 lines/mm Rowland grating and yields a (reciprocal) dispersion of 5.5 Å/mm. The intensity information was impressed on the lines by mounting a step wedge at Sirk's stigmatic position in front of the slit. A 2.9 ampere arc, 8 mm long, struck between two ⅜ inch nickel rods, was focused on the grating by a lens at the step wedge. The plates were measured and reduced at the Observatory, the intensity versus wavelength and the temperature calibrations being carried out by comparison with the NBS Intensity Tables. The values of log *gf* were adjusted to the CB scale. The results cover the wavelength range 5424 to 6533 Å and are reported in the column 10, headed ULO.

3.3. Data From National Bureau of Standards [1964]

Because of conflicting results in the region between 3800 and 5000 Å, I made a new set of observations using a different light source, a spark in air between two nickel rods. The power was drawn from a capacitor of 0.007 microfarads through an inductor of 14 microhenries and passed through a 2 mm gap between the electrodes. The spectrograms were made in the second order of a 600 line/mm concave grating in a Wadsworth stigmatic mounting at a reciprocal dispersion of 2.4 Å/mm between 3800 and 4400Å. Further observations were made in the first order of the same instrument at 5 Å/mm in the region from 3800 to 5050 Å. Because of the scarcity of nickel lines in the NBS Intensity Tables in this region, the response of the apparatus was determined by using iron and cobalt sparks. The temperature of the spark was determined by plotting log $I\lambda^3/gf_{\mathrm{CB}}$ versus upper energy level value for those nickel lines in this region which are also found in Corliss and Bozman. An independent study of similar sparks in cobalt and iron shows that there is no detectable departure from a Boltzmann distribution in these sparks up to 55000 K. On this basis I calculated oscillator strengths for Ni I lines observed in the spark in this region, assuming a Boltzmann distribution at 6170 °K. The resulting values (CHC) are adjusted to the CB scale and entered in column 8.

4. Results

The various values of log *gf*, obtained as described in the two preceding sections, have been entered in columns 6 through 14 in table 2. Except for about a dozen lines in the infrared that are taken from Meggers and Kiess [1932], the wavelengths are taken from Burns and Sullivan [1947, 1948] and rounded off to the nearest 0.01 Å. The classifications are taken from the same authors, and the numerical values of the energy levels are given to the nearest kayser (cm^{-1}) in columns 2 and 3. The lower excitation potential in electron volts has been calculated by multiplying the lower energy level in column 2 by 0.00012398 and the result, rounded off to two decimal places, is entered in column 4. The multiplet numbers in column 5 are those assigned by Moore [1945, 1952] in her Multiplet Tables.

The recommended or "best" value of log *gf*, given in column 15, is the unweighted mean of the individual values in the preceding columns, with the exception of the HD values below 4200 Å, which have been rejected. If the maximum and minimum values for any line differ by more than 0.4, no best value is recommended unless there is an obviously discrepant value. No best value has been recommended for about 10 percent of the lines. Most of these lines are faint lines in the region from 3800 to 4200 Å, where the discordance amongst individual determinations is extraordinarily bad.

Log $gf\lambda$ and log gA/λ have been computed from the best value and are given in the last two columns. Log $gf\lambda$ is useful in dealing with curves of growth in absorption spectra and log gA/λ in determining temperatures from intensities in emission spectra. Also, it may be noted that the line strength, S, is equal to $gf\lambda/304$, or log $S=\log gf\lambda-2.48$.

5. Discussion of the Absolute Scale

There have been a number of attempts, by both theoretical and experimental methods, to determine absolute oscillator strengths for selected lines of Ni I. The first was by Estabrook (1950), who determined the total absorption of three resonance lines of nickel, using a quartz cell containing nickel vapor in a wire-wound electric furnace operated at about 1300 °C. His values are now generally agreed to be too low. (See e.g., Goldberg, Müller, and Aller (1960), pp. 98–107.) They are smaller than the values in table 2 by a factor of ten. Lawrence, Link, and King (1965), using new vapor pressure data, have raised Estabrook's values by a factor of two but they are still too low.

Hinnov and Kohn (1957) determined the absolute oscillator strength of Ni I 3524.55 Å in a flame. They found a lower limit for log gf of 0.12 which compares with the value in table 2 of 0.13.

Goldberg, Müller, and Aller, using the f-sum rule, computed absolute values of log gf for two groups of lines in Ni I; one in the region 3300 to 3700 Å and the other from 4800 to 5700 Å. For the first group of 20 lines their values of log gf averaged 0.20 larger than those in table 2, while for the second group of 29 lines their values averaged 0.05 larger than the ones in table 2.

King, Lawrence, and Link (1964) have determined absolute values for six resonance lines of Ni I using the atomic beam method. On the average, their values of log gf are smaller than the ones in table 2 by 0.22.

It seems reasonable to conclude from the above comparisons that the scale of values in table 2 does not depart from the absolute scale by more than the uncertainty with which the absolute scale for Ni I is known, and that this uncertainty is about 0.2 in log gf.

I would like to acknowledge my obligation to W. R. S. Garton who invited me to spend a year at Imperial College, to Professor C. W. Allen who extended to me the hospitality of the London Observatory, to W. R. Bozman and C. R. Drew who helped prepare the tables on IBM equipment and to Ruth Peterson who helped make the tables and put them on punched cards.

6. References

Allen, C. W. (1960) Monthly Notices Roy. Astron. Soc. **121,** 299.
Allen, C. W., and Asaad, A. S. (1957) ibid. **117,** 36.
Allen, C. W., and Corliss, C. H. (1963) ibid. **126,** 37.
Burns, K. and Sullivan, F. (1947) Science Studies St. Bonaventure College **13,** 4; (1948) ibid. **14,** 2.
Corliss, C. H., and Bozman, W. R. (1962) Experimental Transition Probabilities for Spectral Lines of Seventy Elements, NBS Mono. No. 53 [Washington: Government Printing Office].
Corliss, C. H., and Warner, B. (1964) Astrophys. J. Suppl. Ser. **8,** 395, No. 83.
Estabrook, F. B. (1951) Astrophys. J. **113,** 684.
Goldberg, L., Müller, E. A., and Aller, L. H. (1960) Astrophys. J. Supplement Series No. 45.
Heid, R. L., and Dieke, G. H. (1954) J. Opt. Soc. Am. **44,** 402.
Hinnov, E., and Kohn, H. (1957) J. Opt. Soc. Am. **47,** 156.
King, R. B., 1948, Astrophys. J. **108,** 87.
Lawrence, G. M., Link, J. K., and King, R. B. (1965) Astrophys. J. **141,** 293.
Meggers, W. F., Corliss, C. H., and Scribner, B. F. (1961) Tables of Spectral-Line Intensities, NBS Mono. No. 32, Washington.
Meggers, W. F., and Kiess, C. C. (1932) BS J. Res. **9,** 309.
Mitrofanova, L. A. (1960) Publ. Pulkovo Obs. **21,** 185.
Moore, C. E. (1945) A Multiplet Table of Astrophysical Interest, Contr. Princeton U. Obs. No. 20.
Moore, C. E. (1952) An Ultraviolet Multiplet Table, NBS Circ. 488, Section 2.
Ornstein, L. S., and Bouma, T. (1930) Phys. Rev. **36,** 679.
Parchevskii, G. F., and Penkin, N. P. (1954) Vestnik Leningrad State University **11,** 113. Translated by J. Tech in Astron. Papers Trans. from the Russian, No. II (1964) Smithsonian Astrophys. Obs., Cambridge, Mass.
Penkin, N. P. (1964) J. Quant. Spectr. Radiative Transfer **4,** 41. Translated by J. Tech in Astron. Papers Trans. from the Russian, No. II (1964) Smithsonian Astrophys. Obs., Cambridge, Mass.
Russell, H. N. (1929) Phys. Rev. **34,** 821.
van Driel, H. (1935) Thesis, University of Utrecht, also published in King (1948).

TABLE 2.—*Oscillator Strengths for Ni* I

Wave-length Å	Energy Levels K		Lower e.p. Volts	Mult. No.	CB	K	vD	AA	OBA	OBS	HD	PP	IC	Best	Log gfλ	Log gA/λ
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
2798.65	880 –	36601	0.11	UV26	−1.18				−1.06	−1.14				−1.13	2.32	4.35
2803.14	13521 –	49185	1.68	UV69					−0.47					−0.47	2.98	5.01
2805.08	0 –	35639	0.00	UV 1					−1.89	−2.20				−2.04	1.41	3.44
2814.35	27261 –	62783	3.38	UV79					−0.17					−0.17	3.28	5.31
2821.29	205 –	35639	0.03	UV25	−1.07				−1.06	−1.13				−1.09	2.36	4.38
2834.55	1332 –	36601	0.17	UV 2					−1.78	−1.54				−1.66	1.79	3.81
2838.95	13521 –	48735	1.68	UV68					−0.52					−0.52	2.93	4.94
2849.82	15610 –	50689	1.93	UV77					−0.69					−0.69	2.76	4.77
2865.50	1713 –	36601	0.21	UV26	−1.63				−1.44	−1.59				−1.55	1.91	3.90
2868.74	15610 –	50458	1.93	UV76					−0.45					−0.45	3.01	5.00
2905.75	15734 –	50139	1.95	UV74					−0.73					−0.73	2.73	4.70
2907.46	2217 –	36601	0.27	UV 2	−1.51				−1.33					−1.42	2.04	4.01
2914.01	1332 –	35639	0.17	UV 1	−2.03				−1.79	−2.15				−1.99	1.47	3.44
2916.85	28542 –	62815	3.54						−0.49					−0.49	2.97	4.94
2917.53	28542 –	62808	3.54						−0.49					−0.49	2.98	4.94
2930.91	25754 –	59863	3.19	UV78					−0.28					−0.28	3.19	5.14
2943.91	205 –	34163	0.03	UV24	−0.89					−0.90				−0.90	2.57	4.52
2958.28	15610 –	49403	1.93	UV74					−0.64					−0.64	2.83	4.77
2969.19	15734 –	49403	1.95	UV74					−0.40	−0.29				−0.34	3.13	5.07
2973.73	13521 –	47139	1.68	UV66					−1.17					−1.17	2.30	4.23
2981.64	880 –	34409	0.11	UV24	−0.78					−0.78				−0.78	2.69	4.62
2983.43	13521 –	47030	1.68	UV66					−0.30					−0.30	3.17	5.10
2984.13	0 –	33501	0.00	12	−1.26				−1.22	−1.18				−1.22	2.25	4.18
2991.11	2217 –	35639	0.27	UV 1					−2.20					−2.20	1.28	3.20
2992.59	205 –	33611	0.03	25	−0.94					−0.99				−0.96	2.52	4.44
2994.45	205 –	33590	0.03	27	−0.64					−0.79				−0.72	2.76	4.67
3002.48	205 –	33501	0.03	UV24	−0.04									−0.04	3.44	5.35
3003.62	880 –	34163	0.11	UV24	−0.21									−0.21	3.27	5.18
3012.00	3410 –	36601	0.42	41	0.31	0.27								0.29	3.77	5.68
3017.95	15610 –	48735	1.93	UV74					−1.06					−1.06	2.42	4.32
3019.14	0 –	33112	0.00	11	−1.14	−1.12				−1.08				−1.11	2.37	4.27
3029.29	15734 –	48735	1.95	UV74					−0.75					−0.75	2.73	4.63
3031.87	0 –	32973	0.00	11	−1.60	−1.46			−1.36	−1.55				−1.49	1.99	3.89
3037.93	205 –	33112	0.03	25	−0.44	−0.35				−0.54				−0.44	3.04	4.94
3045.01	1332 –	34163	0.17	12	−1.37	−1.43			−1.21	−1.45				−1.36	2.12	4.01
3050.82	205 –	32973	0.03	25	−0.15	0.05						0.03		−0.02	3.46	5.35
3054.31	880 –	33611	0.11	25	−0.43	−0.39				−0.51		−0.42		−0.44	3.04	4.93
3057.64	1713 –	34409	0.21	UV24	−0.24	−0.11						−0.27		−0.21	3.28	5.16
3064.62	880 –	33501	0.11	UV24	−0.92	−0.82				−0.89		−1.01		−0.91	2.58	4.45
3066.44	27261 –	59863	3.38						−0.10					−0.10	3.39	5.26
3080.75	1713 –	34163	0.21	UV24	−0.86	−1.01				−0.97				−0.95	2.54	4.41
3097.12	1332 –	33611	0.17	11	−1.12	−1.12			−1.08	−1.27				−1.15	2.34	4.20
3099.11	1332 –	33590	0.17	13	−1.22	−1.20			−1.18	−1.39				−1.25	2.24	4.10
3101.56	880 –	33112	0.11	25	−0.17	0.04								−0.06	3.43	5.29
3101.88	3410 –	35639	0.42	40	−0.17	0.12				−0.28				−0.11	3.38	5.24
3105.46	2217 –	34409	0.27	12	−1.09	−1.10			−1.00	−1.25				−1.11	2.38	4.24
3107.71	1332 –	33501	0.17	12		−2.67			−2.55					−2.61	0.88	2.74
3114.12	880 –	32982	0.11	24	−1.17	−1.23				−1.28		−1.32		−1.25	2.24	4.09
3116.72	25754 –	57829	3.19	95					−0.38					−0.38	3.11	4.96
3129.30	2217 –	34163	0.27	12		−1.99			−1.85	−2.19				−2.01	1.49	3.33
3134.10	1713 –	33611	0.21	25	−0.07	−0.01						−0.09		−0.06	3.44	5.28
3145.11	0 –	31786	0.00	7		−3.48			−3.28					−3.38	0.12	1.95
3145.70	1332 –	33112	0.17	11	−1.84	−1.90			−1.72					−1.82	1.68	3.51
3154.58	15734 –	47425	1.95	78					−0.92					−0.92	2.58	4.41
3159.52	1332 –	32973	0.17	11		−3.03			−2.88					−2.96	0.54	2.37
3164.16	15734 –	47329	1.95	79					−1.15					−1.15	2.35	4.17
3165.50	205 –	31786	0.03	21		−3.04			−2.98					−3.01	0.49	2.31
3170.72	15610 –	47139	1.93	78					−1.16					−1.16	2.34	4.16
3176.29	15734 –	47208	1.95	77					−1.03					−1.03	2.47	4.29
3181.74	15610 –	47030	1.93	78	−0.11				−0.18					−0.14	3.36	5.18

TABLE 2.—*Oscillator Strengths for Ni* I—Continued

Wave-length Å	Energy Levels K		Lower e.p. Volts	Mult. No.	CB	K	vD	AA	OBA	OBS	HD	PP	IC	Best	Log gfλ	Log gA/λ
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
3183.02	16017 –	47425	1.99	78					−0.69					−0.69	2.81	4.63
3183.25	15734 –	47139	1.95	78					−0.36					−0.36	3.14	4.96
3184.37	2217 –	33611	0.27	11	−1.51	−1.73			−1.56					−1.60	1.90	3.71
3191.86	28542 –	59863	3.54	125					−0.29					−0.29	3.21	5.02
3195.57	2217 –	33501	0.27	12	−1.77	−2.02			−1.89					−1.89	1.61	3.42
3197.11	1713 –	32982	0.21	24	−1.39	−1.52			−1.46	−1.43				−1.45	2.05	3.86
3200.42	205 –	31442	0.03	23		−2.45			−2.46					−2.46	1.05	2.85
3202.14	25754 –	56974	3.19	94	0.55				0.58					0.56	4.07	5.87
3206.95	27415 –	58588	3.40	94					−0.29					−0.29	3.22	5.02
3209.91	26666 –	57810	3.31	94					0.33					0.33	3.84	5.63
3213.41	27415 –	58526	3.40	91					0.10					0.10	3.61	5.40
3214.06	25754 –	56858	3.19	93	1.05				0.92	0.84				0.94	4.45	6.24
3216.82	26666 –	57744	3.31	93					0.50	0.85				0.68	4.19	5.98
3217.82	25754 –	56821	3.19	91	1.05				1.13	1.06				1.08	4.59	6.38
3219.79	27944 –	58993	3.46	94					0.02					0.02	3.53	5.32
3221.27	30923 –	61958	3.83	185	0.94				0.69	1.27				0.97	4.48	6.27
3221.65	0 –	31031	0.00	8	−1.61	−1.51			−1.45	−1.42		−1.62		−1.52	1.99	3.78
3223.53	25754 –	56767	3.19	94					0.21					0.21	3.72	5.51
3225.02	3410 –	34409	0.42	39	−1.07	−1.02			−0.87	−0.95		−1.10		−1.00	2.51	4.30
3226.98	0 –	30980	0.00	7		−2.15			−2.04	−1.76		−2.00		−1.99	1.52	3.31
3232.93	0 –	30923	0.00	7	−0.77	−0.80	−0.49			−0.78		−0.97		−0.76	2.75	4.54
3233.94	15610 –	46523	1.93	77					−0.86					−0.86	2.65	4.43
3234.65	880 –	31786	0.11	21	−1.25	−1.29			−1.35	−1.28				−1.29	2.22	4.00
3235.75	2217 –	33112	0.27	11		−2.82			−2.65					−2.74	0.77	2.55
3243.04	205 –	31031	0.03	22	−1.01	−1.06	−0.98			−0.97		−1.11		−1.03	2.48	4.26
3245.38	28068 –	58873	3.48	108					−0.27					−0.27	3.24	5.02
3248.46	205 –	30980	0.03	21	−1.80	−1.85			−1.77	−1.71				−1.78	1.73	3.51
3249.44	2217 –	32982	0.27	10		−2.17			−2.07	−1.66				−1.97	1.54	3.32
3250.74	3410 –	34163	0.42	39	−1.32	−1.37			−1.18	−1.21				−1.27	2.24	4.02
3268.96	27944 –	58526	3.46	91					−0.67					−0.67	2.84	4.61
3271.11	880 –	31442	0.11	23	−1.74	−1.92			−1.74	−1.80				−1.80	1.71	3.48
3273.45	28578 –	59118	3.54	108					−0.38					−0.38	3.14	4.90
3277.19	27944 –	58449	3.46	90					−0.37					−0.37	3.15	4.91
3281.88	28578 –	59040	3.54	106					0.16					0.16	3.68	5.44
3282.69	1332 –	31786	0.17	7	−1.60	−1.95			−1.83	−1.76				−1.78	1.74	3.50
3282.83	28068 –	58521	3.48	106						0.41				0.41	3.93	5.69
3284.42	26666 –	57104	3.31	96					0.02					0.02	3.54	5.29
3286.94	205 –	30619	0.03	19		−2.11			−2.02	−2.08				−2.07	1.45	3.20
3293.63	27415 –	57768	3.40	90					0.04					0.04	3.56	5.31
3296.26	27415 –	57744	3.40						−0.38					−0.38	3.14	4.89
3304.94	27580 –	57829	3.42	108					0.31	0.38				0.34	3.86	5.61
3307.01	27580 –	57810	3.42	107					−0.23					−0.23	3.29	5.04
3310.20	3410 –	33611	0.42	38		−2.44			−2.25					−2.34	1.18	2.92
3312.32	27580 –	57762	3.42	106					0.89	0.89				0.89	4.41	6.15
3312.99	29013 –	59189	3.60	106					0.32	0.81				0.56	4.08	5.82
3315.66	880 –	31031	0.11	22	−0.95	−0.90	−1.21	−0.94		−0.89		−1.02		−0.98	2.54	4.28
3320.26	1332 –	31442	0.17	9	−1.19	−1.04	−1.07	−1.00		−1.04		−1.21		−1.09	2.43	4.17
3322.31	3410 –	33501	0.42	39	−0.97	−1.01	−0.98			−0.99		−1.18		−1.03	2.49	4.23
3326.67	28578 –	58630	3.54	108					0.09	0.28				0.18	3.70	5.44
3327.39	26666 –	56711	3.31	90					0.20					0.20	3.72	5.46
3328.71	880 –	30913	0.11	20		−2.93			−2.90					−2.92	0.60	2.34
3337.01	205 –	30163	0.03	17		−3.69			−3.40					−3.54	−0.02	1.71
3338.76	13521 –	43464	1.68	54					−2.07					−2.07	1.45	3.18
3339.05	28578 –	58518	3.54	104					0.09					0.09	3.61	5.34
3351.05	0 –	29833	0.00	3		−4.23								−4.23	−0.70	1.02
3359.10	28068 –	57829	3.48	108					0.64	0.52	0.26			0.58	4.11	5.83
3361.55	880 –	30619	0.11	19	−1.28	−1.11	−1.10	−1.13		−1.05		−1.20		−1.14	2.39	4.10
3362.80	1713 –	31442	0.21	23		−2.47			−2.42	−2.37	−2.08			−2.42	1.11	2.82
3363.60	28068 –	57790	3.48	105					0.26		−0.05			0.26	3.79	5.50
3364.58	27261 –	56974	3.38	107					0.51		0.06			0.51	4.04	5.75

TABLE 2.—*Oscillator Strengths for Ni* I—Continued

Wave-length Å (1)	Energy Levels K (2)	(3)	Lower e.p. Volts (4)	Mult. No. (5)	CB (6)	K (7)	vD (8)	AA (9)	OBA (10)	OBS (11)	HD (12)	PP (13)	IC (14)	Best (15)	Log gfλ (16)	Log gA/λ (17)
3365.76	3410 –	33112	0.42	38	−0.97	−1.01	−0.93			−0.91				−0.96	2.57	4.28
3366.16	1332 –	31031	0.17	8	−1.23	−1.04	−1.04	−1.15		−1.08				−1.11	2.42	4.13
3366.80	27261 –	56954	3.38	108	0.69				1.12	1.06	0.73			0.96	4.49	6.20
3367.88	205 –	29888	0.03	20	−2.06	−2.43			−2.29		−1.98			−2.26	1.27	2.98
3369.56	0 –	29669	0.00	6	−0.45	−0.44	−0.28	−0.47				−0.68		−0.46	3.07	4.78
3371.99	1332 –	30980	0.17	7	−1.15	−0.99	−0.76	−1.11		−1.05		−0.96		−1.00	2.53	4.24
3374.22	205 –	29833	0.03	17	−1.47	−1.41	−1.32		−1.49	−1.37		−1.20		−1.38	2.15	3.86
3374.64	27261 –	56885	3.38	106	0.99				1.52	1.02				1.18	4.71	6.42
3375.55	29013 –	58630	3.60	108					0.22		−0.33			0.22	3.75	5.46
3376.32	28068 –	57678	3.48	104					0.41		0.05			0.41	3.94	5.65
3380.57	3410 –	32982	0.42	37	0.02	0.09	0.03	0.17						0.08	3.61	5.32
3380.89	2217 –	31786	0.27	7	−1.26	−1.06			−1.61	−0.81				−1.18	2.35	4.06
3387.46	880 –	30392	0.11	17		−3.69			−3.45		−3.30			−3.57	−0.04	1.66
3391.04	0 –	29481	0.00	5	−0.80	−0.85	−0.75	−0.82		−0.79		−1.03		−0.84	2.69	4.39
3392.98	205 –	29669	0.03	20	−0.38	−0.37	−0.17	−0.40				−0.49		−0.36	3.17	4.87
3396.18	29084 –	58521	3.60	122					0.30	0.70	0.03			0.50	4.03	5.73
3401.16	27580 –	56974	3.42	107					0.78	0.57	0.40			0.68	4.21	5.91
3403.43	27580 –	56954	3.42	108					0.84	0.77	0.45			0.80	4.33	6.03
3409.58	0 –	29321	0.00	5	−1.82	−2.01			−1.99	−1.89	−1.88			−1.93	1.60	3.30
3413.48	1332 –	30619	0.17	5	−1.26	−1.01			−1.41	−1.01				−1.17	2.36	4.05
3413.94	880 –	30163	0.11	17	−1.31	−1.37				−1.35				−1.34	2.19	3.88
3414.76	205 –	29481	0.03	19	0.00	0.02	0.09	−0.04						0.02	3.55	5.24
3420.73	2217 –	31442	0.27	9		−2.61			−2.75		−2.28			−2.68	0.85	2.54
3421.34	28542 –	57762	3.54	122					0.89	0.73	0.52			0.81	4.34	6.03
3422.32	28578 –	57790	3.54	105					0.37		−0.02			0.37	3.90	5.59
3422.87	29833 –	59040	3.70	122					0.66		0.17			0.66	4.19	5.88
3423.71	1713 –	30913	0.21	20	−0.52	−0.49	−0.42	−0.51		−0.53		−0.53		−0.50	3.03	4.72
3433.56	205 –	29321	0.03	19	−0.51	−0.52	−0.39	−0.48				−0.58		−0.50	3.04	4.72
3435.48	13521 –	42621	1.68	53					−1.42		−1.35			−1.42	2.12	3.80
3437.28	0 –	29084	0.00	3	−0.96	−0.91	−0.81	−1.03		−0.70		−0.91		−0.89	2.65	4.33
3442.04	27580 –	56625	3.42	104					0.47					0.47	4.01	5.68
3442.59	29833 –	58873	3.70	124					0.17					0.17	3.71	5.38
3443.03	28068 –	57104	3.48						−0.16					−0.16	3.38	5.05
3444.25	30163 –	59189	3.74	122					0.48		0.12			0.48	4.02	5.69
3446.26	880 –	29888	0.11	20	−0.17	−0.27	−0.13	−0.28				−0.30		−0.23	3.31	4.98
3452.88	880 –	29833	0.11	17	−0.74	−0.61	−0.50	−0.68		−0.63		−0.68		−0.64	2.90	4.57
3458.46	1713 –	30619	0.21	19	−0.06	−0.05	0.01	−0.06				−0.11		−0.05	3.49	5.16
3461.66	205 –	29084	0.03	17	−0.24	−0.25	−0.08	−0.27				−0.24		−0.22	3.32	4.99
3464.13	32973 –	61832	4.09						0.08					0.08	3.62	5.29
3467.50	1332 –	30163	0.17	3	−1.52	−1.70	−1.64		−1.54	−1.65				−1.61	1.93	3.59
3469.48	2217 –	31031	0.27	8	−1.32	−1.36	−1.53		−1.29	−1.31				−1.36	2.18	3.84
3472.55	880 –	29669	0.11	20	−0.65	−0.55	−0.40	−0.62		−0.61		−0.68		−0.58	2.96	4.62
3476.62	29833 –	58588	3.70	123					0.20		−0.20			0.20	3.74	5.40
3477.88	29084 –	57829	3.60	124					−0.12					−0.12	3.42	5.08
3478.32	29889 –	58630	3.70	173					0.20					0.20	3.74	5.40
3479.26	28068 –	56802	3.48	105					0.25		−0.16			0.25	3.79	5.45
3480.17	29084 –	57810	3.60	123					0.19		−0.12			0.19	3.73	5.39
3483.77	2217 –	30913	0.27	6	−0.97	−0.63	−0.80			−0.75		−0.73		−0.78	2.76	4.42
3485.11	29833 –	58518	3.70	118							−0.03					
3485.88	1713 –	30392	0.21	17	−1.66	−1.70	−1.87		−1.69	−1.88				−1.76	1.78	3.44
3488.30	29084 –	57744	3.60	121					0.20		−0.35			0.20	3.74	5.40
3492.96	880 –	29501	0.11	18	−0.14	−0.14	−0.03	−0.23				−0.16		−0.14	3.40	5.05
3496.35	29084 –	57678	3.60	118					0.49		0.13			0.49	4.03	5.68
3498.19	0 –	28578	0.00	2		−4.23								−4.23	−0.69	0.96
3500.85	1332 –	29888	0.17	6	−1.01	−0.91	−0.96	−1.16		−0.91		−1.06		−1.00	2.54	4.19
3502.60	0 –	28542	0.00	3	−2.18	−2.29			−2.42	−2.31	−2.13			−2.30	1.24	2.89
3507.69	1332 –	29833	0.17	3	−2.10	−2.01			−2.10	−1.97	−1.85			−2.04	1.51	3.15
3510.33	1713 –	30192	0.21	18	−0.37	−0.48	−0.51	−0.43				−0.20		−0.40	3.15	4.79
3511.61	29321 –	57790	3.63	152						0.56				0.56	4.11	5.75
3511.91	30163 –	58630	3.74	124					0.24					0.24	3.79	5.43

TABLE 2.—*Oscillator Strengths for Ni* I—Continued

Wave-length Å	Energy Levels K		Lower e.p. Volts	Mult. No.	CB	K	vD	AA	OBA	OBS	HD	PP	IC	Best	Log gfλ	Log gA/λ
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
3513.93	1713 —	30163	0.21	17	−1.37	−1.47	−1.64		−1.51					−1.50	2.05	3.69
3515.05	880 —	29321	0.11	19	−0.08	−0.07	0.08	−0.13				−0.07		−0.09	3.46	5.10
3516.22	28542 —	56974	3.54	123					1.15	0.90	0.70			1.02	4.57	6.21
3518.63	28542 —	56954	3.54	124					0.97	0.70	0.59			0.84	4.39	6.02
3519.76	2217 —	30619	0.27	5	−0.92	−0.92	−1.09			−1.05		−0.80		−0.96	2.59	4.22
3523.07	3410 —	31786	0.42	34		−2.81			−1.95					−2.81	0.74	2.37
3523.44	205 —	28578	0.03	16		−2.06			−2.04					−2.05	1.50	3.13
3524.55	205 —	28569	0.03	18	−0.07	0.11	0.13	0.13				0.33		0.13	3.68	5.31
3526.53	29481 —	57829	3.65	155					0.63		0.28			0.63	4.18	5.81
3527.98	1332 —	29669	0.17	6	−1.81	−1.70	−1.91		−1.80	−1.81				−1.81	1.74	3.37
3528.88	29481 —	57810	3.65	154					0.41					0.41	3.96	5.59
3529.62	15610 —	43933	1.93	76					−1.15		−1.13			−1.15	2.40	4.03
3530.59	28542 —	56858	3.54	121					0.56		0.23			0.56	4.11	5.74
3537.24	29481 —	57744	3.65	153					0.12					0.12	3.67	5.30
3537.62	28542 —	56802	3.54	120					0.22					0.22	3.77	5.40
3542.03	28542 —	56767	3.54	119					0.10		−0.38			0.10	3.65	5.28
3545.16	15734 —	43933	1.95	76					−1.34		−1.26			−1.34	2.21	3.84
3548.18	2217 —	30392	0.27	3	−1.24	−1.00	−1.28	−1.05		−1.21		−0.98		−1.13	2.42	4.04
3548.18	1713 —	29889	0.21	20		−1.18	−1.33	−1.05						−1.19	2.36	3.98
3551.53	1332 —	29481	0.17	5	−2.12	−2.06			−2.19	−2.04	−1.89			−2.10	1.45	3.07
3553.48	880 —	29013	0.11	16		−2.33			−2.74	−2.09	−2.16			−2.33	1.22	2.84
3559.92	28542 —	56625	3.54	118					0.24		−0.13			0.24	3.79	5.41
3561.75	0 —	28068	0.00	2	−2.21	−2.12			−2.18	−2.07	−2.00			−2.14	1.41	3.03
3566.37	3410 —	31442	0.42	36	0.08	−0.03	0.02	−0.05				0.11		0.03	3.58	5.20
3571.86	1332 —	29321	0.17	5	−0.88	−0.80	−0.82	−0.92		−0.77		−0.74		−0.82	2.73	4.35
3575.93	29833 —	57790	3.70	120					0.29		−0.55			0.29	3.84	5.45
3577.23	2217 —	30163	0.27	3		−3.31			−3.18		−2.99			−3.24	0.31	1.92
3587.93	205 —	28068	0.03	16	−1.90	−1.97	−2.06		−1.99	−2.21		−1.88		−2.00	1.55	3.16
3597.70	1713 —	29501	0.21	18	−0.73	−0.79	−0.85	−0.80		−0.73		−0.74		−0.77	2.79	4.39
3599.54	29084 —	56858	3.60	121					0.18		−0.45			0.18	3.74	5.34
3602.28	1332 —	29084	0.17	3		−1.70	−1.78		−1.67	−1.66		−2.21		−1.70	1.86	3.45
3604.26	29084 —	56822	3.60								−0.63					
3606.85	29084 —	56802	3.60	120					0.31		−0.13			0.31	3.87	5.46
3609.31	880 —	28578	0.11	16		−1.69	−1.72		−1.69	−1.47				−1.64	1.92	3.51
3610.46	880 —	28569	0.11	18	−0.83	−0.92	−0.85	−0.80		−0.74		−1.35		−0.83	2.73	4.32
3611.43	29084 —	56767	3.60	119							0.06					
3611.54	1332 —	29013	0.17	2		−3.80								−3.80	−0.24	1.35
3612.74	2217 —	29888	0.27	6	−1.07	−0.97	−1.15	−1.10		−0.93		−2.03		−1.04	2.52	4.11
3619.39	3410 —	31031	0.42	35	0.17	0.15	0.27	0.18				0.40		0.19	3.75	5.34
3624.73	0 —	27580	0.00	2	−1.95	−1.96			−1.94	−1.79				−1.91	1.65	3.24
3629.90	30980 —	58521	3.84	182					0.26		−0.12			0.26	3.82	5.40
3634.95	3410 —	30913	0.42	33		−2.11			−2.12		−1.88			−2.12	1.44	3.02
3641.64	2217 —	29669	0.27	6		−3.03			−3.28		−2.82			−3.16	0.40	1.98
3642.38	16017 —	43464	1.99	75					−1.46		−1.63			−1.46	2.10	3.68
3643.94	29669 —	57104	3.68	174							−0.64					
3656.54	29481 —	56822	3.65								−0.91					
3657.70	31786 —	59118	3.94	183							−0.65					
3661.95	1713 —	29013	0.21	16		−2.47			−2.59		−2.31			−2.53	1.03	2.60
3664.09	2217 —	29501	0.27	4	−1.53	−1.52		−1.48	−1.64	−1.47				−1.53	2.03	3.60
3668.21	31786 —	59040	3.94	182					0.45		−0.23			0.45	4.01	5.58
3669.24	1332 —	28578	0.17	2	−1.81	−2.14			−2.06		−1.94			−2.00	1.56	3.13
3670.43	1332 —	28569	0.17	4	−1.69	−1.77		−1.87	−1.90	−1.59				−1.76	1.80	3.37
3674.06	205 —	27415	0.03	15		−2.37	−1.80		−1.59							
3674.15	3410 —	30619	0.42	32	−1.65	−1.23	−1.48	−1.5		−1.31						
3688.41	2217 —	29321	0.27	5	−1.59	−1.69			−1.76	−1.82				−1.76	1.81	3.36
3693.93	880 —	27944	0.11	15	−2.06	−2.44			−2.48		−2.27			−2.46	1.11	2.66
3696.91	29669 —	56711	3.68	172					0.24		−0.28			0.24	3.81	5.36
3705.10	3410 —	30392	0.42	30							−3.85					
3713.70	15734 —	42654	1.95	74					−1.47					−1.47	2.10	3.64
3715.50	30923 —	57829	3.83	183					0.20		−0.61			0.20	3.77	5.31

TABLE 2.—*Oscillator Strengths for Ni* I—Continued

Wave-length Å (1)	Energy Levels K (2)	(3)	Lower e.p. Volts (4)	Mult. No. (5)	CB (6)	K (7)	CHC (8)	AA (9)	OBA (10)	OBS (11)	HD (12)	PP (13)	IC (14)	Best (15)	Log gfλ (16)	Log gA/λ (17)
3722.49	1713 –	28569	0.21	18	−1.79	−1.75			−1.81	−1.84				−1.80	1.77	3.31
3724.82	30923 –	57762	3.83	182					0.32		−0.19			0.32	3.89	5.43
3728.92	30980 –	57790	3.84	181					0.22		−0.62			0.22	3.79	5.33
3730.75	2217 –	29013	0.27	2		−2.95			−3.00		−2.76			−2.98	0.59	2.13
3736.81	3410 –	30163	0.42	30	−1.50	−1.33			−1.23	−1.47				−1.38	2.19	3.73
3739.23	1332 –	28068	0.17	2	−2.15	−2.14			−2.11	−1.98				−2.10	1.47	3.01
3739.79	31786 –	58518	3.94	180					1.14					1.14	4.71	6.25
3744.56	30980 –	57678	3.84	180					0.66		−0.07			0.66	4.23	5.76
3749.05	0 –	26666	0.00	1		−2.73			−2.69		−2.49			−2.71	0.86	2.39
3762.62	22102 –	48672	2.74						−0.32		−0.76			−0.32	3.26	4.78
3772.53	1713 –	28213	0.21	15		−2.84			−2.90		−2.66			−2.87	0.71	2.22
3775.57	3410 –	29888	0.42	33	−0.92	−0.87		−0.95		−0.85		−0.97		−0.91	2.67	4.18
3778.06	205 –	26666	0.03	15		−3.00			−3.01		−2.80			−3.00	0.58	2.09
3783.53	3410 –	29833	0.42	30	−0.85	−0.84		−0.99		−0.79		−0.85		−0.86	2.72	4.23
3792.34	2217 –	28578	0.27	2		−2.71			−2.62		−2.48			−2.67	0.91	2.42
3793.60	2217 –	28569	0.27	4		−2.34			−2.26		−2.12			−2.30	1.28	2.79
3807.14	3410 –	29669	0.42	33	−0.86	−0.77	−0.84	−0.89		−0.64		−0.78		−0.79	2.79	4.29
3811.28	1713 –	27944	0.21	15		−3.67			−3.84		−3.51			−3.76	−0.18	1.32
3831.69	3410 –	29501	0.42	31	−1.64	−1.63	−1.60	−1.65	−1.52					−1.61	1.97	3.46
3832.87	1332 –	27415	0.17	1		−2.96	−2.85		−2.99		−2.72			−2.93	0.65	2.14
3844.26	28569 –	54575	3.54	137			−0.61		0.21							
3844.56	31786 –	57790	3.94	181			−0.57		0.24							
3854.68	30923 –	56858	3.83				−0.34									
3855.84	33112 –	59040	4.10				−0.45									
3858.30	3410 –	29321	0.42	32	−0.62	−0.48	−0.66	−0.65		−0.38				−0.56	3.03	4.50
3863.06	30923 –	56802	3.83	181			0.11		0.53		−0.10					
3871.59	30980 –	56802	3.84	181			−0.38				−0.78					
3885.87	2217 –	27944	0.27	1		−3.71								−3.71	−0.12	1.35
3889.67	1713 –	27415	0.21	15	−2.41	−3.10	−2.16		−2.81		−2.60					
3908.92	29084 –	54660	3.60	117			−0.44		0.44		−0.16					
3912.29	30619 –	56173	3.80	151					0.34		−0.16					
3912.97	205 –	25754	0.03	15		−3.48	−3.20		−3.83		−3.24					
3941.84	30913 –	56275	3.83	171					0.07		−0.62					
3944.11	29321 –	54668	3.63	151					0.57		0.11					
3954.53	29481 –	54761	3.65						−0.03		−0.51					
3962.13	31031 –	56263	3.85	199					0.09		−0.45					
3970.48	29481 –	54660	3.65	151			−0.24		0.53		0.09					
3972.16	3410 –	28578	0.42	29	−2.19		−2.34		−2.42		−2.30			−2.32	1.28	2.71
3973.55	3410 –	28569	0.42	31	−1.71		−1.88	−1.75	−1.97		−1.82			−1.82	1.78	3.21
3974.64	31031 –	56184	3.85	198			−0.16		0.63		−0.01					
3984.14	29669 –	54761	3.68	171			−0.39		0.29		−0.07		−0.68			
3986.36	25754 –	50832	3.19										−2.03			
3993.93	29669 –	54700	3.68	170					−0.01		−0.34		−0.83			
3996.12	33501 –	58518	4.15										−1.40			
3999.03	29669 –	54668	3.68										−1.31			
4002.51	33611 –	58588	4.17										−1.10			
4009.98	29321 –	54251	3.63	150			−0.80		−1.19		−1.11		−1.22			
4012.58	33611 –	58526	4.17										−1.10			
4017.44	29888 –	54773	3.70	171			−0.45		0.18		−0.20		−0.68			
4019.07	15610 –	40484	1.93	72			−1.99		−2.05		−2.19		−2.40			
4022.05	32973 –	57829	4.09	241			−0.34				−0.95		−0.79			
4024.00	29889 –	54732	3.70	170							−0.53		−0.82			
4025.10	32973 –	57810	4.09	240			−0.46						−0.84	−0.65	2.95	4.36
4025.42	29833 –	54668	3.70	117					0.00				−1.04			
4027.66	31442 –	56263	3.90								−0.39		−0.63			
4028.49	32973 –	57790	4.09										−1.24			
4039.03	15610 –	40361	1.93										−3.07			
4045.38	25754 –	50466	3.19				−0.98									
4046.75	32973 –	57678	4.09								−1.25		−0.99			
4051.18	33112 –	57790	4.10	239									−0.99			

TABLE 2.—*Oscillator Strengths for Ni* I—Continued

Wave-length Å (1)	Energy Levels K (2)	(3)	Lower e.p. Volts (4)	Mult. No. (5)	CB (6)	K (7)	CHC (8)	AA (9)	OBA (10)	OBS (11)	HD (12)	PP (13)	IC (14)	Best (15)	Log gfλ (16)	Log gA/λ (17)
4057.27	26666 –	51306	3.31	89			−1.08		−0.30		−1.16		−1.28			
4059.66	27415 –	52041	3.40										−1.90			
4064.37	30980 –	55577	3.84	179			−0.23		−0.22		−0.50		−0.58	−0.34	3.27	4.66
4069.15	29669 –	54237	3.68				−0.88						−1.26			
4072.86	31031 –	55577	3.85	197					−0.92		−1.22		−1.40			
4074.90	3410 –	27944	0.42	28					−4.45		−4.24		−4.05			
4093.03	34163 –	58588	4.23				−0.24						−1.29			
4103.57	34163 –	58526	4.23										−1.29			
4112.44	33501 –	57810	4.15										−1.64			
4115.98	33501 –	57790	4.15	255			0.06		−0.23		−0.48		−0.38			
4121.98	29501 –	53754	3.66										−1.39			
4123.79	33501 –	57744	4.15								−1.04		−0.94			
4130.52	29501 –	53704	3.66										−1.98			
4131.17	33590 –	57790	4.16										−1.23			
4138.49	33611 –	57768	4.17	237			−0.31		−0.82		−0.94		−0.91			
4142.16	31442 –	55577	3.90	212									−1.10			
4142.96	32973 –	57104	4.09								−0.78		−0.92			
4148.73	27944 –	52041	3.46	89									−1.42			
4150.37	31786 –	55874	3.94	178			−0.32		−0.40		−0.63		−0.77			
4158.53	34409 –	58449	4.26								−1.34		−1.26			
4161.33	25754 –	49778	3.19	86							−1.61		−1.88			
4164.64	3410 –	27415	0.42	28			−3.21		−4.37		−3.68		−4.15			
4165.44	32973 –	56974	4.09										−2.08			
4166.96	33112 –	57104	4.10				−0.30		−0.53		−0.75		−0.82			
4184.47	27415 –	51306	3.40	89			−0.75		−0.42		−0.66		−0.91			
4188.97	29889 –	53754	3.70										−1.81			
4193.70	30923 –	54761	3.83										−1.72			
4195.52	32973 –	56802	4.09	239			0.25		0.17		−0.09		−0.05	0.12	3.74	5.08
4200.45	26666 –	50466	3.31	89			−0.40		−0.18		−0.29		−0.64			
4201.71	32973 –	56767	4.09	238			0.26		0.35				−0.03	0.19	3.81	5.14
4202.14	31786 –	55577	3.94	179									−0.96	−0.96	2.66	3.99
4217.78	28569 –	52272	3.54										−2.24	−2.24	1.39	2.71
4221.68	26666 –	50346	3.31	86			−0.99				−1.13		−1.37	−1.16	2.47	3.79
4226.39	33112 –	56767	4.10										−0.91	−0.91	2.72	4.04
4229.49	31031 –	54668	3.85										−1.62	−1.62	2.01	3.33
4231.03	28569 –	52197	3.54	136			−0.42				−0.29		−0.71			
4235.29	34163 –	57768	4.23								−1.36			−1.36	2.27	3.58
4236.37	33112 –	56711	4.10	237							−0.72		−0.66	−0.69	2.94	4.25
4246.76	30163 –	53704	3.74										−2.02	−2.02	1.61	2.92
4252.02	30192 –	53704	3.74	136							−1.13		−1.44	−1.28	2.35	3.66
4260.92	28578 –	52041	3.54										−2.14	−2.14	1.49	2.80
4284.68	25754 –	49086	3.19	86			−0.59				−0.29		−0.61	−0.50	3.13	4.43
4285.18	27415 –	50745	3.40	86									−1.74	−1.74	1.89	3.19
4287.99	30923 –	54237	3.83	178			0.40				0.44		0.39	0.41	4.04	5.34
4290.26	27415 –	50717	3.40										−1.94	−1.94	1.69	2.99
4295.88	30980 –	54251	3.84	178			0.04				0.06		−0.06	0.01	3.64	4.93
4296.97	33501 –	56767	4.15								−1.14		−1.14	−1.14	2.49	3.78
4298.51	30980 –	54237	3.84	178			−0.51						−0.77	−0.64	2.99	4.28
4298.76	3410 –	26666	0.42	28									−4.59	−4.59	−0.96	0.33
4302.09	28068 –	51306	3.48	102									−1.64	−1.64	1.99	3.28
4307.28	33501 –	56711	4.15				−0.31				−0.72		−0.84			
4322.94	27580 –	50706	3.42										−1.74	−1.74	1.90	3.18
4325.36	29084 –	52197	3.60	116			−0.93						−0.75	−0.84	2.80	4.08
4325.60	26666 –	49778	3.31	86			−0.32						−0.36	−0.34	3.30	4.58
4330.70	30619 –	53704	3.80	149			−0.50				−0.46		−0.73	−0.56	3.08	4.35
4331.64	13521 –	36601	1.68	52			−1.38				−1.20		−1.52	−1.37	2.27	3.54
4333.19	33112 –	56184	4.10										−1.03	−1.03	2.61	3.88
4341.45	29013 –	52041	3.60										−1.73	−1.73	1.91	3.18
4355.90	29321 –	52272	3.63	149			−0.56				−0.38		−0.73	−0.56	3.08	4.35
4357.85	34163 –	57104	4.23	256							−1.82		−1.79	−1.80	1.84	3.11

TABLE 2.—*Oscillator Strengths for Ni* I—Continued

Wave-length Å (1)	Energy Levels K (2)	(3)	Lower e.p. Volts (4)	Mult. No. (5)	CB (6)	K (7)	CHC (8)	AA (9)	ULO (10)	OBS (11)	HD (12)	PP (13)	IC (14)	Best (15)	Log gfλ (16)	Log gA/λ (17)
4359.58	27415 –	50346	3.40	86			−0.17				0.06		−0.26	−0.09	3.55	4.82
4367.33	27944 –	50834	3.46	88							−1.42		−1.84			
4368.31	27580 –	50466	3.42	102			−0.66				−0.69		−1.01	−0.79	2.85	4.11
4370.04	29321 –	52197	3.63	149			−0.95				−0.72		−1.04	−0.90	2.74	4.00
4382.70	27944 –	50754	3.46										−1.84	−1.84	1.80	3.06
4382.87	31442 –	54251	3.90								−0.82		−1.10	−0.96	2.68	3.94
4384.53	27944 –	50745	3.46	86			−0.46				−0.22		−0.50	−0.39	3.25	4.51
4386.46	30913 –	53704	3.83	168			−0.54				−0.71		−1.05			
4389.86	27944 –	50717	3.46	87			−0.80				−0.55		−0.91	−0.75	2.89	4.15
4390.32	29501 –	52272	3.66	136							−0.69		−1.03	−0.86	2.78	4.04
4396.92	28569 –	51306	3.54								−1.49		−1.79	−1.64	2.00	3.25
4398.62	28578 –	51306	3.54	102							−1.00		−1.16	−1.08	2.56	3.81
4399.60	31031 –	53754	3.85	196			−0.20				−0.29		−0.46	−0.32	3.32	4.57
4400.87	29481 –	52197	3.65	149			−0.27				−0.15		−0.50	−0.31	3.33	4.58
4401.54	25754 –	48467	3.19	86	0.83		0.81						0.93	0.86	4.50	5.75
4410.52	26666 –	49333	3.31	88			−0.50				−0.27		−0.67	−0.48	3.16	4.41
4422.43	26666 –	49272	3.31										−2.38	−2.38	1.27	2.51
4422.99	29669 –	52272	3.68	168							−0.73		−1.17			
4424.84	33590 –	56184	4.16	262							−1.41		−1.94			
4431.03	33611 –	56173	4.17										−1.24	−1.24	2.41	3.64
4433.82	34163 –	56711	4.23										−1.80	−1.80	1.85	3.08
4435.35	29501 –	52041	3.66								−1.31		−1.59	−1.45	2.20	3.43
4436.97	28213 –	50745	3.50	86			−0.14				−0.06		−0.38	−0.19	3.46	4.69
4437.57	29669 –	52197	3.68	168			−0.40				−0.31		−0.71	−0.47	3.18	4.41
4441.44	26666 –	49175	3.31								−1.28		−1.69			
4442.43	28213 –	50717	3.50	87			−0.64				−0.57		−0.94	−0.72	2.93	4.16
4444.55	26666 –	49159	3.31										−2.56	−2.56	1.09	2.32
4450.10	31786 –	54251	3.94	178									−1.28	−1.28	2.37	3.60
4450.21	33112 –	55577	4.10	236									−1.28	−1.28	2.37	3.60
4459.03	26666 –	49086	3.31	86	0.78		0.69				0.82		0.76	0.76	4.41	5.64
4462.45	27944 –	50346	3.46	86	0.23		0.23				0.44		0.31	0.30	3.95	5.18
4463.42	28068 –	50466	3.48	102			−0.75				−0.63		−0.87	−0.75	2.90	4.12
4466.38	29889 –	52272	3.70	168									−0.78	−0.78	2.87	4.09
4470.48	27415 –	49778	3.40	86	0.67		0.51				0.68		0.51	0.59	4.24	5.46
4480.56	31442 –	53754	3.90	211							−0.52		−0.76	−0.64	3.01	4.23
4481.24	29889 –	52197	3.70	168							−1.18		−1.55	−1.36	2.29	3.51
4484.49	29013 –	51306	3.60	102							−1.80		−1.93	−1.86	1.79	3.01
4490.53	28569 –	50832	3.54	134							−0.59		−0.94	−0.76	2.89	4.11
4492.33	28578 –	50832	3.54								−1.56		−1.98	−1.77	1.88	3.10
4501.67	29833 –	52041	3.70	115							−1.37		−1.63	−1.50	2.15	3.36
4506.30	28569 –	50754	3.54	133							−1.22		−1.44	−1.33	2.32	3.53
4508.10	28578 –	50754	3.54										−2.30	−2.30	1.35	2.56
4512.99	29889 –	52041	3.70	163			−0.37				−0.50		−0.64	−0.50	3.15	4.36
4513.32	35639 –	57790	4.42										−1.32	−1.32	2.33	3.54
4513.88	28569 –	50717	3.54	131									−2.31	−2.31	1.34	2.55
4517.84	28578 –	50706	3.54	103							−1.76		−1.94	−1.85	1.80	3.01
4519.98	13521 –	35639	1.68	51			−2.08				−2.04		−2.25	−2.12	1.54	2.74
4521.87	30163 –	52272	3.74	116							−1.51		−1.68	−1.60	2.06	3.26
4523.70	28578 –	50678	3.54	99									−2.18	−2.18	1.48	2.68
4528.53	33501 –	55577	4.15										−0.45	−0.45	3.21	4.41
4542.24	34163 –	56173	4.23										−1.44	−1.44	2.22	3.41
4546.93	33590 –	55577	4.16	261			0.72						0.48	0.60	4.26	5.45
4547.22	29321 –	51306	3.63	146			0.05						−0.25	−0.10	3.56	4.75
4551.23	33611 –	55577	4.17	236			0.09				−0.31		−0.14	−0.12	3.54	4.73
4553.17	29501 –	51457	3.66	135							−0.68		−0.75	−0.72	2.94	4.13
4559.93	28542 –	50466	3.54	115							−0.76		−0.81	−0.78	2.88	4.07
4565.15	27415 –	49314	3.40	88									−2.27	−2.27	1.39	2.58
4567.41	28578 –	50466	3.54	102							−1.43		−1.36	−1.40	2.26	3.44
4569.64	30163 –	52041	3.74										−1.84	−1.84	1.82	3.00
4573.98	27415 –	49272	3.40	87							−1.67		−1.63	−1.65	2.01	3.19

TABLE 2.—*Oscillator Strengths for Ni* I—Continued

Wave-length Å (1)	Energy Levels K (2)	(3)	Lower e.p. Volts (4)	Mult. No. (5)	CB (6)	K (7)	CHC (8)	AA (9)	ULO (10)	OBS (11)	HD (12)	PP (13)	IC (14)	Best (15)	Log gfλ (16)	Log gA/λ (17)
4580.60	29481 –	51306	3.65	146							−0.85		−0.76	−0.80	2.86	4.04
4581.42	29013 –	50834	3.60										−1.34	−1.34	2.32	3.50
4592.53	28578 –	50346	3.54	98	0.57		0.48				0.60		0.61	0.56	4.22	5.40
4595.94	27580 –	49333	3.42	101							−0.39		−0.57	−0.48	3.18	4.36
4597.65	27415 –	49159	3.40										−2.01	−2.01	1.65	2.83
4600.36	29013 –	50745	3.60	98	0.30		0.19				0.38		0.26	0.28	3.94	5.12
4604.99	28068 –	49778	3.48	98	0.77		0.58				0.73		0.85	0.73	4.39	5.56
4606.22	29013 –	50717	3.60	100	0.30		−0.15				−0.01		0.06	−0.03	3.63	4.80
4609.92	32973 –	54660	4.09										−0.85	−0.85	2.81	3.98
4614.58	29013 –	50678	3.60	99							−1.30		−1.27	−1.28	2.38	3.55
4617.96	30392 –	52041	3.77	115							−0.89		−0.83	−0.86	2.80	3.97
4620.39	29669 –	51306	3.68	163							−1.59		−1.51	−1.55	2.11	3.28
4629.54	27580 –	49175	3.42										−1.35	−1.35	2.32	3.48
4641.56	27415 –	48953	3.40										−1.98	−1.98	1.69	2.84
4647.43	29321 –	50832	3.63	148									−1.11	−1.11	2.56	3.71
4648.65	27580 –	49086	3.42	98	0.78		0.73				0.89			0.80	4.47	5.62
4655.65	29833 –	51306	3.70	115							−0.43		−0.38	−0.40	3.27	4.42
4666.98	30619 –	52041	3.80	146			−0.03				−0.17		−0.20	−0.13	3.54	4.69
4667.76	29889 –	51306	3.70	163			0.06				0.03		0.08	0.06	3.73	4.88
4668.62	34163 –	55577	4.23								−1.11		−1.01	−1.06	2.61	3.76
4674.76	29321 –	50706	3.63								−0.57		−0.69	−0.63	3.04	4.18
4675.60	29084 –	50466	3.60	115							−0.84		−0.93	−0.88	2.79	3.93
4681.04	29321 –	50678	3.63	143									−1.80	−1.80	1.87	3.01
4686.21	29013 –	50346	3.60	98	0.39		0.26				0.38		0.23	0.32	3.99	5.13
4698.39	32973 –	54251	4.09	235			−0.03				−0.29		−0.20	−0.17	3.50	4.64
4701.35	28068 –	49333	3.48	101									−0.61	−0.61	3.06	4.20
4701.53	32973 –	54237	4.09	235			0.52						0.54	0.53	4.20	5.34
4703.81	29501 –	50754	3.66	133			0.04				−0.06		0.34	0.11	3.78	4.92
4705.51	28068 –	49314	3.48	101									−1.22	−1.22	2.45	3.59
4705.92	29501 –	50745	3.66	128									−0.77	−0.77	2.90	4.04
4710.05	29481 –	50706	3.65										−1.34	−1.34	2.33	3.46
4712.06	29501 –	50717	3.66	131							−0.76		−0.44	−0.60	3.07	4.20
4714.42	27261 –	48467	3.38	98	0.84		1.02				0.84			0.90	4.57	5.70
4715.76	28578 –	49778	3.54	98	0.26		0.45				0.28		0.62	0.40	4.07	5.20
4723.88	29669 –	50832	3.68	167							−1.83		−1.53	−1.68	1.99	3.12
4727.84	29321 –	50466	3.63	146							−1.19		−0.84	−1.01	2.66	3.79
4728.40	30163 –	51306	3.74	115							−1.48		−1.02			
4729.28	33112 –	54251	4.10	235							−1.01		−0.55			
4731.80	30913 –	52041	3.83	163			0.07				−0.29		0.00	−0.07	3.61	4.73
4732.47	33112 –	54237	4.10	235			0.29				−0.21		0.20	0.09	3.77	4.89
4736.51	28068 –	49175	3.48	99							−1.68		−1.43	−1.56	2.12	3.24
4740.17	28068 –	49159	3.48	99							−1.16		−1.02	−1.09	2.59	3.71
4752.12	29669 –	50706	3.68	165			−0.27						−0.42	−0.35	3.33	4.44
4752.42	29501 –	50537	3.66	132			−0.06						0.15	0.04	3.72	4.83
4754.75	29321 –	50346	3.63	141			−0.14				−0.39		−0.15	−0.23	3.45	4.56
4756.51	28068 –	49086	3.48	98	0.39		0.48				0.35		0.63	0.46	4.14	5.25
4758.42	31031 –	52041	3.85	193							−1.42		−1.29	−1.36	2.32	3.43
4762.63	15610 –	36601	1.93	71			−1.71				−1.87		−1.70	−1.76	1.92	3.03
4763.94	29481 –	50466	3.65	146	0.17		0.15				−0.08		0.12	0.09	3.77	4.88
4772.86	29889 –	50834	3.70	162							−0.99		−0.83	−0.91	2.77	3.88
4773.41	29889 –	50832	3.70	167							−0.93		−0.89	−0.91	2.77	3.88
4786.28	13521 –	34409	1.68	50									−2.33	−2.33	1.35	2.45
4786.54	27580 –	48467	3.42	98	0.47		0.53							0.50	4.18	5.28
4790.97	15734 –	36601	1.95	71							−2.77		−2.73	−2.75	0.93	2.03
4791.24	29889 –	50754	3.70										−1.32	−1.32	2.36	3.46
4793.43	29889 –	50745	3.70	158							−1.67		−1.40	−1.54	2.14	3.24
4795.81	29501 –	50346	3.66	128							−1.85		−1.66	−1.76	1.92	3.02
4799.42	31442 –	52272	3.90										−1.46	−1.46	2.22	3.32
4799.80	29889 –	50717	3.70	161									−0.72	−0.72	2.96	4.06
4806.99	29669 –	50466	3.68	163	0.34						0.00		0.24	0.19	3.87	4.97

TABLE 2.—*Oscillator Strengths for Ni* I—Continued

Wave-length Å	Energy Levels K		Lower e.p. Volts	Mult. No.	CB	K	CHC	AA	ULO	OBS	HD	PP	IC	Best	Log gfλ	Log gA/λ
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
4808.54	28542 –	39333	3.54	114									−2.23	−2.23	1.45	2.55
4808.89	29889 –	50678	3.70	160									−0.74	−0.74	2.94	4.04
4811.98	29501 –	50276	3.66	130							−0.87		−0.64	−0.76	2.92	4.02
4812.90	32982 –	53754	4.09								−1.30		−1.05	−1.18	2.50	3.60
4814.60	29013 –	49778	3.60	98							−1.04		−0.87	−0.96	2.72	3.82
4815.93	28569 –	49328	3.54	131							−1.17		−1.03	−1.10	2.58	3.68
4817.82	33501 –	54251	4.15	254							−0.56		−0.21	−0.38	3.30	4.40
4819.18	28569 –	49314	3.54										−1.79	−1.79	1.89	2.99
4821.12	33501 –	54237	4.15	254							−0.56		−0.15			
4829.02	28569 –	49271	3.54	131	0.25		0.29				0.33		0.34	0.30	3.98	5.07
4831.17	29084 –	49778	3.60	100	0.24		0.38				0.26		0.35	0.31	3.99	5.08
4832.69	30619 –	51306	3.80	146			0.07				−0.29		−0.13	−0.12	3.56	4.65
4836.28	30163 –	50834	3.74	114							−1.37		−1.41	−1.39	2.29	3.38
4836.85	30163 –	50832	3.74										−1.59	−1.59	2.09	3.18
4838.64	33590 –	54251	4.16	260			0.43						0.09	0.26	3.94	5.03
4841.68	29889 –	50537	3.70	164									−1.65	−1.65	2.03	3.12
4841.97	33590 –	54237	4.16	260							−1.23		−1.03	−1.13	2.56	3.64
4843.16	13521 –	34163	1.68	50							−2.60		−2.73	−2.66	1.03	2.11
4843.51	33611 –	54251	4.17	235									−0.53	−0.53	3.16	4.24
4845.17	29833 –	50466	3.70	115							−1.44		−1.71	−1.58	2.11	3.19
4852.55	28569 –	49171	3.54	130			−0.38				−0.39		−0.52	−0.43	3.26	4.34
4853.78	28578 –	49175	3.54	99							−0.86		−1.03	−0.94	2.75	3.83
4855.41	28569 –	49159	3.54	130	0.55		0.54				0.57		0.53	0.55	4.24	5.32
4857.39	30163 –	50745	3.74	111			0.04				−0.23		−0.23	−0.14	3.55	4.62
4863.93	30163 –	50717	3.74	113									−0.40	−0.40	3.29	4.36
4864.27	30192 –	50745	3.74	128									−0.54	−0.54	3.15	4.22
4866.27	28542 –	49086	3.54	111	0.42		0.42				0.37		0.47	0.42	4.11	5.18
4870.83	30192 –	50717	3.74	131			−0.12				−0.23		−0.22	−0.19	3.50	4.57
4873.25	30163 –	50678	3.74	112									−0.66	−0.66	3.03	4.10
4873.44	29833 –	50346	3.70	111	0.25		0.30				0.23		0.22	0.25	3.94	5.01
4874.79	28578 –	49086	3.54	98							−0.83		−0.82	−0.82	2.87	3.94
4886.71	29889 –	50346	3.70	158									−1.11	−1.11	2.58	3.65
4886.98	29321 –	49778	3.63	141							−0.50		−0.53	−0.52	3.17	4.24
4890.44	30392 –	50834	3.77	114							−1.86		−1.92	−1.89	1.80	2.87
4900.97	28068 –	48467	3.48	98							−1.04		−1.05	−1.04	2.65	3.71
4904.41	28569 –	48953	3.54	129	0.48		0.46				0.49		0.36	0.45	4.14	5.20
4912.02	30392 –	50745	3.77	111			−0.02				−0.21		−0.17	−0.13	3.56	4.62
4913.97	30192 –	50537	3.74	132			0.00				−0.03		0.03	0.00	3.69	4.75
4918.36	30980 –	51306	3.84	177	0.43		0.54						0.56	0.51	4.20	5.26
4918.71	30392 –	50717	3.77	113			−0.02						−0.41	−0.22	3.47	4.53
4925.56	29481 –	49778	3.65	141			−0.10				−0.19		−0.24	−0.18	3.51	4.57
4930.80	31031 –	51306	3.85	193							−0.76		−0.72	−0.74	2.95	4.01
4935.83	31786 –	52040	3.94	177	0.26		0.50				0.25		0.28	0.32	4.01	5.06
4937.35	29084 –	49333	3.60	114			0.00				0.12		−0.06	0.02	3.71	4.76
4945.44	30619 –	50834	3.80	145									−0.47	−0.47	3.22	4.27
4946.03	30619 –	50832	3.80	148									−0.90	−0.90	2.79	3.84
4952.28	29084 –	49272	3.60	113							−0.71		−1.00	−0.86	2.83	3.88
4953.21	30163 –	50346	3.74	111			0.15				−0.01		−0.03	0.04	3.73	4.78
4965.17	30619 –	50754	3.80	147							−0.65		−0.87	−0.76	2.94	3.98
4967.53	30619 –	50745	3.80	141							−1.00		−1.08	−1.04	2.66	3.70
4971.34	36601 –	56711	4.54	274			0.73				0.22		0.65			
4974.36	30619 –	50717	3.80										−1.52	−1.52	2.18	3.21
4976.13	29084 –	49174	3.60	112									−0.85	−0.85	2.85	3.88
4976.32	13521 –	33611	1.68	49									−2.59	−2.59	1.11	2.14
4976.70	34163 –	54251	4.23	254									−1.00	−1.00	2.70	3.73
4980.17	29084 –	49158	3.60	112	0.52		0.61				0.61		0.50	0.56	4.26	5.29
4984.11	30619 –	50678	3.80	143	0.64		0.72				0.70		0.66	0.68	4.38	5.41
4995.65	29321 –	49333	3.63	145							−0.99		−1.27	−1.13	2.57	3.60
4996.84	29321 –	49328	3.63	144							−0.39		−0.54	−0.41	3.29	4.32
4998.22	29084 –	49086	3.60	111			0.05				−0.09		−0.14	−0.06	3.64	4.67

Table 2.—*Oscillator Strengths for Ni* I—Continued

Wave-length Å (1)	Energy Levels K (2)	(3)	Lower e.p. Volts (4)	Mult. No. (5)	CB (6)	K (7)	CHC (8)	AA (9)	ULO (10)	OBS (11)	HD (12)	PP (13)	IC (14)	Best (15)	Log gfλ (16)	Log gA/λ (17)
5000.34	29321 –	49314	3.63	145	0.07		0.34				0.20		0.13	0.18	3.88	4.91
5003.74	13521 –	33501	1.68	50							−2.53		−2.66	−2.60	1.10	2.13
5010.02	30392 –	50346	3.77	111			0.00				−0.38		−0.38	−0.25	3.45	4.47
5010.94	29321 –	49272	3.63	144			−0.06				−0.23		−0.39	−0.23	3.47	4.49
5012.44	29833 –	49778	3.70	111	0.18		0.32				0.06		0.09	0.16	3.86	4.88
5014.22	35639 –	55577	4.42								−0.26		−0.01	−0.14	3.56	4.58
5017.58	28542 –	48467	3.54	111	0.53		0.67				0.58		0.58	0.59	4.29	5.31
5018.29	30913 –	50834	3.83	162			0.27				0.12		−0.05	0.11	3.81	4.83
5026.48	29889 –	49778	3.70	158							−1.71		−1.57	−1.64	2.06	3.08
5032.73	31442 –	51306	3.90	207							−0.65		−0.54	−0.60	3.10	4.12
5035.36	29321 –	49175	3.63	143	0.90		0.80						0.71	0.80	4.50	5.52
5035.96	29481 –	49333	3.65	145			0.01						−0.18	−0.08	3.62	4.64
5038.59	30913 –	50754	3.83	166			0.14				0.01		−0.08	0.02	3.72	4.74
5039.36	29321 –	49159	3.63	142							−0.52		−0.57	−0.54	3.16	4.18
5041.03	30913 –	50745	3.83	158							−0.41		−0.29	−0.35	3.35	4.37
5042.18	29501 –	49328	3.66	131			0.11				0.01		0.02	0.05	3.75	4.77
5048.06	30913 –	50717	3.83	161							−0.41		−0.44	−0.42	3.28	4.29
5048.84	31031 –	50832	3.85	195	0.20		0.30				0.17		0.22	0.22	3.92	4.93
5051.51	29481 –	49272	3.65	144							−0.35		−0.36	−0.36	3.34	4.35
5053.31	30923 –	50706	3.83								−1.50		−1.28	−1.39	2.31	3.32
5057.99	29321 –	49086	3.63	141							−0.69		−0.63	−0.66	3.04	4.05
5067.79	30619 –	50346	3.80	141							−1.02		−0.78	−0.90	2.80	3.81
5068.79	31031 –	50754	3.85								−0.78		−0.65	−0.72	2.98	3.99
5075.30	30980 –	50678	3.84										−1.10	−1.10	2.61	3.61
5076.33	29481 –	49175	3.65	143							−0.79		−0.61	−0.70	3.01	4.01
5079.96	14729 –	34409	1.83	60									−2.00	−2.00	1.71	2.71
5080.53	29481 –	49158	3.65	143	0.91								0.91	0.91	4.62	5.62
5081.11	31031 –	50706	3.85	194	0.82						0.91		0.90	0.88	4.59	5.59
5082.36	29501 –	49171	3.66	130							0.08		0.06	0.07	3.78	4.78
5084.09	29669 –	49333	3.68	162	0.32						0.54		0.51	0.46	4.17	5.17
5085.49	29501 –	49159	3.66	130							−0.54		−0.61	−0.58	3.13	4.12
5088.53	31031 –	50678	3.85	190									−0.40	−0.40	3.31	4.30
5088.96	29669 –	49314	3.68	162									−0.60	−0.60	3.11	4.10
5094.41	30913 –	50537	3.83	164							−0.50		−0.47	−0.48	3.23	4.22
5096.86	30163 –	49778	3.74	111							−0.30		−0.19	−0.24	3.47	4.46
5099.31	29481 –	49086	3.65	141	0.15						0.18		0.28	0.20	3.91	4.90
5099.93	29669 –	49271	3.68	161	0.32						0.45		0.41	0.39	4.10	5.09
5102.96	13521 –	33112	1.68	49							−2.28		−2.41	−2.34	1.37	2.36
5115.39	30923 –	50466	3.83	177	0.32						0.53		0.70	0.52	4.23	5.22
5121.56	31786 –	51306	3.94	177							−0.46		−0.34	−0.40	3.31	4.30
5125.23	29669 –	49175	3.68	160							−0.09		−0.20	−0.14	3.57	4.55
5126.82	29833 –	49333	3.70										−2.02	−2.02	1.69	2.67
5128.09	29833 –	49328	3.70	113							−1.18		−1.14	−1.16	2.55	3.53
5129.37	29669 –	49159	3.68	159	0.16						0.03		−0.02	0.06	3.77	4.75
5130.37	30980 –	50466	3.84	177							−0.64		−0.53	−0.58	3.13	4.11
5131.77	29833 –	49314	3.70	114							−0.36		−0.37	−0.36	3.35	4.33
5137.07	13521 –	32982	1.68	48	−1.66						−1.41		−1.55	−1.54	2.17	3.15
5139.25	29501 –	48953	3.66	129							−0.38		−0.39	−0.38	3.33	4.31
5142.78	29888 –	49328	3.70	161	0.29						0.35		0.25	0.30	4.01	4.99
5146.48	29888 –	49314	3.70	162	0.51						0.53		0.44	0.49	4.20	5.18
5148.67	29669 –	49086	3.68	158							−1.15		−1.08	−1.12	2.59	3.57
5155.12	31442 –	50834	3.90	206							−0.05		−0.08	−0.06	3.65	4.63
5155.76	31442 –	50832	3.90	210	0.63						0.48		0.50	0.54	4.25	5.23
5157.98	29084 –	48467	3.60	111							−0.84		−0.78	−0.81	2.90	3.88
5168.66	29833 –	49175	3.70	112	0.11						0.13		0.13	0.13	3.84	4.81
5176.56	31442 –	50754	3.90	209	0.15						0.10		0.03	0.06	3.77	4.74
5179.12	31442 –	50745	3.90	202							−0.96		−0.90	−0.93	2.78	3.75
5182.74	32982 –	52272	4.09										−1.27	−1.27	2.44	3.41
5184.56	29889 –	49171	3.70	159							−0.21		−0.34	−0.28	3.43	4.40
5186.55	31442 –	50717	3.90	205							−0.74		−0.71	−0.72	2.99	3.96

TABLE 2.—*Oscillator Strengths for Ni* I—Continued

Wave-length Å (1)	Energy Levels K (2)	(3)	Lower e.p. Volts (4)	Mult. No. (5)	CB (6)	K (7)	CHC (8)	AA (9)	ULO (10)	OBS (11)	HD (12)	PP (13)	IC (14)	Best (15)	Log gfλ (16)	Log gA/λ (17)
5187.82	29889 –	49159	3.70	159							−1.29		−1.20	−1.24	2.47	3.44
5192.49	29833 –	49086	3.70	111							−0.69		−0.64	−0.66	3.06	4.02
5197.16	31442 –	50678	3.90	204							−0.61		−0.53	−0.57	3.15	4.11
5200.35	32973 –	52197	4.09										−1.64	−1.64	2.08	3.04
5216.48	30163 –	49328	3.74	113							−0.68		−0.79	−0.74	2.98	3.93
5217.94	33112 –	52272	4.10										−1.70	−1.70	2.02	2.97
5220.29	30163 –	49314	3.74	114							−0.66		−0.67	−0.66	3.06	4.01
5235.50	31442 –	50537	3.90	208							−0.48		−0.51	−0.50	3.22	4.17
5243.80	29889 –	48953	3.70								−1.66		−1.62	−1.64	2.08	3.02
5245.62	32982 –	52041	4.09								−1.62		−1.43	−1.52	2.20	3.14
5248.38	31786 –	50834	3.94								−1.39		−1.36	−1.38	2.34	3.28
5249.04	31786 –	50832	3.94								−1.54		−1.54	−1.54	2.18	3.12
5259.48	30163 –	49171	3.74								−1.31		−1.39	−1.35	2.37	3.31
5262.83	30163 –	49159	3.74										−2.04	−2.04	1.68	2.62
5265.71	29481 –	48467	3.65	141							−1.11		−0.96	−1.13	2.59	3.53
5268.33	36601 –	55577	4.54	273							−0.48		−0.12	−0.30	3.42	4.36
5281.66	33112 –	52041	4.10	231							−0.85		−0.71	−0.78	2.94	3.88
5328.72	30192 –	48953	3.74	129							−2.06		−1.93	−2.00	1.73	2.64
5347.71	30619 –	49314	3.80	145							−1.39		−1.38	−1.38	2.35	3.26
5353.39	15734 –	34409	1.95	70							−2.18		−2.13	−2.16	1.57	2.48
5371.33	35639 –	54251	4.42								−0.17		0.12	−0.02	3.71	4.61
5386.36	31786 –	50346	3.94										−1.95	−1.95	1.78	2.68
5388.34	15610 –	34163	1.93	70							−2.93		−2.89	−2.91	0.82	1.72
5392.33	33501 –	52041	4.15	250							−0.77		−0.61	−0.69	3.04	3.94
5411.22	32982 –	51457	4.09	222							−0.23		−0.09	−0.16	3.57	4.46
5424.54	33611 –	52041	4.17	231									0.02	0.02	3.75	4.64
5424.64	15734 –	34163	1.95	70					−1.95		−2.12		−2.02	−2.03	1.70	2.59
5428.86	30913 –	49328	3.83	161					−1.45		−1.73		−1.66	−1.61	2.12	3.01
5430.37	30923 –	49333	3.83						−0.96		−1.31		−1.40			
5435.86	16017 –	34409	1.99	70	−1.89				−1.78		−1.94		−1.94	−1.89	1.85	2.73
5452.82	30980 –	49314	3.84						−1.01				−1.24	−1.12	2.62	3.49
5453.24	32973 –	51306	4.09	231					−0.69				−0.70	−0.70	3.04	3.91
5462.49	31031 –	49333	3.85	192					−0.07		−0.38		−0.32	−0.25	3.49	4.36
5463.92	31031 –	49328	3.85						−1.67				−1.67	−1.67	2.07	2.94
5468.10	31031 –	49314	3.85	192					−0.70		−1.01		−0.78	−0.83	2.91	3.78
5476.90	14729 –	32982	1.83	59	−0.68						−0.48			−0.58	3.16	4.03
5480.78	31031 –	49272	3.85	191					−0.74		−0.99		−0.82	−0.85	2.89	3.76
5494.49	30980 –	49175	3.84										−1.49	−1.49	2.25	3.11
5494.88	33112 –	51306	4.10	231					−0.30		−0.55		−0.37	−0.41	3.33	4.19
5499.41	30980 –	49159	3.84	176					−1.40		−1.70		−1.55	−1.55	2.19	3.05
5504.10	30923 –	49086	3.83	175					−0.82		−1.10		−0.86	−0.93	2.81	3.67
5510.01	31031 –	49175	3.85	190	−0.19				−0.12		−0.35		−0.26	−0.23	3.51	4.37
5514.80	31031 –	49159	3.85	189					−1.12		−1.39		−1.12	−1.21	2.53	3.39
5520.76	34163 –	52272	4.23						−1.45					−1.45	2.29	3.15
5521.43	30980 –	49086	3.84	175					−1.44		−1.76		−1.57	−1.59	2.15	3.01
5537.11	31031 –	49086	3.85	188					−1.24		−1.70		−1.48			
5553.69	15610 –	33611	1.93	69					−2.54		−2.63		−2.56	−2.58	1.16	2.01
5578.72	13521 –	31442	1.68	47	−2.30				−2.20		−2.27		−2.27	−2.26	1.49	2.32
5587.86	15610 –	33501	1.93	70	−1.90				−1.83		−1.89		−1.85	−1.87	1.88	2.71
5589.36	31442 –	49328	3.90	205					−0.44		−0.53		−0.44	−0.47	3.28	4.11
5592.15	34163 –	52041	4.23	250									0.03	0.03	3.78	4.61
5592.26	15734 –	33611	1.95	69	−1.73				−1.66				−1.96	−1.78	1.97	2.80
5593.74	31442 –	49314	3.90	206					−0.14		−0.25		−0.18	−0.19	3.56	4.39
5600.02	32982 –	50834	4.09	219					−0.34		−0.52		−0.40	−0.42	3.33	4.16
5607.00	31442 –	49272	3.90	205					−1.25		−1.58		−1.27	−1.37	2.38	3.21
5614.78	33501 –	51306	4.15	250	0.14				0.13		−0.03		0.18	0.10	3.85	4.68
5625.32	32982 –	50754	4.09	221	−0.14				0.02		−0.17		−0.07	−0.09	3.66	4.48
5628.35	32982 –	50745	4.09	215					−0.57		−0.74		−0.53	−0.61	3.14	3.96
5637.12	32982 –	50717	4.09	218					−0.18		−0.41		−0.27	−0.29	3.46	4.28
5637.68	32973 –	50706	4.09						−1.13				−1.24	−1.18	2.57	3.39

TABLE 2.—*Oscillator Strengths for Ni* I—Continued

Wave-length Å (1)	Energy Levels K (2)	(3)	Lower e.p. Volts (4)	Mult. No. (5)	CB (6)	K (7)	CHC (8)	AA (9)	ULO (10)	OBS (11)	HD (12)	PP (13)	IC (14)	Best (15)	Log gfλ (16)	Log gA/λ (17)
5638.75	31442 –	49171	3.90	203					−0.93		−1.16		−0.92	−1.00	2.75	3.57
5641.12	33112 –	50834	4.10	230					−1.14		−1.22		−1.10	−1.15	2.60	3.42
5641.88	33112 –	50832	4.10	234					−0.27		−0.50		−0.30	−0.36	3.39	4.21
5642.61	31442 –	49159	3.90	203					−1.09				−1.08	−1.08	2.67	3.49
5643.08	33590 –	51306	4.16	259					−0.54				−0.43	−0.48	3.27	4.09
5649.70	33611 –	51306	4.17	231	−0.22				−0.29		−0.47		−0.30	−0.32	3.43	4.25
5663.99	36601 –	54251	4.54	272	0.08				0.08		−0.25		0.05	−0.01	3.74	4.55
5666.80	33112 –	50754	4.10	233					−1.34		−1.73		−1.26			
5669.95	34409 –	52041	4.26	250					−0.34		−0.57		−0.36	−0.42	3.33	4.14
5682.20	33112 –	50706	4.10	232	0.22				0.25		0.10		0.24	0.20	3.95	4.76
5691.48	33112 –	50678	4.10	228					−1.26		−1.59		−1.11			
5694.98	32982 –	50537	4.09	220	0.04				0.08		−0.06		0.11	0.04	3.80	4.60
5703.69	31786 –	49314	3.94						−1.09		−1.49		−1.13			
5709.55	13521 –	31031	1.68	46	−1.76				−1.96		−1.79		−1.74	−1.81	1.95	2.74
5711.89	15610 –	33112	1.93	69	−1.86				−1.98		−1.90		−1.80	−1.88	1.88	2.67
5715.07	32973 –	50466	4.09	231	0.16				0.21		0.15		0.31	0.21	3.97	4.76
5748.35	13521 –	30913	1.68	45					−2.74		−2.82		−2.67	−2.74	1.02	1.81
5749.29	31786 –	49175	3.94	176					−1.13		−1.42		−1.14	−1.23	2.53	3.32
5754.66	15610 –	32982	1.93	68	−1.69				−1.52		−1.72		−1.63	−1.64	2.12	2.90
5760.83	33112 –	50466	4.10	231	0.05				−0.06		−0.18		0.03	−0.04	3.72	4.50
5780.73	32982 –	50276	4.09	217					−1.28		−1.74		−1.28			
5796.08	15734 –	32982	1.95	68					−3.04		−3.18		−3.04	−3.09	0.67	1.44
5798.23	33590 –	50832	4.16						−1.05		−1.30		−1.02	−1.12	2.64	3.41
5805.22	33611 –	50832	4.17	234					0.02		−0.11		0.06	−0.01	3.75	4.52
5820.22	33501 –	50678	4.15						−1.81				−1.53	−1.67	2.09	2.86
5831.60	33611 –	50754	4.17	233					−0.26		−0.39		−0.33	−0.32	3.45	4.21
5831.74	34163 –	51306	4.23	250									−1.09	−1.09	2.68	3.44
5847.00	13521 –	30619	1.68	44					−2.93		−2.95		−3.03	−2.97	0.80	1.55
5857.75	33611 –	50678	4.17	228	0.21				0.13		0.09		0.09	0.13	3.90	4.65
5863.93	34409 –	51457	4.26	253					−1.15		−1.35		−1.07	−1.19	2.58	3.33
5892.87	16017 –	32982	1.99	68	−1.83				−1.77		−1.73		−1.84	−1.79	1.98	2.72
5906.50	33611 –	50537	4.17						−1.12				−1.08	−1.10	2.67	3.41
5923.94	33590 –	50466	4.16	259					−1.07				−0.91	−0.99	2.78	3.52
5925.80	13521 –	30392	1.68	42					−4.43					−4.43	−0.66	0.08
5996.74	34163 –	50834	4.23	249					−0.57				−0.51	−0.54	3.24	3.95
5997.59	34163 –	50832	4.23	252					−0.77				−0.65	−0.71	3.07	3.78
5998.85	33112 –	49778	4.10	226					−1.96				−1.50			
6007.31	13521 –	30163	1.68	42					−3.08				−2.78	−2.93	0.85	1.56
6025.76	34163 –	50754	4.23	251					−1.28				−1.12	−1.20	2.58	3.28
6039.30	34163 –	50717	4.23	248					−1.58				−1.35	−1.46	2.32	3.02
6053.69	34163 –	50678	4.23	247					−0.57				−0.43	−0.50	3.28	3.98
6086.28	34409 –	50834	4.26	249					−0.24				0.04	−0.10	3.68	4.37
6095.34	35639 –	52041	4.42						−1.86				−1.41			
6105.76	34163 –	50537	4.23						−1.59				−1.32	−1.46	2.33	3.01
6108.12	13521 –	29888	1.68	45	−2.16				−2.53				−2.20	−2.30	1.49	2.17
6111.07	32973 –	49333	4.09	230					−0.51				−0.47	−0.49	3.30	3.98
6116.18	32982 –	49328	4.09	218					−0.12				0.01	−0.06	3.73	4.40
6118.10	32973 –	49314	4.09	230					−1.82				−1.51	−1.66	2.13	2.80
6119.76	34409 –	50745	4.26	244					−1.01				−0.66	−0.84	2.95	3.62
6128.98	13521 –	29833	1.68	42					−3.14				−2.92	−3.03	0.76	1.43
6130.13	34409 –	50717	4.26	248					−0.54				−0.36	−0.45	3.34	4.01
6133.97	32973 –	49272	4.09	229					−1.42				−1.30	−1.36	2.43	3.10
6142.03	33501 –	49778	4.15	244					−1.67				−1.42	−1.54	2.25	2.92
6163.42	33112 –	49333	4.10	230					−0.26				−0.36	−0.31	3.48	4.14
6165.25	33112 –	49328	4.10	229									−1.58	−1.58	2.21	2.87
6170.58	32973 –	49175	4.09	228					−0.99				−0.81	−0.90	2.89	3.55
6175.36	32982 –	49171	4.09	217					−0.11				−0.03	−0.07	3.72	4.38
6176.81	32973 –	49158	4.09	228	0.16				0.16				0.23	0.18	3.97	4.63
6177.24	14729 –	30913	1.83	58					−3.42				−3.05	−3.28	0.51	1.17
6177.55	34163 –	50346	4.23	244									−1.15	−1.15	2.64	3.30

TABLE 2.—*Oscillator Strengths for Ni* I—Continued

Wave-length Å (1)	Energy Levels K (2)	(3)	Lower e.p. Volts (4)	Mult. No. (5)	CB (6)	K (7)	CHC (8)	AA (9)	ULO (10)	OBS (11)	HD (12)	PP (13)	IC (14)	Best (15)	Log gfλ (16)	Log gA/λ (17)
6179.99	32982 –	49159	4.09	214									−1.29	−1.29	2.50	3.16
6180.16	15610 –	31786	1.93	65					−3.60				−3.84	−3.72	0.07	0.73
6183.10	27944 –	44112	3.46						−2.63				−2.21			
6183.85	33611 –	49778	4.17	226					−1.49				−1.24	−1.36	2.43	3.09
6186.72	33112 –	49272	4.10	229					−0.46				−0.43	−0.44	3.35	4.01
6191.18	13521 –	29669	1.68	45	−2.17				−2.12				−2.12	−2.14	1.65	2.31
6198.63	34409 –	50537	4.26										−1.52	−1.52	2.27	2.93
6204.61	32973 –	49086	4.09	226					−0.68				−0.49	−0.58	3.21	3.87
6223.99	33112 –	49175	4.10	228					−0.55				−0.46	−0.50	3.29	3.94
6230.09	33112 –	49159	4.10	227					−0.85				−0.64	−0.74	3.05	3.70
6256.36	13521 –	29501	1.68	43	−2.08				−2.14				−2.19	−2.14	1.66	2.29
6258.59	33112 –	49086	4.10	226					−0.90				−0.76	−0.83	2.97	3.60
6259.60	32982 –	48953	4.09	216					−0.96				−0.82	−0.89	2.91	3.54
6271.78	26666 –	42606	3.31						−2.00				−2.04	−2.02	1.78	2.41
6272.64	34409 –	50346	4.26	244					−1.14				−1.13	−1.14	2.66	3.29
6300.34	34409 –	50276	4.26	246					−1.40				−1.43	−1.42	2.38	3.01
6314.66	15610 –	31442	1.93	67	−1.93				−1.76				−1.92	−1.87	1.93	2.55
6316.58	33501 –	49328	4.15	248					−1.34				−1.31	−1.32	2.48	3.10
6322.17	33501 –	49314	4.15	249					−0.69				−0.58	−0.64	3.16	3.78
6327.60	13521 –	29321	1.68	44					−2.80				−2.79	−2.80	1.00	1.62
6339.12	33501 –	49272	4.15	248					−0.10				−0.07	−0.08	3.72	4.34
6350.49	33590 –	49333	4.16						−1.25				−1.37	−1.31	2.49	3.11
6360.81	33611 –	49328	4.17	229					−0.55				−0.60	−0.58	3.22	3.83
6364.58	15734 –	31442	1.95	67					−3.56				−3.51	−3.54	0.26	0.87
6366.48	33611 –	49314	4.17	230					−0.32				−0.42	−0.37	3.43	4.04
6370.35	28569 –	44263	3.54	127					−1.21				−1.23	−1.22	2.58	3.19
6375.23	33590 –	49272	4.16						−1.45				−1.41	−1.43	2.37	2.98
6378.26	33501 –	49175	4.15	247					−0.22				−0.17	−0.20	3.60	4.21
6381.11	35639 –	51306	4.42						−1.49				−1.27	−1.38	2.42	3.03
6384.67	33501 –	49159	4.15	246					−0.38				−0.39	−0.38	3.43	4.03
6414.59	33501 –	49086	4.15	244					−0.27				−0.43	−0.35	3.46	4.05
6421.52	33590 –	49159	4.16	258					−0.28				−0.51	−0.40	3.41	4.00
6424.86	33611 –	49171	4.17	227					−0.60				−0.81	−0.70	3.11	3.70
6432.00	28569 –	44112	3.54	126					−1.97				−1.96	−1.96	1.85	2.44
6451.56	33590 –	49086	4.16	257					−1.24				−1.12	−1.18	2.63	3.21
6452.70	32973 –	48467	4.09	226									−1.38	−1.38	2.43	3.01
6482.80	15610 –	31031	1.93	66					−2.08				−2.17	−2.12	1.69	2.27
6502.21	27415 –	42790	3.40						−1.89				−1.78	−1.84	1.97	2.54
6516.08	33611 –	48953	4.17						−1.31				−1.31	−1.31	2.50	3.07
6532.88	15610 –	30913	1.93	64					−2.72				−2.78	−2.75	1.07	1.63
6580.22	35639 –	50832	4.42	265									−0.59	−0.59	3.23	3.78
6586.31	15734 –	30913	1.95	64									−2.25	−2.25	1.57	2.12
6592.51	34163 –	49328	4.23	248									−0.47	−0.47	3.35	3.90
6598.60	34163 –	49314	4.23	249									−0.34	−0.34	3.48	4.03
6610.82	42621 –	57744	5.28										−0.86	−0.86	2.96	3.50
6617.09	34163 –	49272	4.23	248									−1.86	−1.86	1.96	2.50
6621.14	29013 –	44112	3.60	97									−1.86	−1.86	1.96	2.50
6635.13	35639 –	50706	4.42	264									−0.19	−0.19	3.63	4.17
6643.64	13521 –	28569	1.68	43	−1.86								−1.85	−1.86	1.96	2.50
6661.33	34163 –	49171	4.23	246									−0.96	−0.96	2.86	3.39
6666.71	34163 –	49159	4.23										−1.76	−1.76	2.06	2.59
6690.77	29321 –	44263	3.63	140									−1.76	−1.76	2.07	2.59
6700.90	34409 –	49328	4.26	248									−1.62	−1.62	2.21	2.73
6711.59	16017 –	30913	1.99										−3.81	−3.81	0.02	0.53
6716.14	15734 –	30619	1.95										−3.90	−3.90	−0.07	0.44
6733.75	27944 –	42790	3.46										−2.44	−2.44	1.39	1.90
6742.59	35639 –	50466	4.42										−1.19	−1.19	2.64	3.15
6759.44	34163 –	48953	4.23	245									−1.52	−1.52	2.31	2.81
6767.77	14729 –	29501	1.83	57	−1.58								−1.64	−1.61	2.22	2.72
6772.32	29501 –	44263	3.66	127	−0.17								−0.20	−0.18	3.65	4.15

TABLE 2.—*Oscillator Strengths for Ni* I—Continued

Wave-length Å	Energy Levels K		Lower e.p. Volts	Mult. No.	CB	K	CHC	AA	ULO	OBS	HD	PP	IC	Best	Log gfλ	Log gA/λ
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
6782.50	43090 –	57829	5.34										−0.23	−0.23	3.60	4.10
6798.43	36601 –	51306	4.54										−1.28	−1.28	2.55	3.05
6813.62	43090 –	57762	5.34	288									0.04	0.04	3.87	4.36
6842.04	29501 –	44112	3.66	126									−0.56	−0.56	3.28	3.76
6850.38	29669 –	44263	3.68	157									−1.63	−1.63	2.21	2.69
6861.24	43259 –	57829	5.36	293									−0.06	−0.06	3.78	4.25
6870.15	43259 –	57810	5.36										−0.10	−0.10	3.74	4.21
6876.69	28068 –	42606	3.48	97									−1.25	−1.25	2.59	3.06
6902.80	42621 –	57104	5.28										−0.20	−0.20	3.64	4.11
6914.56	15734 –	30192	1.95	62	−1.79								−1.68	−1.74	2.10	2.56
6928.19	29833 –	44263	3.70	110									−1.55	−1.55	2.29	2.75
6955.03	29889 –	44263	3.70	157									−0.86	−0.86	2.98	3.44
6973.49	42768 –	57104	5.30										−0.38	−0.38	3.46	3.91
7001.54	15610 –	29889	1.93	64									−2.94	−2.94	0.91	1.35
7004.19	44315 –	58588	5.49										−0.34	−0.34	3.51	3.95
7023.68	36601 –	50834	4.54										−0.48	−0.48	3.37	3.80
7024.87	36601 –	50832	4.54	271									−0.02	−0.02	3.83	4.26
7028.54	29889 –	44112	3.70										−1.43	−1.43	2.42	2.85
7028.96	15610 –	29833	1.93	61									−3.02	−3.02	0.83	1.26
7030.01	28569 –	42790	3.54	126									−0.96	−0.96	2.89	3.32
7034.38	28578 –	42790	3.54	97									−1.16	−1.16	2.69	3.12
7037.35	44315 –	58521	5.49	288									−0.07	−0.07	3.78	4.21
7049.61	42585 –	56767	5.28										−0.48	−0.48	3.37	3.80
7062.95	15734 –	29889	1.95	64									−2.92	−2.92	0.93	1.36
7063.55	36601 –	50754	4.54	270									−0.43	−0.43	3.42	3.85
7067.45	42621 –	56766	5.28	277									−0.44	−0.44	3.41	3.84
7095.37	42621 –	56711	5.28	276									−0.09	−0.09	3.76	4.18
7101.94	36601 –	50678	4.54										−0.92	−0.92	2.93	3.35
7110.90	15610 –	29669	1.93	64	−1.99								−2.54	−2.36	1.49	1.91
7122.20	28569 –	42606	3.54	126	0.29								0.42	0.36	4.21	4.63
7126.68	28578 –	42606	3.54	97									−1.63	−1.63	2.22	2.64
7129.16	44565 –	58588	5.52										−0.36	−0.36	3.49	3.90
7166.98	30163 –	44112	3.74	109									−0.94	−0.94	2.92	3.32
7170.08	42768 –	56711	5.30	282									−0.34	−0.34	3.52	3.92
7173.73	36601 –	50537	4.54	269									−0.71	−0.71	3.15	3.55
7181.97	30192 –	44112	3.74	126	−0.11								−0.07	−0.09	3.77	4.17
7197.02	15610 –	29501	1.93	62	−2.00								−2.08	−2.04	1.82	2.21
7220.76	43259 –	57104	5.36	294									−0.06	−0.06	3.80	4.19
7225.04	45281 –	59118	5.61										−0.26	−0.26	3.60	3.99
7261.93	15734 –	29501	1.95	62	−1.99								−2.10	−2.04	1.82	2.20
7266.20	45281 –	59040	5.61	288									0.20	0.20	4.06	4.44
7286.55	30392 –	44112	3.77	109									−1.40	−1.40	2.46	2.84
7290.88	43090 –	56802	5.34	287									0.21	0.21	4.07	4.45
7291.45	15610 –	29321	1.93	63	−2.06								−2.42	−2.42	1.44	1.82
7297.68	45419 –	59118	5.63	293									−0.10	−0.10	3.76	4.13
7309.57	43090 –	56767	5.34										−0.40	−0.40	3.46	3.83
7327.65	30619 –	44263	3.80	140									−1.05	−1.05	2.81	3.18
7351.40	43259 –	56858	5.36										−0.34	−0.34	3.53	3.88
7381.92	43259 –	56802	5.36	292									0.46	0.46	4.33	4.68
7385.24	22102 –	35639	2.74	84	−1.34								−1.40	−1.37	2.50	2.85
7386.20	43090 –	56625	5.34	286									0.69	0.69	4.56	4.91
7393.60	29084 –	42606	3.60	109	0.14								0.25	0.20	4.07	4.42
7401.14	43259 –	56767	5.36	291									0.36	0.36	4.23	4.58
7409.35	30619 –	44112	3.80	139	0.33								0.36	0.34	4.21	4.55
7414.51	16017 –	29501	1.99	62	−1.96								−2.05	−2.00	1.87	2.21
7419.29	44315 –	57790	5.49	287									−0.11	−0.11	3.76	4.10
7422.28	29321 –	42790	3.63	139	0.31								0.32	0.32	4.19	4.53
7433.46	43655 –	57104	5.41	280									−0.07	−0.07	3.80	4.14
7481.48	44315 –	57678	5.49	286									0.18	0.18	4.05	4.38
7488.70	30913 –	44263	3.83	157									−1.44	−1.44	2.43	2.76

TABLE 2.—*Oscillator Strengths for Ni* I—Continued

Wave-length Å	Energy Levels K		Lower e.p. Volts	Mult. No.	CB	K	CHC	AA	ULO	OBS	HD	PP	IC	Best	Log gfλ	Log gA/λ
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
7521.03	44475 –	57768	5.51	282									−0.15	−0.15	3.73	4.05
7522.76	29501 –	42790	3.66	126	0.09								0.08	0.08	3.96	4.27
7525.12	29321 –	42606	3.63	139	−0.09								−0.03	−0.06	3.82	4.13
7545.50	45281 –	58530	5.61	287									−0.13	−0.13	3.75	4.06
7552.52	45281 –	58518	5.61	286									0.06	0.06	3.94	4.25
7555.60	31031 –	44263	3.85	187	0.45								0.50	0.48	4.36	4.67
7559.66	44565 –	57790	5.52	292									0.08	0.08	3.96	4.27
7574.05	30913 –	44112	3.83	156	0.03								0.12	0.08	3.96	4.27
7586.04	44565 –	57744	5.52										−0.29	−0.29	3.59	3.89
7616.98	29481 –	42606	3.65	139	0.32								0.42	0.37	4.25	4.55
7619.21	29669 –	42790	3.68	156	−0.05								−0.05	−0.05	3.83	4.13
7624.74	45419 –	58530	5.63	292									−0.06	−0.06	3.82	4.12
7657.26	43655 –	56711	5.41	278									0.04	0.04	3.92	4.21
7714.32	15610 –	28569	1.93	62	−1.53								−1.65	−1.59	2.30	2.57
7715.58	29833 –	42790	3.70	109	−0.28								−0.33	−0.30	3.59	3.86
7727.61	29669 –	42606	3.68	156	0.27								0.31	0.29	4.18	4.45
7748.89	29889 –	42790	3.70	156	0.30								0.28	0.29	4.18	4.45
7788.94	15734 –	28569	1.95	62	−1.71								−1.81	−1.76	2.13	2.39
7797.59	31442 –	44263	3.90	201	0.31								0.42	0.36	4.25	4.51
7826.76	29833 –	42606	3.70	109									−1.05	−1.05	2.84	3.09
7855.14	36601 –	49328	4.54	267									−0.54	−0.54	3.36	3.60
7861.05	29889 –	42606	3.70	156									−1.13	−1.13	2.77	3.01
7863.79	36601 –	49314	4.54	268									−0.22	−0.22	3.68	3.92
7890.15	31442 –	44112	3.90	200									−1.20	−1.20	2.70	2.93
7917.44	30163 –	42790	3.74	109	−0.67								−0.60	−0.64	3.26	3.49
7953.03	36601 –	49171	4.54	266									−0.89	−0.89	3.01	3.23
8012.93	31786 –	44263	3.94										−1.45	−1.45	2.45	2.66
8417.19	30913 –	42790	3.83	156									−1.09	−1.09	2.84	2.96
8501.80	31031 –	42790	3.85	186									−0.73	−0.73	3.20	3.31
8606.38	42621 –	54237	5.28	275									0.28	0.28	4.21	4.30
8637.00	31031 –	42606	3.85	186									−0.89	−0.89	3.05	3.12
8770.68	22102 –	33501	2.74	82									−2.18	−2.18	1.76	1.81
8809.42	31442 –	42790	3.90	200	−0.53								−0.53	−0.53	3.41	3.46
8862.55	32982 –	44263	4.09	214	0.33								0.34	0.34	4.29	4.32
8877.01	44315 –	55577	5.49	285									0.47	0.47	4.42	4.45
8954.65	31442 –	42606	3.90	200									−1.52	−1.52	2.43	2.45
8965.96	33112 –	44263	4.10	225									−0.07	−0.07	3.88	3.90
8968.14	43090 –	54237	5.34	284									0.60	0.60	4.55	4.57
8982.35	32982 –	44112	4.09	213									−1.35	−1.35	2.60	2.61
9005.14	44475 –	55577	5.51										0.00	0.00	3.95	3.96
9078.70	44565 –	55577	5.52										−0.35	−0.35	3.61	3.60
9085.25	31786 –	42790	3.94										−1.27	−1.27	2.69	2.68
9106.40	43259 –	54237	5.36	289									0.16	0.16	4.12	4.11
9196.18	22102 –	32973	2.74										−3.19	−3.19	0.77	0.74
9385.62	33611 –	44263	4.17	225									−0.88	−0.88	3.09	3.03
9447.29	43655 –	54237	5.41										−0.02	−0.02	3.96	3.88
9520.06	33611 –	44112	4.17	224									−0.03	−0.03	3.95	3.86
9898.90	34163 –	44263	4.23	243									−0.22	−0.22	3.78	3.62

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