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THE ARC SPECTRUM OF NICKEL (Ni I)

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Abstract

Extension of the analysis of the spectrum of Ni I.—Almost all the known lines (1071) of Ni I have been classified. There are included in the classification 66 lines from the solar spectrum which have not been found in the laboratory. The spectrum, in spite of its apparent complexity, is admirably regular. Every observed term fits without constraint into the scheme predicted by Hund's theory. A few of the predicted terms have not been found, but in all cases their combinations should either be faint or out of range. Term values, combinations, configurations and identified lines are tabulated.

Ionization potential of the Ni atom.—The principal ionization potential of the neutral Ni atom is calculated to be 7.606 volts. It corresponds to a double electron change from the configuration d^8s^2 to d^9.

NICKEL affords an excellent example of a spectrum in which the term separations are wide and the multiplets overlap. Numerous energy levels were identified by Walters[1] and these were assorted into terms by Bechert[2,3] and Sommer[2] who greatly extended the analysis, identifying almost all the important low terms, proving the existence of singlet, triplet and quintet systems, and classifying all the strongest lines. Many lines, including some fairly strong ones, were however unassigned. Subsequent work by Meggers and Walters[4] and Menzies[5] added new terms from lines in the remote ultra-violet.

The present communication records the extension of the analysis to include almost all the lines and increases the number of those classified from 622 to 1071.

1. Observations

The principal source for wave-lengths has been the extensive and accurate work of Hamm,[6] extended towards the red by that of Meggers and Kiess.[7]

[1] Walters, J. Washington Acad. Sci. **15,** 88 (1925).
[2] Bechert and Sommer, Ann. d. Physik **77,** 351 (1925).
[3] Bechert, Ann. d. Physik **77,** 538 (1925).
[4] Meggers and Walters, Sci. Papers Bureau of Standards **22,** 205 (No. 551), (1927).
[5] Menzies, Phil. Mag. **6,** 1210 (1928).
[6] Hamm, Zeits. f. Wiss. Photographie **13,** 105 (1913).
[7] Meggers and Kiess, Sci. Papers Bureau of Standards **14,** 649 (No. 324), (1918).

Many fainter lines have been taken from Exner and Haschek,[8] or from Hasselberg.[8] The measures by Randall and Barker[9] give data in the infra-red.

New measures have been made in the ultra-violet, upon three plates taken by Professor Shenstone with the large Hilger quartz spectrograph of the Palmer Physical Laboratory, and containing exposures on the arc and spark spectra. These were measured by Miss Charlotte E. Moore, using lines of Cu I, Cu II, and Ni II as standards. They show 129 lines between λ2244 and λ1963, which appear to belong to Ni I—twice as many as had previously been recorded. Comparison of the observed frequency differences with the known term-intervals indicates that the probable error of these measures is $\pm$ 0.18 cm^{-1}, which corresponds to $\pm$ 0.008A at the mean wave-length.

Finally, a number of lines in the solar spectrum which are in the predicted positions of the fainter members of certain multiplets, which have not yet been observed in the laboratory, and show the anticipated intensities, are included. As nickel is very prominent in the solar spectrum, the appearance there of many of these "predicted" lines is to be anticipated.[10] Only those which showed a close agreement with the anticipated intensity, as well as wave-length, have been included, and all blends omitted. In spite of this decidedly conservative policy, 66 lines have been added.

King's observations[11] of intensity and temperature class have been of great value in the analysis, as have also been those of Meggers and Walters[4] upon the under-water spark in the ultra-violet.

No modern observations of the Zeeman effect exist for this spectrum. This has been a considerable handicap in the analysis, and the fact that, without this knowledge, it has been possible to classify almost all the energy-levels is to be credited mainly to the aid given by the theory of Hund, which in this case, as in all others, proves to be completely successful.

2. Observed Terms

Table I gives a list of all the energy levels so far recognized in Ni I. Its arrangement follows the notation recently suggested as a result of correspondence among many spectroscopists.[12] The second column gives the designation of each level, and the first the initials of the investigators who detected it. When these initials are in parentheses the level has been newly classified in the present work, and when no initital appears, the level is new. A "?" following the term designation indicates that the assignment is tentative.

The third column gives the energy levels. The final column headed "connection" is designed to aid in picking out the components of the multiple terms which are much intermingled. Its arrangement is obvious.

[8] See Kayser's *Handbuch der Spectroscopie* **6,** 177 (1912).

[9] Randall and Barker Astrophys. J. **49,** 55 (1919).

[10] Compare *The Presence of Predicted Iron Lines in the Solar Spectrum,* Mt. Wilson Contribution No. 365, Astrophys. J. **68,** 151 (1928).

[11] King, Mt. Wilson Contribution No. 108; Astrophys. J. **42,** 344 (1915); Mt. Wilson Contribution No. 181; Astrophys. J. **51,** 182 (1920).

[12] *Report on Notation for Atomic Spectra,* Russell, Shenstone and Turner, Phys. Rev. **33,** 900 (1929).

The number of energy levels is 186, of which all but six have been allocated as components of 81 spectroscopic terms, of which 48 are even and 33 odd. The weaker components of some of the higher terms remain to be found. The unassigned levels are denoted by Arabic numbers. The energy values are measured, as usual, upward from the lowest level. The low (stable or metastable) terms, which in this case are even, are lettered a, b, $\cdots$ the middle odd being z, y, x $\cdots$ and the high even terms e, f, g, $\cdots$.

Table II shows what combinations have been observed among these terms. Below the designation of each term is written its leading energy-level (for reference to Table I) and on the right are listed all the terms which combine with it. Below each of these is the number assigned to the corresponding multiplet in Table V. The ° mark for the odd terms is omitted here—though not in the first column,—since no confusion can arise, as the even terms are lettered a to i and the odd z to u.

3. The low terms, with one exception, were found by Bechert and Sommer and assigned to electron configurations by Hund.[13] They comprise ^1S from d^{10}, ^3D, ^1D from d^9s, and ^3F, ^3P, ^1D, ^1G from d^8s^2. The ^1G term is new. Its reality is confirmed by three good lines, one of which is in the infra-red. There should also be a ^1S term from this configuration, which has not been detected. It might be expected to lie at about the level of the ^1G, and almost all its combinations would be in the infra-red.

4. The middle terms are of more interest. The lower-lying among them were arranged by Hund into triads, $^1P°D°F°$, $^3P°D°F°$ arising from d^9p and $^5D°F°G°$, $^3D°F°G°$, $^1D°F°G°$ from d^8sp, with the limits ^4F, ^2F. An additional $^3F°$ term (Bechert and Sommer's $\bar{f}^1$) appeared also to be present, though no place could be found for it in Hund's theoretical scheme, while only the first two components of the $^5F°$ term were given by these authors. In the course of the present work, a neighboring unclassified level with $j=1$ was found and it appeared subsequently that the level previously called $^5F_4^\circ$ was fictitious, the lines which were assigned to it belonging elsewhere. At this point it became obvious that the five remaining levels were really the components of the $^5F°$ term predicted by theory, which was normal in all respects except for a moderate departure from the interval-rule, and gave excellent multiplets.

The one serious apparent exception to Hund's theory which has been found in the whole range of spectra which have so far been analyzed thus disappears—reminding one of the old tale of the Eastern freight-agent, who reading on his way-bills "one burro" and supposing the words to be misspelled, wrote at the end of his day's work "one bureau missing; one jackass over."

There are numerous higher odd levels, which combine with the lowest terms to give strong lines in the far ultra-violet. Among these we should expect by analogy with other spectra[14] a triad $^3D°F°G°$ with limit ^4F, and combining very strongly with the low a^3F. The absorption data of Meggers and Kiess identify these terms securely. Mixed with these multiplets

[13] Hund, *Linienspektren*, Berlin 1927, p. 165.

[14] H. N. Russell, Astrophys. J. **66,** 184 (1927) (especially p. 201).

are fainter ones which appear to belong to $^3P^\circ D^\circ F^\circ$ and $^1P^\circ D^\circ F^\circ$ triads with the limit a^2D in Ni II—the next lowest to those already exhausted. For these terms the components of smallest j have not been detected and the identification of some of the others is uncertain.

The next highest limit term is ^4P, which should give $^3S^\circ P^\circ D^\circ$ and $^5S^\circ P^\circ D^\circ$. The $^3D^\circ$ term may be safely identified with v^3D°, which gives a characteristic multiplet with a^3P; and x^3P° has also been put here, mainly because of the other evidence, discussed below, that in this spectrum the members of a triad or pentad of terms occur at nearly the same level. The quintet terms have not been worked out, but there are two unassigned levels (1_3° and 2_2°) which lie in about the position where these might be expected. and find no other theoretical place. Their combinations with the low triplet terms are faint as should be the case for inter-combinations, and there are several unclassified absorption lines near by.

Above the terms already mentioned lies a tangle of levels, revealed by lines in the far ultra-violet. Some of these combine also with e^3D to give lines observed by Randall in the infra-red. As the latter certainly comes from $d^9 \cdot 5s$, the former terms must be attributed to $d^9 \cdot 5p$. The remainder of the ^3PDF, ^1PDF triads of this configuration were then easy to find. They will be discussed further in section 5. The term v^3F° combines more strongly with a^3F (d^8s^2) than with a^3D (d^9s), and this at first cast doubt on its assignment, but the combination with e^3F settles the question. Few odd levels remain. The three highest appear to form the term u^3F° which can be assigned only to the triad ^3FGH having the limit a^2G in Ni II. Of the six unclassified odd levels 1° and 2° are discussed above, while 6° and 5° may perhaps be part of a ^3D term with the limit a^2P (the only remaining metastable configuration in Ni II).

5. The high even terms include e^3D, e^1D and f^3F, e^5F, which were discovered by Bechert and Sommer, and undoubtedly arise from $d^9 \cdot 5s$ and $d^8s \cdot 5s$. The configurations $d^9 \cdot 4d$ and $d^8s \cdot 4d$ should give pentads $SPDFG$ (triplets and singlets), $PDFGH$ (quintets and triplets). The former should give multiplets of hazy lines in the green, and the latter lines in the near ultra-violet. All the components of the former pentad have been found and all but a few of the latter.

Search for later series members revealed the terms g^1D, $g^3D(d^9 \cdot 6s)$, which fixed the series limit accurately. A large part of the pentads $d^9 \cdot 5d$ was then found, and also terms arising from the addition of a $5s$ or $4d$ electron to the ^2F term of Ni II and a $6s$ or $5d$ electron to ^4F. Only the leading components of the latter terms have been found, and they are identified largely by means of series relations.

Table III shows the terms which have been assigned to each configuration, with the leading energy level and the separations between the remaining components, in order of decreasing j.

6. Series Relations

The identification of the third members of the $d^9s \cdot ms$ series permits an accurate determination of the limits. Ritz formulae give the values 61573

for $^3D_3$, 61583 for $^3D_2$, 63080 for $^3D_1$ and 63093 for $^1D_2$, (all above the lowest level $^3F_2$ in Ni I). The first two evidently converge toward the lower component $a^2D_{2\frac{1}{2}}$ of the ground-term of Ni II and the others to $a^2D_{1\frac{1}{2}}$, which lies 1507 cm^{-1} higher. Allowing for this the four series give a range of only 13 cm^{-1} in the value of $^3F_2 - ^2D_{2\frac{1}{2}}$, which indicates that the mean value 61579 can be adopted with confidence. The corresponding ionization potential for the neutral atom is *7.606 volts*. This is the principal I.P. but corresponds to a double electron change, from d^8s^2 to d^9.[15] The correlation of the term components and their limits is of the "inverted" type pointed out by Shenstone[16] and accepted by Hund in his latest paper[17] on the subject.

All the terms arising from the a^2D limit of Ni II show the same inverted convergence. The separation of the two limits is usually large compared with that arising from the added electron, and the levels belonging to a given electron configuration fall sharply into two groups, one containing the two leading components of the triplet terms, and the other the triplet with smallest j and the singlets. The latter have the higher limit, with the smaller j value.

The same behavior is shown by the terms with limit a^2F in Ni II; but it is remarkable that those with a^4F as limit behave differently. In the $d^8s \cdot 4p$ configuration, the triplets and quintets are widely separated and in $d^8s \cdot 5s$ they barely overlap—but in the pentads arising from $d^8s \cdot 4d$ the terms with largest j, both of the triplets and quintets, form a compact group, followed at a considerable interval by those with the next largest j, and so on. This indicates convergence of the "normal" type first suggested by Hund, in which the components of greatest j for both multiplicities go to the limit component of greatest j.

It might be doubted whether the levels here called $^3H_6$, $^3G_5$, etc., should not rather be $^5H_6$, $^5G_5 \cdots$ as would be demanded by inverted convergence. But the intensities of the individual lines appear to settle the question. The levels in question combine more strongly with triplets than with quintets.

It is a matter of general experience that the intensity rules in multiplets maintain their validity, at least qualitatively, long after the interval rule, and Lande's g-values have broken down. In the "super-multiplets" of Ni I arising from transitions such as $d^8sp - d^8s \cdot d$ the relative intensities throughout the group are qualitatively in very good accordance with theory, except that the components of smaller j give fainter lines than might be expected. This accounts for the failure to locate some components of the terms.

The convergence suggested by these terms is consistent with the latest form of Hund's theory, according to which the levels of any given inner quantum number are divided among the various limiting components of the spark term simply in order of their own position—those which happen to be lowest going in appropriate number to the lowest limit, and so on.

On this principle the terms involving an s electron should show inverted convergence; those from a d electron, normal convergence; and those derived from a p electron the following curious arrangement;

[15] Russell, Astrophys. J. **66,** 251 (1927).
[16] Shenstone, Nature **122,** 727 (1928).
[17] Hund, Zeits. f. Physik **52,** 601 (1928).

Limit ^4F	$4\frac{1}{2}$	$3\frac{1}{2}$	$2\frac{1}{2}$	$1\frac{1}{2}$
^5G	654	3	2	
^5F	5	43	2	1
^5D	43	2	1	0
^3G		5	4	3
^3F		4	3	2
^3D			3	21

The terms w^3D°, w^3F°, y^3G°, which arise from the addition of a $4p$ electron to this limit, are however grouped with their components of highest j close together, followed at an interval by those of next highest j, and so on,—which suggests that each of the groups of components has one of the components of the ^4F term as limit.

It would be of great interest to know what actually happens; but, unfortunately, only the leading components of a few of the terms involving a $6s$ or $5d$ electron can be identified. The $5p$ configuration should combine with the low terms to give multiplets near λ1800, where nothing is known about the arc spectrum, and its combinations with $d^8s \cdot 5s$ are in the infra-red.

The full evidence for the series assignments of the present paper may be found in Table IV, which gives the quantum defects for all the components of the terms arising from the limit a^2D, and for the components of highest j of the terms assigned to other limits. The relative levels of the lines in Ni II are taken from Shenstone.[18] It has been assumed that the convergence is everywhere inverted, except that for the configuration $d^8s(^4F)d$ it is supposed normal.

The principal evidence for the existence of a number of the high even terms, which are located by only one or two lines, is the agreement of the quantum defects with those anticipated from series relations. The value given for the quintets under a^4P represents roughly the levels near 40300 which have been attributed to this configuration.

7. List of Lines of Ni I

Table V includes all the lines which have been classified as belonging to Ni I, and also all but the weakest of the unclassified lines. Among the latter, all those given by Randall and Barker in the infra-red are included, all those found in absorption by Meggers and Kiess in the under-water spark, and all which have recently been measured here in the ultra-violet. All lines observed by Hamm, or by Meggers and Kiess, have been included, except those to which they assign the minimum intensity 1. A total of 196 unclassified lines of intensity 1 have been omitted of which 81 were listed by Hamm, 22 by Meggers and Kiess, 90 by Exner and Haschek and 3 by Stüting.

The first column gives the source of the data (as explained at the foot of the Table), the second the wave-length—in air up to λ2000 and in vacuum beyond, the third the intensity, and the fourth the temperature class.

King's estimates of intensity have been adopted for all lines for which he gives a temperature class except those to the red of λ6500, where his values

[18] Shenstone, Phys. Rev. **30**, 255 (1927).

are relatively low. For the ultra-violet lines observed in absorption by Meggers and Walters, their absorption intensity is listed in column 3, and *A* is inserted under "Class." This is undoubtedly equivalent to King's Class I or II. The intensities of the remaining lines are taken from the sources mentioned in column 1, and are given in parentheses in the Table. They are on a much more compressed scale, 1 to 10 as against 1 to 100 or more.

The fifth column gives the wave-numbers and the sixth the designation of the classified lines. In a number of cases, where there is good reason to believe that a weaker line is masked by a stronger, the designation of the former is added in parentheses.

The last column gives a multiplet number, for cross-reference to Table II.

Practically all the lines of any importance have been classified, except in the infra-red. Here there are two unidentified groups, with values of λ about 5500 and 7200. The former is in just the place for lines arising from the transition $d^9 \cdot 4d - d^9 \cdot 4f$, and the latter for $d^8s \cdot 5s - d^8s \cdot 5p$. In both cases there should be a complex group of overlapping multiplets which cannot be worked out without further data.

8. Conclusion

The arc spectrum of nickel, in spite of its apparent complexity, is admirably regular. Every observed term fits without constraint into the scheme predicted by Hund's theory. A few of the predicted terms have not been found, but in all cases their combinations should either be faint or out of range.

It is hoped that the present analysis is about as complete as the existing data permit, but there is a great deal of profitable work still to be done on this spectrum. First may be mentioned the observation of the spectrum in the infra-red (where only the strongest lines have so far been detected), and in the ultra-violet beyond λ2000. Observations with an arc in nitrogen and vacuum spectrograph, following Fowler's very successful work on Si I,[19] would certainly be repaying.

A search for later members of the known series would be well worth while, if a source could be found which intensified the last members already known. Many interesting questions of correlation to multiple limits might thus be settled.

The Zeeman effect in this spectrum has never been adequately investigated, and offers an extensive field for work. It may be anticipated that many *g*-values will be abnormal, especially for the higher terms, but this should be important in studying the changes of coupling of the vectors which are involved. Finally the intensities of the lines afford an extensive and fruitful field for precise measurement.

In conclusion it is a pleasure to express the writer's indebtedness to Professor A. G. Shenstone for valuable comments, and for the photographs of the ultra-violet spectrum, and especially to Miss Charlotte E. Moore, for her extensive and accurate work in the measurement of these plates and in the preparation of the tabular data and of the manuscript, and the correction of the proofs.

[19] Fowler, Proc. Roy. Soc. **A 123,** 422 (1929).

TABLE I. *Terms of Ni I.*

Source	Designation	Level	Connection
BS	a^3F_4	0.00	+
BS	a^3D_3	204.82	· +
BS	a^3D_2	879.82	· +
BS	a^3F_3	1332.15	+ ·
BS	a^3D_1	1713.11	· +
BS	a^3F_2	2216.55	+
BS	a^1D_2	3409.95	
BS	b^1D_2	13521.29	
BS	a^1S_0	14728.92	
BS	a^3P_2	15609.81	+
BS	a^3P_1	15734.03	+
BS	a^3P_0	16017.30	+
	a^1G_4	22102.27	
B	$z^5D_4^\circ$	*25753.57*	+
B	$z^5D_3^\circ$	*26665.97*	+
B	$z^5G_6^\circ$	*27260.96*	· +
B	$z^5D_2^\circ$	*27414.92*	+ ·
B	$z^5G_5^\circ$	*27580.48*	· +
B	$z^5D_1^\circ$	*27943.58*	+ ·
B	$z^5G_4^\circ$	*28068.18*	· +
B	$z^5D_0^\circ$	*28213.10*	+ ·
B	$z^5F_5^\circ$	*28541.94*	· +
BS	$z^3P_2^\circ$	*28569.30*	· · +
B	$z^5G_3^\circ$	*28578.10*	+ · ·
B	$z^5G_2^\circ$	*29013.28*	+ · ·
(BS)	$z^5F_4^\circ$	*29084.47*	+ ·
BS	$z^3F_3^\circ$	*29320.75*	· · +
BS	$z^3F_4^\circ$	*29480.96*	· · +
BS	$z^3P_1^\circ$	*29500.75*	· + ·
BS	$z^3D_3^\circ$	*29668.89*	· · · +
(BS)	$z^5F_3^\circ$	*29832.77*	+ · · ·
BS	$z^3D_2^\circ$	*29888.47*	· · · +
(BS)	$z^5F_2^\circ$	*30163.16*	+ · · ·
BS	$z^3P_0^\circ$	*30192.30*	· + · ·
	$z^5F_1^\circ$	*30391.96*	+ · ·
BS	$z^3F_2^\circ$	*30619.40*	+ ·
BS	$z^3D_1^\circ$	*30912.87*	+
B	$z^3G_5^\circ$	*30922.61*	+
B	$z^3G_4^\circ$	*30979.70*	+
BS	$z^1F_3^\circ$	*31031.02*	·
BS	$z^1D_2^\circ$	*31441.64*	·
B	$z^3G_3^\circ$	*31786.13*	+
BS	$y^3F_4^\circ$	*32973.33*	+
BS	$z^1P_1^\circ$	*32982.30*	·
BS	$y^3F_3^\circ$	*33112.30*	+
BS	$y^3D_3^\circ$	*33500.80*	· +
B	$z^1G_4^\circ$	*33590.12*	· ·
BS	$y^3F_2^\circ$	*33610.88*	+ ·
BS	$y^3D_2^\circ$	*34163.24*	+
BS	$y^3D_1^\circ$	*34408.54*	+
BS	$y^1F_3^\circ$	*35639.09*	
BS	$y^1D_2^\circ$	*36600.78*	
(BS)	1_3°	*40361.10*	
(BS)	2_2°	*40484.10*	
(BS)	$x^3F_4^\circ$	*42585.04*	+
BS	e^3D_3	42605.84	· +
(BS)	$x^3D_3^\circ$	*42620.95*	· · +
(BS)	$y^3P_2^\circ$	*42653.65*	· · · +
	$y^3P_1^\circ$	*42656.27*	· · · +
(BS)	$w^3D_3^\circ$	*42767.72*	· · · +
BS	e^3D_2	42789.95	· + · ·
(BS)	$x^3D_2^\circ$	*42954.17*	· · + ·
(BS)	$y^3G_5^\circ$	*43089.52*	· · · +
BS	$w^3F_4^\circ$	*43258.67*	· · · · +
	$y^1P_1^\circ$	*43463.90*	· · · · ·
(BS)	$x^3F_3^\circ$?	*43654.91*	+ · · · ·
(BS)	$x^1D_2^\circ$	*43933.37*	· · · ·
BS	e^3D_1	44112.13	+ · · ·
(BS)	$x^1F_3^\circ$	*44206.42*	· · ·
BS	e^1D_2	44262.52	· · ·
(BS)	$y^3G_4^\circ$	*44314.85*	· + ·
	3°	*44336.10*	· · ·
(BS)	$w^3D_2^\circ$	*44475.07*	+ · ·
BS	$w^3F_3^\circ$	*44565.01*	· · +
(MW)	$w^3D_1^\circ$	*45122.29*	+ · ·
(BS)	$y^3G_3^\circ$	*45281.14*	+ ·

TABLE I (*Continued*)

Source	Designation	Level	Connection
BS	$w^3F_2^\circ$	*45418.81*	
(MW)	$x^3P_2^\circ$	*46522.77*	
(MW)	$v^3D_3^\circ$	*47029.98*	
(MW)	$v^3D_2^\circ$	*47139.25*	
	$x^3P_1^\circ$	*47208.13*	
	4_2°	*47328.6*	
	$v^3D_1^\circ$	*47424.93*	
	$x^3P_0^\circ$?	*47687.50*	
B	e^5F_5	48466.52	
	$v^3F_3^\circ$	*48671.9*	
	$v^3F_4^\circ$	*48715.2*	
	$w^3P_2^\circ$	*48735.18*	
	$5_{1,2}^\circ$	*48817.6*	
	e^3S_1	48953.40	
	6_3°	*49032.6*	
B	e^5F_4	49085.94	
(BS)	e^3G_5	49158.49	
	e^3P_2	49159.03	
	e^3P_1	49170.98	
(BS)	e^3G_4	49174.60	
	$u^3D_2^\circ$	*49184.8*	
B	f^3D_3	49271.35	
(BS)	e^3F_3	49313.51	
(M)	$u^3D_3^\circ$	*49327.4*	
B	f^3D_2	49327.94	
	e^3F_4	49332.58	
	$w^3P_1^\circ$	*49403.30*	
B	e^5F_3	49777.51	
	$v^3F_2^\circ$	*50038.8*	
	$w^3P_0^\circ$	*50138.38*	
	$w^1F_3^\circ$	*50142.8*	
	e^3P_0	50276.35	
B	e^5F_2	50346.40	
	$x^1P_1^\circ$	*50457.9*	
B	f^3F_4	50466.08	
	e^1P_1	50536.74	
(BS)	e^3G_3	50677.53	
(M)	$w^1D_2^\circ$	*50689.1*	

Source	Designation	Level	Connection
	e^1G_4	50706.25	
	f^3D_1	50716.90	
B	e^5F_1	50744.57	
	f^1D_2	50754.11	
(M)	$u^3F_4^\circ$	*50789.5*	
BS	e^1F_3	50832.04	
(BS)	e^3F_2	50834.30	
(M)	$u^3D_1^\circ$	*50851.0*	
(M)	$u^3F_3^\circ$	*51124.8*	
B	f^3F_3	51306.02	
(M)	$u^3F_2^\circ$	*51343.6*	
	e^1S_0	51457.20	
B	f^3F_2	52040.46	
(BS)	g^3D_3	52197.41	
	g^3D_2	52271.65	
	g^3D_1	53703.78	
	g^1D_2	53753.89	
	g^3F_4	54237.10	
	g^3F_3	54251.24	
	f^3S_1	54574.65	
	f^3G_5	54659.68	
	f^3G_4	54667.85	
	h^3D_3	54699.58	
	h^3D_2?	54732.43	
	h^3F_4	54761.22	
	h^3F_3	54772.19	
	f^1F_3	55576.76	
	g^3F_2	55873.75	
	f^3G_3	56172.64	
	f^1G_4	56183.19	
	g^1F_3	56263.05	
	h^3F_2	56274.34	
	e^3H_6	56624.60	
	f^3P_2	56710.80	
	i^3F_4	56766.40	
	g^3G_5	56801.50	
	e^5P_3	56821.42	
	e^5D_4	56857.93	

TABLE I (*Continued*)

Source	Designation	Level	Connection	Source	Designation	Level	Connection
	e^5H_7	56885.29	· · · · · · · +		g^3G_3	58530.35	·+ · · ·
	e^5G_6	56954.20	· · · · · · · · +		f^5F_3	58588.16	· · · +
	f^5F_5	56973.68	· · · · · · · · · +		e^5G_3	58629.50	· · + ·
	i^3D_3	57103.91	· · · · · · · · · ·		i^3F_2	58629.95	+ · · ·
	e^5P_2	57586.63	· · · · + · · · ·		e^5G_4	58872.72	· · + ·
	e^3H_5	57677.50	+ · · · · · · · ·		f^5F_2	58992.42	· · · +
	e^5D_3	57743.63	· · · · · + · · ·		e^5H_4	59039.73	+ · · ·
	e^5H_6	57761.95	· · · · · · + · ·		e^5G_2	59117.84	· + · ·
	f^3P_1	57767.25	· + · · · · · ·		e^5H_3	59188.65	+ · ·
	g^3G_4	57789.54	· · · · + · · · ·		f^5F_1	59226.03	+
	f^5F_4	57810.35	· · · · · · · · +		g^5F_5	59862.40	
	e^5G_5	57829.38	· · · · · · · + ·		j^3F_4	61832.42	
	i^3F_3	57968.14	· · + · · · · · ·		h^3G_5	61843.28	
	f^3P_0	58448.62	· + · · · · · · ·		f^3H_6?	61957.23	
	e^3H_4	58518.12	+ · · · · · · · ·		f^5H_7	62782.45	
	e^5H_5	58520.93	· · · · + · · ·		f^5G_6	62807.61	
	e^5P_1	58525.58	· · · + · · · ·		h^5F_5?	62815.49	

Sources in Table I.

BS Bechert and Sommer, Ann. d. Physik **77**, 351 (1925).
B Bechert, Ann. d. Physik **77**, 537 (1925).
MW Meggers and Walters, Sci. Papers Bureau of Standards **22**, 221 (No. 551 (1927)).
M Menzies, Phil. Mag. **6**, 1210 (1928).

TABLE II. *Combinations in the spectrum of Ni I.*

Term Low even terms	Combinations						
a^1S 14729	z^1P 139	z^3P 75	z^3D 105	y^3D 172			
a^1D 3410	z^1P 313	x^1P 394	z^1D 287	y^1D 344	x^1D 365	w^1D 396	z^1F 281
	y^1F 338	x^1F 368	z^3P 253	y^3P 360	x^3P 382	w^3P 391	z^3D 263
	y^3D 319	x^3D 362	w^3D 361	u^3D 390	z^3F 262	y^3F 316	x^3F 363
	w^3F 370	v^3F 388	u^3F 398	z^3G 295	y^3G 375	z^5D 232	z^5F 266
	z^5G 254						
b^1D 13521	z^1P 165	y^1P 318	z^1D 133	y^1D 230	x^1D 324	z^1F 121	y^1F 214
	z^3P 80	x^3P 342	w^3P 355	z^3D 102	y^3D 181	x^3D 307	v^3D 347
	u^3D 359	z^3F 98	y^3F 167	z^5F 106			
a^1G 22102	z^1F 7	y^1F 48	z^1G 20	y^3D 19			
a^3P 15610	z^1P 112	y^1P 278	x^1P 352	z^1D 95	y^1D 200	x^1D 291	w^1D 354

Term Low even terms	Combinations						
a^3P *Cont.*	z^1F 86	z^3P 31	y^3P 270	x^3P 335	w^3P 343	z^3D 61	y^3D 132
	v^3D 334	z^3F 54	y^3F 120	x^3F 288	z^3G 103	z^5F 68	z^5G 33
a^3D 205	z^1P 331	x^1P 403	z^1D 317	y^1D 353	w^1D 404	z^1F 321	y^1F 356
	x^1F 383	w^1F 406	z^1G 345	z^3P 269	y^3P 369	x^3P 385	w^3P 400
	z^3D 290	y^3D 341	x^3D 371	w^3D 376	v^3D 389	u^3D 397	x^3F 297
	y^3F 336	x^3F 379	w^3F 381	v^3F 399	u^3F 407	z^3G 326	y^3G 384
	z^5D 258	z^5F 298	z^5G 274				
a^3F 0	z^1P 325	y^1P 372	x^1P 401	z^1D 308	y^1D 351	x^1D 374	w^1D 402
	z^1F 301	y^1F 346	x^1F 378	w^1F 408	z^1G 339	z^3P 264	y^3P 364
	x^3P 387	w^3P 395	z^3D 279	y^3D 332	x^3D 367	w^3D 366	v^3D 386
	u^3D 393	z^3F 273	y^3F 327	x^3F 373	w^3F 377	v^3F 392	u^3F 405
	z^3G 312	y^3G 380	z^5D 260	z^5F 285	z^5G 265		

TABLE II (*Continued*)

Term High even terms	Combinations						
e^1S 51457	z^1P 143	z^3P 210	y^3D 114				
e^1P 50536	z^1P 123	z^1D 154	y^1D 60	z^3P 187	z^3D 168	y^3D 101	y^3F 111
e^1D 44263	z^1P 17	z^1D 30	z^1F 38	w^1F 2	z^3P 74	z^3D 45	z^3F 51
	y^3F 15	z^3G 26	z^5F 71				
f^1D 50754	z^1P 128	z^1D 160	y^1D 65	z^3P 204	z^3D 178	y^3D 108	z^3F 184
	y^3F 115						
g^1D 53754	z^1P 197	z^1D 219	z^1F 226				
e^1F 50832	z^1D 162	y^1D 69	z^1F 175	y^1F 84	z^1G 117	z^3P 217	z^3D 201
	y^3D 109	z^3F 185	y^3F 116	z^3G 151	z^5G 216		
f^1F 55577	z^1D 240	y^1D 148	z^1F 242	y^1F 180	z^1G 212	y^3P 32	y^3D 205
	w^3D 13	y^3F 211	w^3F 12	z^3G 235	y^3G 16		
g^1F 56263	z^1D 245	z^1F 256					

Term High even terms	Combinations						
e^1G 50706	z^1F 170	y^1F 81	z^3D 202	y^3F 124	z^3G 173	z^5G 215	
f^1G 56183	z^1F 252	z^1G 224					
e^3S 48953	z^1P 99	z^3P 147	z^3D 153	y^3D 76			
f^3S 54575	z^1P 206	z^3P 251					
e^3P 49159	z^1P 104	z^1D 126	y^1D 27	z^1F 136	z^3P 169	z^3D 140	y^3D 79
	z^3F 177	y^3F 89	z^5F 150				
f^3P 56711	y^1D 183	z^3D 271	y^3D 231	x^3D 62	w^3D 44	y^3F 234	x^3F 34
	w^3F 24	z^5D 309					
e^3D 42606	z^1P 9	z^1D 18	z^1F 21	z^3P 43	w^3P 3	z^3D 23	y^3D 6
	u^3D 4	z^3F 36	y^3F 8	v^3F 1	z^3G 11	z^5D 85	z^5F 25
	z^5G 57						
f^3D 49271	z^1P 107	z^1D 129	y^1D 28	z^1F 138	y^1F 50	z^1G 93	z^3P 176

TABLE II (*Continued*)

Term High even terms	Combinations						
f^3D *Cont.*	z^3D 142	y^3D 78	z^3F 174	y^3F 96	z^5D 207	z^5F 156	z^5G 195
g^3D 52197	z^1P 196	z^1D 199	z^3P 227	z^3D 218	z^3F 225	z^5F 213	
h^3D 54700	z^3D 248						
i^3D 57104	z^3D 277	y^3D 229	x^3D 72	w^3D 70	y^3F 239	x^3F 46	w^3F 59
	z^5D 315	z^5G 305					
e^3F 49333	z^1P 130	z^1D 131	y^1D 29	z^1F 141	z^1G 97	z^3D 164	y^3D 83
	z^3F 146	y^3F 94	z^3G 122	z^5D 209	z^5F 155	z^5G 203	
f^3F 50466	z^1P 152	z^1D 179	y^1D 73	z^1F 186	y^1F 77	z^1G 110	z^3P 223
	z^3D 198	y^3D 113	z^3F 194	y^3F 118	z^3G 145	y^3G 5	z^5D 237
	z^5F 191	z^5G 208					
g^3F 54237	z^1D 228	y^1D 125	y^1F 144	z^1G 193	y^3D 182	x^3D 22	z^3F 244
	y^3F 192	w^3F 10	z^3G 221	y^3G 14			

Term High even terms	Combinations						
h^3F 54761	z^3D 250	z^3F 257					
i^3F 56766	z^3D 272	y^3D 233	x^3D 64	w^3D 47	y^3F 236	x^3F 66	w^3F 37
	y^3G 52	z^5D 320	z^5F 282				
j^3F 61832	y^3D 293	y^3F 302					
e^3G 49158	z^1D 157	z^1F 137	z^1G 90	z^3D 166	y^3D 92	z^3F 171	y^3F 100
	z^3G 119	z^5D 222	z^5F 161	z^5G 190			
f^3G 54660	z^3F 255	z^5F 246					
g^3G 56802	y^3D 241	z^3F 299	y^3F 238	x^3F 67	w^3F 35	z^3G 261	y^3G 41
	z^5F 283	z^5G 300					
h^3G 61843	y^3F 303	z^3G 328					
e^3H 56625	y^3F 243	z^3G 259	y^3G 39	z^5F 289	z^5G 306		
f^3H ? 61957	z^3G 330						

TABLE II (*Continued*)

Term	Combinations						
High even terms							
e^5P	z^3F	z^5D	z^5F				
56821	275	322	284				
e^5D	x^3D	w^3D	z^3F	w^3F	z^5D	z^5F	
56858	82	42	276	49	323	280	
e^5F	z^1P	z^1D	y^1D	z^1F	z^1G	z^3P	z^3D
48467	127	159	63	134	88	189	163
	y^3D	z^3F	y^3F	z^3G	z^5D	z^5F	z^5G
	91	149	87	135	220	158	188
f^5F	z^3F	y^3F	w^3F	y^3G	z^5D	z^5F	z^5G
56974	292	247	40	55	329	286	311
g^5F	z^5D	z^5F	z^5G				
59862	348	333	340				
h^5F ?	z^5F						
62815	350						
e^5G	z^3F	y^3F	w^3F	z^3G	y^3G	z^5D	z^5F
56954	294	249	53	268	58	337	296
	z^5G						
	310						
f^5G	z^5F	z^5G					
62808	349	358					
e^5H	z^3G	y^3G	z^5F	z^5G			
56885	267	56	304	314			
f^5H	z^5G						
62782	357						

Term	Combinations						
Odd terms							
z^1P°	a^1S	e^1S	e^1P	a^1D	b^1D	e^1D	f^1D
32982	139	143	123	313	165	17	128
	g^1D	e^3S	f^3S	a^3P	e^3P	a^3D	e^3D
	197	99	206	112	104	331	9
	f^3D	g^3D	a^3F	e^3F	f^3F	e^5F	
	107	196	325	130	152	127	
y^1P°	b^1D	a^3P	a^3F				
43464	318	278	372				
x^1P°	a^1D	a^3P	a^3D	a^3F			
50458	394	352	403	401			
z^1D°	e^1P	a^1D	b^1D	e^1D	f^1D	g^1D	e^1F
31442	154	287	133	30	160	219	162
	f^1F	g^1F	a^3P	e^3P	a^3D	e^3D	f^3D
	240	245	95	126	317	18	129
	g^3D	a^3F	e^3F	f^3F	g^3F	e^3G	e^5F
	199	308	131	179	228	157	159
y^1D°	e^1P	a^1D	b^1D	f^1D	e^1F	f^1F	a^3P
36601	60	344	230	65	69	148	200
	e^3P	f^3P	a^3D	f^3D	a^3F	e^3F	f^3F
	27	183	353	28	351	29	73
	g^3F	e^5F					
	125	63					
x^1D°	a^1D	b^1D	a^3P	a^3F			
43933	365	324	291	374			

TABLE II (*Continued*)

Term Odd terms	Combinations						
w^1D°	a^1D	a^3P	a^3D	a^3F			
50689	396	354	404	402			
z^1F°	a^1D	b^1D	e^1D	g^1D	e^1F	f^1F	g^1F
31031	281	121	38	226	175	242	256
	a^1G	e^1G	f^1G	a^3P	e^3P	a^3D	e^3D
	7	170	252	86	136	321	21
	f^3D	a^3F	e^3F	f^3F	e^3G	e^5F	
	138	301	141	186	137	134	
y^1F°	a^1D	b^1D	e^1F	f^1F	a^1G	e^1G	a^3D
35639	338	214	84	180	48	81	356
	f^3D	a^3F	f^3F	g^3F			
	50	346	77	144			
x^1F°	a^1D	a^3D	a^3F				
44206	368	383	378				
w^1F°	e^1D	a^3D	a^3F				
50143	2	406	408				
z^1G°	e^1F	f^1F	a^1G	f^1G	a^3D	f^3D	a^3F
33590	117	212	20	224	345	93	339
	e^3F	f^3F	g^3F	e^3G	e^5F		
	97	110	193	90	88		
z^3P°	a^1S	e^1S	e^1P	a^1D	b^1D	e^1D	f^1D
28569	75	210	187	253	80	74	204
	e^1F	e^3S	f^3S	a^3P	e^3P	a^3D	e^3D
	217	147	251	31	169	269	43

Term Odd terms	Combinations						
z^3P°	f^3D	g^3D	a^3F	f^3F	e^5F		
Cont.	176	227	264	223	189		
y^3P°	a^1D	f^1F	a^3P	a^3D	a^3F		
42654	360	32	270	369	364		
x^3P°	a^1D	b^1D	a^3P	a^3D	a^3F		
46523	382	342	335	385	387		
w^3P°	a^1D	b^1D	a^3P	a^3D	e^3D	a^3F	
48735	391	355	343	400	3	395	
z^3D°	a^1S	e^1P	a^1D	b^1D	e^1D	f^1D	e^1F
29669	105	168	263	102	45	178	201
	e^1G	e^3S	a^3P	e^3P	f^3P	a^3D	e^3D
	202	153	61	140	271	290	23
	f^3D	g^3D	h^3D	i^3D	a^3F	e^3F	f^3F
	142	218	248	277	279	164	198
	h^3F	i^3F	e^3G	e^5F			
	250	272	166	163			
y^3D°	a^1S	e^1S	e^1P	a^1D	b^1D	f^1D	e^1F
33501	172	114	101	319	181	108	109
	f^1F	a^1G	e^3S	a^3P	e^3P	f^3P	a^3D
	205	19	76	132	79	231	341
	e^3D	f^3D	i^3D	a^3F	e^3F	f^3F	g^3F
	6	78	229	332	83	113	182
	i^3F	j^3F	e^3G	g^3G	e^5F		
	233	293	92	241	91		

TABLE II (*Continued*)

Term Odd terms	Combinations						
x^3D° 42621	a^1D 362	b^1D 307	f^3P 62	a^3D 371	i^3D 72	a^3F 367	g^3F 22
	i^3F 64	e^5D 82					
w^3D° 42768	a^1D 361	f^1F 13	f^3P 44	a^3D 376	i^3D 70	a^3F 366	i^3F 47
	e^5D 42						
v^3D° 47030	b^1D 347	a^3P 334	a^3D 389	a^3F 386			
u^3D° 49327	a^1D 390	b^1D 359	a^3D 397	e^3D 4	a^3F 393		
z^3F° 29481	a^1D 262	b^1D 98	e^1D 51	f^1D 184	e^1F 185	a^3P 54	e^3P 177
	a^3D 297	e^3D 36	f^3D 174	g^3D 225	a^3F 273	e^3F 146	f^3F 194
	g^3F 244	h^3F 257	e^3G 171	f^3G 255	g^3G 299	e^5P 275	e^5D 276
	e^5F 149	f^5F 292	e^5G 294				
y^3F° 32973	e^1P 111	a^1D 316	b^1D 167	e^1D 15	f^1D 115	e^1F 116	f^1F 211
	e^1G 124	a^3P 120	e^3P 89	f^3P 234	a^3D 336	e^3D 8	f^3D 96

Term Odd terms	Combinations						
y^3F° *Cont.*	i^3D 239	a^3F 327	e^3F 94	f^3F 118	g^3F 192	i^3F 236	j^3F 302
	e^3G 100	g^3G 238	h^3G 303	e^3H 243	e^5F 87	f^5G 247	e^5G 249
x^3F° 42585	a^1D 363	a^3P 288	f^3P 34	a^3D 379	i^3D 46	a^3F 373	i^3F 66
	g^3G 67						
w^3F° 43259	a^1D 370	f^1F 12	f^3P 24	a^3D 381	i^3D 59	a^3F 377	g^3F 10
	i^3F 37	g^3G 35	e^5D 49	f^5F 40	e^5G 53		
v^3F° 48715	a^1D 388	a^3D 399	e^3D 1	a^3F 392			
u^3F° 50790	a^1D 398	a^3D 407	a^3F 405				
z^3G° 30923	a^1D 295	e^1D 26	e^1F 151	f^1F 235	e^1G 173	a^3P 103	a^3D 326
	e^3D 11	a^3F 312	e^3F 122	f^3F 145	g^3F 221	e^3G 119	g^3G 261
	h^3G 328	e^3H 259	f^3H 330	e^5F 135	e^5G 268	e^5H 267	
y^3G° 43090	a^1D 375	f^1F 16	a^3D 384	a^3F 380	f^3F 5	g^3F 14	i^3F 52

TABLE II (*Continued*)

Term Odd terms	Combinations						
y^3G° *Cont.*	g^3G 41	e^3H 39	f^5F 55	e^5G 58	e^5H 56		
z^5D° 25754	a^1D 232	f^3P 309	a^3D 258	e^3D 85	f^3D 207	i^3D 315	a^3F 260
	e^3F 209	f^3F 237	i^3F 320	e^3G 222	e^5P 322	e^5D 323	e^5F 220
	f^5F 329	g^5F 348	e^5G 337				
z^5F° 28542	a^1D 266	b^1D 106	e^1D 71	a^3P 68	e^3P 150	a^3D 298	e^3D 25
	f^3D 156	g^3D 213	a^3F 285	e^3F 155	f^3F 191	i^3F 282	e^3G 161
	f^3G 246	g^3G 283	e^3H 289	e^5P 284	e^5D 280	e^5F 158	f^5F 286
	g^5F 333	h^5F 350	e^5G 296	f^5G 349	e^5H 304		

Term Odd terms	Combinations						
z^5G° 27261	a^1D 254	e^1F 216	e^1G 215	a^3P 33	a^3D 274	e^3D 57	f^3D 195
	i^3D 305	a^3F 265	e^3F 203	f^3F 208	e^3G 190	g^3G 300	e^3H 306
	e^5F 188	f^5F 311	g^5F 340	e^5G 310	f^5G 358	e^5H 314	f^5H 357
1° 40361	a^1D	a^3D	a^3F				
2° 40484	a^1D	a^3P	a^3D	a^3F			
3° 44336	a^3F						
4° 47329	a^3P	a^3D					
5° 48818	a^1D	a^3D	a^3F				
6° 49033	a^1D	a^3P	a^3D	a^3F			

TABLE III. *Configurations.*

Config.	Desig.	Level	Separations			
d^{10}	a^1S	14729				
d^9s	a^3D	204	675	833		
	a^1D	3410				
d^8s^2	a^3P	15610	124	283		
	a^3F	0	1332	884		
	^1S	—				
	b^1D	13521				
	a^1G	22102				
$d^9\cdot 4p$	z^3P°	28569	931	692		
	z^3D°	29669	220	1024		
	z^3F°	29481	−160	1299		
	z^1P°	32982				
	z^1D°	31442				
	z^1F°	31031				
$d^9\cdot 5p$	w^3P°	48735	668	735		
	u^3D°	49327	−142	666		
	v^3F°	48715	−43	1367		
	x^1P°	50458				
	w^1D°	50689				
	w^1F°	50143				
$d^8s\cdot 4p$ (^4F)	z^5D°	25754	912	749	529	269
	z^5F°	28542	543	748	330	229
	z^5G°	27261	320	488	510	435
	w^3D°	42768	1707	647		
	w^3F°	43259	1306	854		
	y^3G°	43090	1225	966		
$d^8s\cdot 4p$ (^2F)	y^3D°	33501	662	245		
	y^3F°	32973	139	499		
	z^3G°	30923	57	806		
	y^1D°	36601				
	y^1F°	35639				
	z^1G°	33590				

Config.	Desig.	Level	Separations	
$d^8s\cdot 4p$ (^2D)	y^3P°	42654	3	—
	x^3D°	42621	333	—
	x^3F°	42585	1070	—
	y^1P°	43464		
	x^1D°	43933		
	x^1F°	44206		
$d^8s\cdot 4p$ (^4P)	$^3S^\circ$	—		
	x^3P°	46523	685	479
	v^3D°	47030	109	286
$d^8s\cdot 4p$ (^2G)	u^3F°	50790	335	219
		—		
$d^9\cdot 5s$	e^3D	42606	184	1322
	e^1D	44263		
$d^9\cdot 6s$	g^3D	52197	74	1432
	g^1D	53754		
$d^9\cdot 4d$	e^3S	48953		
	e^3P	49159	12	1105
	f^3D	49271	57	1389
	e^3F	49333	−19	1520
	e^3G	49158	16	1503
	e^1S	51457		
	e^1P	50537		
	f^1D	50754		
	e^1F	50832		
	e^1G	50706		
$d^9\cdot 5d$	f^3S	54575		
	^3P	—	—	—
	h^3D	54700	33	—
	h^3F	54761	11	1502
	f^3G	54660	8	1505
	—	—		

TABLE III (*Continued*)

Config.	Desig.	Level	Separations			
$d^9 \cdot 5d$	g^1F	56263				
Cont.	f^1G	56183				
$d^8s \cdot 5s$	e^5F	48467	619	692	569	398
(^4F)	f^3F	50466	840	734		
$d^8s \cdot 6s$	g^5F	59862	—	—	—	—
(^4F)	—	—				
$d^8s \cdot 4d$	e^5P	56821	765	939		
(^4F)	e^5D	56858	886	—	—	—
	f^5F	56974	837	778	404	234
	e^5G	56954	875	1043	−243	488
	e^5H	56885	877	759	519	149
	f^3P	56711	1056	681		
	i^3D	57104	—	—		

Config.	Desig.	Level	Separations			
$d^8s \cdot 4d$	i^3F	56766	1202	662		
Cont.	g^3G	56802	988	741		
	e^3H	56625	1053	841		
$d^8s \cdot 5d$	—	—				
(^4F)	h^5F	62815	—	—	—	—
	f^5G	62808	—	—	—	—
	f^5H	62782	—	—	—	—
$d^8s \cdot 5s$	g^3F	54237	14	623		
(^2F)	f^1F	55577				
$d^8s \cdot 4d$	—	—				
(^2F)	j^3F	61832	—	—		
	h^3G	61843	—	—		
	f^3H	61957	—	—		

TABLE IV. *Quantum Defects for Ni I.*

Electron	Limit a^2D				Limit a^4F			Limit a^2F	
	Term	Triplets		Singlets	Term	Quintets	Triplets	Triplets	Singlets
4*s*	*D*	2.663	2.656	2.644	*F*		2.756	2.792	
5*s*		2.596	2.585	2.596	2.586	2.741	2.684	2.708	2.714
6*s*		2.581	2.567	2.582	2.572	2.706			
4*p*	*F*°	2.152	2.156	2.162	2.150	*G*	2.397	2.014	2.425	2.403
5*p*		2.080	2.085	2.101	2.089				
4*p*	*D*°	2.146	2.140	2.154	2.150	*F*	2.373	2.008	2.387	2.363
5*p*		2.008	2.025	2.006	2.026				
4*p*	*P*°	2.177	2.151	2.175	2.091	*D*	2.425	2.026	2.377	2.343
5*p*		2.078	1.999	2.090	2.053				
4*d*	*G*	1.029	1.026	1.027	1.024	*H*	1.105	1.135	1.113	
5*d*		1.019	1.017	1.017	1.014		1.094			
4*d*	*F*	1.007	1.010	1.008	1.008	*G*	1.097	1.114	1.126	
5*d*		0.993	0.986	0.987	0.991		1.087			
4*d*	*D*	1.015	1.008	1.022	1.018	*F*	1.094	1.118	1.128	
5*d*		1.007	0.998				1.082			
4*d*	*P*	1.028	1.027	1.074	1.044	*D*	1.108	1.080		
4*d*	*S*	1.052			0.929	*P*	1.112	1.124		
5*d*		1.043								

Electron	Limit b^2D			Limit a^4P			Limit a^2G		
	Term	Triplets	Singlets	Term	Quintets	Triplets	Term	Triplets	Singlets
4*s*	*D*		2.678	*P*		2.674	*G*		2.687
4*p*	*F*	2.196	2.171	*D*	2.30:	2.121	*H*		
	D	2.195	2.178	*P*		2.133	*G*		
	P	2.194	2.191	*S*			*F*		2.227

TABLE V. *Identified Lines of Ni I.*

Source	I.A.	Int.	Temp. Class	ν (vac)	Designation	Multiplet
4	18040.6	(15)		5541.9		
4	17986.8	(20)		5586.3		
4	16999.6	(60)		5881.3	$e^3D_2-v^3F_3^\circ$	1
					$e^1D_2-w^1F_3^\circ$	2
4	16868.5	(15)		5927.0	$e^3D_1-v^3F_2^\circ$	1
4†	16495.5	(120)		6061.4		
4†	16409.4	(50)		6092.8		
4	16363.0	(100)		6110.0	$e^3D_3-v^3F_4^\circ$	1
4	16313.0	(15)		6128.9	$e^3D_3-w^3P_2^\circ$	3
4	14874.7	(30)		6721.5	$e^3D_3-u^3D_3^\circ$	4
4	14102.1	(20)		7089.8		
4	13969.0	(20)		7157.3		
4	13829.6	(30)		7229.5		
4	13722.6	(50)		7283.8		
4	13553.7	(20)		7376.6	$y^3G_5^\circ-f^3F_4$	5
4	11591.1	(30)		8625.6	$y^3D_2^\circ-e^3D_2$	6
4	11198.1	(35)		8928.0	$a^1G_4-z^1F_3^\circ$	7
4	10980.4	(50)		9105.2	$y^3D_3^\circ-e^3D_3$	6
4	10378.1	(40)		9633.9	$y^3F_4^\circ-e^3D_3$	8
4	10330.0	(25)		9678.6	$y^3F_3^\circ-e^3D_2$	8
4	10301.4	(25)		9705.5	$y^3D_1^\circ-e^3D_1$	6
4	10195.1	(50)		9806.7	$z^1P_1^\circ-e^3D_2$?	9
2*	9519.99	(40)		10501.3	$y^3F_2^\circ-e^3D_1$	8
2	9106.33	(3)		10978.4	$w^3F_4^\circ-g^3F_4$	10
2	9085.15	(1)		11004.0	$z^3G_3^\circ-e^3D_2$	11
2	9078.67	(2)		11011.8	$w^3F_3^\circ-f^1F_3$	12
2	9058.55	(2)		11036.3		
2	9005.05	(1)		11101.8	$w^3D_2^\circ-f^1F_3$	13
2	8968.16	(2)		11147.5	$y^3G_5^\circ-g^3F_4$	14
2	8965.96	(2)		11150.2	$y^3F_3^\circ-e^1D_2$	15
2	8877.07	(1)		11261.9	$y^3G_4^\circ-f^1F_3$	16
2	8862.60	(4)		11280.3	$z^1P_1^\circ-e^1D_2$	17
2	8809.46	(3)		11348.3	$z^1D_2^\circ-e^3D_2$	18
⊙	8770.68	(−2)		11398.5	$a^1G_4-y^3D_3^\circ$	19
2	8702.46	(2)		11487.9	$a^1G_4-z^1G_4^\circ$	20
2	8637.05	(2)		11574.9	$z^1F_3^\circ-e^3D_3$	21
2	8606.43	(1)		11616.0	$x^3D_3^\circ-g^3F_4$	22
2	8501.81	(2)		11759.0	$z^1F_3^\circ-e^3D_2$	21
2	8417.22	(2)		11877.2	$z^3D_1^\circ-e^3D_2$	23
2	8095.93	(1)		12348.5	$w^3F_2^\circ-f^3P_1$	24
2	8034.55	(1)		12442.8	$z^5F_2^\circ-e^3D_3$	25
2	8012.94	(2)		12476.4	$z^3G_3^\circ-e^1D_2$	26
2	7994.50	(2)		12505.2		
2	7953.13	(1)		12570.2	$y^1D_2^\circ-e^3P_1$	27
2	7917.47	(7)		12626.8	$z^5F_2^\circ-e^3D_2$	25
2	7890.18	(3)		12670.5	$z^1D_2^\circ-e^3D_1$	18
					$y^1D_2^\circ-f^3D_3$	28
2	7863.70	(5)		12713.2	$y^1D_2^\circ-e^3F_3$	29
2	7861.10	(4)		12717.4	$z^3D_2^\circ-e^3D_3$	23
2	7855.05	(3)		12727.2	$y^1D_2^\circ-f^3D_2$	28
2	7826.84	(4)		12773.0	$z^5F_3^\circ-e^3D_3$	25
2	7797.66	(8)	V	12820.8	$z^1D_2^\circ-e^1D_2$	30
2	7788.95	(6)	III. A	12835.2	$a^3P_1-z^3P_2^\circ$	31
2	7748.94	(10)	IV	12901.5	$z^3D_2^\circ-e^3D_2$	23
2	7735.99	(1)		12923.0	$y^3P_2^\circ-f^1F_3$	32
2	7727.68	(10)	IV	12936.9	$z^3D_3^\circ-e^3D_3$	23
2	7715.64	(7)		12957.1	$z^5F_3^\circ-e^3D_2$	25
2	7714.27	(8)	I A	12959.4	$a^3P_2-z^3P_2^\circ$	31
2	7709.05	(1)		12968.2	$a^3P_2-z^5G_3^\circ$	33
2	7657.28	(3)		13055.9	$x^3F_3^\circ-f^3P_2$	34
2	7624.75	(2)		13111.6	$w^3F_2^\circ-g^3G_3$	35
2	7619.24	(9)	III	13121.1	$z^3D_3^\circ-e^3D_2$	23
2	7617.02	(10)	III	13124.9	$z^3F_4^\circ-e^3D_3$	36
2	7610.02	(3)		13137.0		
2	7574.10	(7)	V	13199.3	$z^3D_1^\circ-e^3D_1$	23
2	7567.35	(1)		13211.0	$w^3F_2^\circ-i^3F_2$	37
2	7559.63	(3)		13224.5	$w^3F_3^\circ-g^3G_4$	35
2	7555.67	(9)	III	13231.5	$z^1F_3^\circ-e^1D_2$	38
2	7552.25	(2)		13237.5	$y^3G_3^\circ-e^3H_4$?	39
2	7547.65	(1)		13245.5	$w^3F_3^\circ-f^5F_4$	40
2	7545.69	(2)		13249.0	$y^3G_3^\circ-g^3G_3$	41
2	7534.57	(1)		13268.5	$w^3D_2^\circ-e^5D_3$	42
2	7525.18	(8)	III	13285.1	$z^3F_3^\circ-e^3D_3$	36
2	7522.87	(8)	III	13289.2	$z^3P_1^\circ-e^3D_2$	43

TABLE V (*Continued*)

Source	I.A.	Int.	Temp. Class	ν (vac)	Designation	Multiplet
2	7521.09	(2)		13292.3	$w^3D_2^\circ - f^3P_1$	44
2	7501.81	(1)		13326.5	$w^3D_1^\circ - f^3P_0$	44
2	7488.72	(2)		13349.8	$z^3D_1^\circ - e^1D_2$	45
2	7481.49	(5)		13362.6	$y^3G_4^\circ - e^3H_5$	39
2	7458.92	(1)		13403.1	$w^3F_3^\circ - i^3F_3$	37
2	7433.40	(3)		13449.1	$x^3F_3^\circ - i^3D_3$	46
2	7422.34	(9)	III	13469.1	$z^3F_3^\circ - e^3D_2$	36
2	7419.28	(2)		13474.7	$y^3G_4^\circ - g^3G_4$	41
2	7414.51	(6)	III A	13483.4	$a^3P_0 - z^3P_1^\circ$	31
2	7409.35	(9)	IV	13492.8	$z^3F_2^\circ - e^3D_1$ $(w^3D_2^\circ - i^3F_3)$	36 47
2	7401.12	(4)		13507.8	$w^3F_4^\circ - i^3F_4$ $(w^3D_1^\circ - i^3F_2)$	37 47
2	7393.67	(10)	III	13521.4	$z^5F_4^\circ - e^3D_3$	25
2	7386.24	(7)	III A?	13535.0	$y^3G_5^\circ - e^3H_6$	39
2	7385.23	(7)	IV?	13536.8	$a^1G_4 - y^1F_3^\circ$	48
2	7381.93	(5)		13542.9	$w^3F_4^\circ - g^3G_5$	35
2	7351.35	(3)Fe ?		13599.2	$w^3F_4^\circ - e^5D_4$	49
2	7333.57	(2)Fe ?		13632.2	$y^1F_3^\circ - f^3D_3$	50
2	7327.69	(4)		13643.1	$z^3F_2^\circ - e^1D_2$	51
2	7309.57	(2)		13676.9	$y^3G_5^\circ - i^3F_4$	52
2	7297.75	(3)		13699.1	$w^3F_2^\circ - e^5G_2$	53
2§	7291.30	(8)	III A	13711.2	$a^3P_2 - z^3F_3^\circ$ $y^3G_3^\circ - f^5F_2$	54 55
2	7290.88	(1)		13712.0	$y^3G_5^\circ - g^3G_5$	41
2	7286.59	(2)		13720.1	$z^5F_1^\circ - e^3D_1$	25
2	7266.14	(4)		13758.7	$y^3G_3^\circ - e^5H_4$	56
2	7261.94	(8)	III A	13766.6	$a^3P_1 - z^3P_1^\circ$	31
2	7256.72	(1)		13776.5	$z^5G_2^\circ - e^3D_2$	57
2	7225.13	(1)		13836.8	$y^3G_3^\circ - e^5G_2$	58
2	7220.74	(3)		13845.2	$w^3F_4^\circ - i^3D_3$	59
2	7197.07	(7)	III A	13890.7	$a^3P_2 - z^3P_1^\circ$	31
2	7182.06	(9)	V	13919.74	$z^3P_0^\circ - e^3D_1$	43
2	7173.70	(2)		13936.0	$y^1D_2^\circ - e^1P_1$	60
2	7170.10	(2)		13943.0	$w^3D_3^\circ - f^3P_2$	44
2	7167.04	(4)		13948.9	$z^5F_2^\circ - e^3D_1$	25
2	7150.81	(2)		13980.6		
2	7141.55	(1)		13998.7	$w^3D_3^\circ - i^3F_4$	47
2	7129.15	(1)		14023.1	$w^3F_3^\circ - f^5F_3$	40
2	7126.73	(2)		14027.8	$z^5G_3^\circ - e^3D_3$	57
1	7122.28	(10)	IV ?	14036.6	$z^3P_2^\circ - e^3D_3$	43
2	7110.98	(6)	III A	14058.9	$a^3P_2 - z^3D_3^\circ$	61
2	7095.47	(4)Fe ?		14089.6	$x^3D_3^\circ - f^3P_2$	62
2	7082.22	(1)		14116.0	$y^1D_2^\circ - f^3D_1$	28
2	7068.27	(1)		14143.8	$y^1D_2^\circ - e^5F_1$	63
2	7067.38	(2)		14145.6	$x^3D_3^\circ - i^3F_4$	64
2	7063.52	(2)		14153.4	$y^1D_2^\circ - f^1D_2$	65
2	7063.05	(4)		14154.3	$a^3P_1 - z^3D_2^\circ$	61
2	7049.56	(1)		14181.4	$x^3F_4^\circ - i^3F_4$	66
2	7037.21	(2)		14206.3	$y^3G_4^\circ - e^5H_5$	56
2	7034.42	(4)	V	14211.9	$z^5G_3^\circ - e^3D_2$	57
2	7032.16	(1)		14216.5	$x^3F_4^\circ - g^3G_5$	67
2	7030.10	(5)	V	14220.6	$z^3P_2^\circ - e^3D_2$	43
2	7028.79	(2)		14223.3	$a^3P_2 - z^5F_3^\circ$ $z^3D_2^\circ - e^3D_1$	68 23
2	7024.76	(8)	V	14231.5	$y^1D_2^\circ - e^1F_3$	69
2	7004.32	(1)		14273.0	$y^3G_4^\circ - f^5F_3$?	55
2	7001.55	(4)	IV	14278.6	$a^3P_2 - z^3D_2^\circ$	61
2	6973.51	(2)		14336.0	$w^3D_3^\circ - i^3D_3$	70
2	6955.10	(5)	V	14374.0	$z^3D_2^\circ - e^1D_2$	45
2	6928.36	(2)		14429.5	$a^3P_1 - z^5F_2^\circ$ $z^5F_3^\circ - e^1D_2$	68 71
1	6914.56	(5)	II	14458.3	$a^3P_1 - z^3P_0^\circ$	31
2	6902.83	(2)Fe ?		14482.8	$x^3D_3^\circ - i^3D_3$	72
2	6901.89	(1)		14484.8	$w^3F_4^\circ - e^5D_3$	49
2	6876.77	(3)	IV	14537.7	$z^5G_4^\circ - e^3D_3$	57
2	6870.13	(3)		14551.8	$w^3F_4^\circ - f^5F_4$	40
2	6861.20	(3)		14570.7	$w^3F_4^\circ - e^5G_5$	53
2	6850.46	(2)		14593.5	$z^3D_3^\circ - e^1D_2$	45
1	6842.06	(2)	V	14611.5	$z^3P_1^\circ - e^3D_1$	43
2	6813.60	(3)		14672.5	$y^3G_5^\circ - e^5H_6$	56
2	6798.44	(1)		14705.2	$y^1D_2^\circ - f^3F_3$	73
2	6791.19	(1)		14720.9	$y^3G_5^\circ - f^5F_4$	55
2	6782.43	(2)		14739.9	$y^3G_5^\circ - e^5G_5$	58

TABLE V (*Continued*)

Source	I.A.	Int.	Temp. Class	ν (vac)	Designation	Multiplet
1	6772.35	(4)	V	14761.9	$z^3P_1^\circ - e^1D_2$	74
1	6767.79	(6)	I	14771.8	$a^1S_0 - z^3P_1^\circ$	75
2	6759.41	(1)		14790.1	$y^3D_2^\circ - e^3S_1$	76
2	6742.64	(1)		14826.9	$y^1F_3^\circ - f^3F_4$	77
2	6700.90	(1)		14919.3	$y^3D_1^\circ - f^3D_2$	78
2	6690.82	(2)		14941.7	$z^3F_3^\circ - e^1D_2$	51
2	6661.45	(3)		15007.6	$y^3D_2^\circ - e^3P_1$	79
1	6643.66	(10)	I	15047.8	$b^1D_2 - z^3P_2^\circ$	80
1	6635.14	(3)	V	15067.1	$y^1F_3^\circ - e^1G_4$	81
2	6621.24	(1)		15098.8	$z^5G_2^\circ - e^3D_1$	57
2	6610.82	(1)		15122.6	$x^3D_3^\circ - e^5D_3$	82
1	6598.59	(4)	IV	15150.6	$y^3D_2^\circ - e^3F_3$	83
1	6592.47	(3)		15164.6	$y^3D_2^\circ - f^3D_2$	78
1	6586.33	(5)	II	15178.8	$a^3P_1 - z^3D_1^\circ$	61
1	6510.18	(2u)		15193.0	$y^1F_3^\circ - e^1F_3$	84
⊙	6576.91	(−3)		15200.5	$w^3D_3^\circ - i^3F_3$	47
1	6532.89	(3)		15302.9	$a^3P_2 - z^3D_1^\circ$	61
1	6502.25	(1u)		15375.1	$z^5D_2^\circ - e^3D_2$	85
1	6482.82	5	V	15421.1	$a^3P_2 - z^1F_3^\circ$	86
2	6452.77	(1)		15493.0	$y^3F_4^\circ - e^5F_5$	87
2	6451.59	(2)		15495.8	$z^1G_4^\circ - e^5F_4$	88
2	6432.06	(1)		15542.8	$z^3P_2^\circ - e^3D_1$	43
1	6424.90	(2u)		15560.2	$y^3F_2^\circ - e^3P_1$	89
1	6421.50	(5u)		15568.4	$z^1G_4^\circ - e^3G_5$	90
1	6414.63	(5)		15585.1	$y^3D_3^\circ - e^5F_4$	91
1	6384.69	(5u)		15658.2	$y^3D_3^\circ - e^3P_2$	79
2	6380.99	(1)		15667.2	$y^1F_3^\circ - f^3F_3$	77
1	6378.25	5	IV?	15674.0	$y^3D_3^\circ - e^3G_4$	92
2	6375.32	(1)		15681.2	$z^1G_4^\circ - f^3D_3$	93
1	6370.39	(4)		15693.3	$z^3P_2^\circ - e^1D_2$	74
1	6366.48	4	IV	15702.94	$y^3F_2^\circ - e^3F_3$	94
1	6364.60	(1)		15707.6	$a^3P_1 - z^1D_2^\circ$	95
1	6362.41	(5)		15713.0		
1	6360.80	(5)		15717.0	$y^3F_2^\circ - f^3D_2$	96
2	6350.39	(1)		15742.7	$z^1G_4^\circ - e^3F_4$?	97
1	6339.16	7	IV	15770.6	$y^3D_3^\circ - f^3D_3$	78
1	6327.62	5	II?	15799.4	$b^1D_2 - z^3F_3^\circ$	98
1	6322.15	(3)		15813.0	$y^3D_3^\circ - e^3F_3$	83
2	6316.61	(1)		15826.9	$y^3D_3^\circ - f^3D_2$	78
1	6314.67	15	II	15831.8	$a^3P_2 - z^1D_2^\circ$ $(y^3D_3^\circ - e^3F_4)$	95 83
1	6300.36	(1)		15867.7	$y^3D_1^\circ - e^3P_0$	79
1	6272.65	(1)		15937.8	$y^3D_1^\circ - e^5F_2$	91
2	6271.84	(1)		15939.9	$z^5D_3^\circ - e^3D_3$	85
1	6259.58	2	V	15971.1	$z^1P_1^\circ - e^3S_1$	99
1	6258.62	2	V	15973.6	$y^3F_3^\circ - e^5F_4$	87
1	6256.36	15	I	15979.3	$b^1D_2 - z^3P_1^\circ$	80
1	6230.11	2	V	16046.7	$y^3F_3^\circ - e^3P_2$	89
1	6223.97	3	V	16062.5	$y^3F_3^\circ - e^3G_4$	100
1	6204.64	2	III	16112.5	$y^3F_4^\circ - e^5F_4$	87
2	6198.62	(1)		16128.2	$y^3D_1^\circ - e^1P_1$	101
1	6191.20	12	I	16147.5	$b^1D_2 - z^3D_3^\circ$	102
1	6186.74	2	V	16159.1	$y^3F_3^\circ - f^3D_3$	96
1	6183.89	(1)		16166.6	$y^3F_2^\circ - e^5F_3$	87
2	6183.14	(1)		16168.6	$z^5D_1^\circ - e^3D_1$	85
8	6180.10	(1u)		16176.5	$a^3P_2 - z^3G_3^\circ$ $z^1P_1^\circ - e^3P_2$	103 104
3	6177.49	(1)		16183.3	$y^3D_2^\circ - e^5F_2$	91
1	6177.26	(3)		16183.9	$a^1S_0 - z^3D_1^\circ$	105
1	6176.80	12	V	16185.1	$y^3F_4^\circ - e^3G_5$	100
1	6175.43	8	V	16188.7	$z^1P_1^\circ - e^3P_1$	104
1	6170.55	(3)		16201.5	$y^3F_4^\circ - e^3G_4$ $y^3F_3^\circ - e^3F_3$	100 94
⊙	6165.17	(−3)		16215.7	$y^3F_3^\circ - f^3D_2$	96
1	6163.38	5n	V	16220.4	$y^3F_3^\circ - e^3F_4$	94
1	6142.05	(1)		16276.7	$y^3D_3^\circ - e^5F_3$	91
2	6134.03	(1)		16298.0	$y^3F_4^\circ - f^3D_3$	96
1	6130.17	(3)		16308.3	$y^3D_1^\circ - f^3D_1$	78
1	6128.99	(3)		16311.4	$b^1D_2 - z^5F_3^\circ$	106
1	6119.79	(2)		16335.9	$y^3D_1^\circ - e^5F_1$	91
2	6118.06	(1)		16340.5	$y^3F_4^\circ - e^3F_3$	94
1	6116.16	6n	V	16345.6	$z^1P_1^\circ - f^3D_2$ $y^3D_1^\circ - f^1D_2$	107 108
1	6111.03	2n	V	16359.3	$y^3F_4^\circ - e^3F_4$	94

TABLE V (*Continued*)

Source	I.A.	Int.	Temp. Class	ν (vac)	Designation	Multiplet
1	6108.14	8	II	16367.1	$b^1D_2-z^3D_2^\circ$	102
2	6105.72	(1)		16373.6	$y^3D_2^\circ-e^1P_1$	101
2	6095.38	(1)		16401.4	$y^1F_3^\circ-f^3F_2$	77
1	6086.33	5n	V	16425.7	$y^3D_1^\circ-e^3F_2$	83
1	6053.69	2	V	16514.3	$y^3D_2^\circ-e^3G_3$	92
8	6039.31	(1u)		16553.6	$y^3D_2^\circ-f^3D_1$	78
3	6030.68	(2)		16577.3		
2	6025.73	(1)		16590.9	$y^3D_2^\circ-f^1D_2$	108
1	6012.25	(5)		16628.1		
1	6007.31	3	II	16641.8	$b^1D_2-z^5F_2^\circ$	106
2	5998.86	(1)		16665.2	$y^3F_3^\circ-e^5F_3$	87
1	5997.58	2n	V	16668.8	$y^3D_2^\circ-e^1F_3$	109
1	5996.77	3n	V	16671.0	$y^3D_2^\circ-e^3F_2$	83
2	5973.66	(1)		16735.5	$y^3F_2^\circ-e^5F_2$	87
⊙	5925.84	(−3)		16870.6	$b^1D_2-z^5F_1^\circ$	106
1	5923.95	(1)		16876.0	$z^1G_4^\circ-f^3F_4$	110
1	5906.48	(1u)		16925.9	$y^3F_2^\circ-e^1P_1$	111
1	5892.88	12	II	16964.9	$a^3P_0-z^1P_1^\circ$ $(y^3D_3^\circ-f^3F_4)$	112 113
2	5863.97	(2)		17048.6	$y^3D_1^\circ-e^1S_0$	114
1	5857.76	7	IV?	17066.7	$y^3F_2^\circ-e^3G_3$	100
1	5847.01	(3)		17098.0	$b^1D_2-z^3F_2^\circ$	98
1	5831.59	2	V	17143.2	$y^3D_2^\circ-f^3F_3$? $y^3F_2^\circ-f^1D_2$	113 115
1	5805.21	5	V	17221.1	$y^3F_2^\circ-e^1F_3$	116
2	5798.20	(1)		17242.0	$z^3G_4^\circ-e^1F_3$	117
2	5796.10	(2) Fe ?		17248.2	$a^3P_1-z^1P_1^\circ$	112
2	5780.77	(1)		17294.0	$z^1P_1^\circ-e^3P_0$	104
1	5760.84	4	IV	17353.8	$y^3F_3^\circ-f^3F_4$	118
1	5754.66	10	II	17372.4	$a^3P_2-z^1P_1^\circ$	112
2	5749.28	(1)		17388.7	$z^3G_3^\circ-e^3G_4$	119
1	5748.35	2	II	17391.5	$b^1D_2-z^3D_1^\circ$	102
1	5715.09	6	V	17492.7	$y^3F_4^\circ-f^3F_4$	118
1	5711.89	5	II	17502.5	$a^3P_2-y^3F_3^\circ$	120
1	5709.56	12	I	17509.6	$b^1D_2-z^1F_3^\circ$	121
2	5703.65	(1)		17527.8	$z^3G_3^\circ-e^3F_3$	122
1	5694.98	6	IV ?	17554.5	$z^1P_1^\circ-e^1P_1$	123
2	5691.52	(1) Fe ?		17565.1	$y^3F_3^\circ-e^3G_3$	100
1	5682.19	8	V	17594.0	$y^3F_3^\circ-e^1G_4$	124
1	5669.94	(3)		17632.0	$y^3D_1^\circ-f^3F_2$	113
⊙	5666.79	(−2)		17641.8	$y^3F_3^\circ-f^1D_2$	115
1	5664.02	3	V	17650.4	$y^1D_2^\circ-g^3F_3$	125
1	5649.68	2	V	17695.2	$y^3F_2^\circ-f^3F_3$	118
1	5643.10	(2)		17715.9	$z^1G_4^\circ-f^3F_3$	110
3	5642.62	(1)		17717.4	$z^1D_2^\circ-e^3P_2$	126
2	5641.80	(4)		17719.9	$y^3F_2^\circ-e^1F_3$	116
1	5641.11	(1)		17722.1	$y^3F_3^\circ-e^3F_2$	94
2	5638.82	(1)		17729.3	$z^1D_2^\circ-e^3P_1$	126
1	5637.12	2	V	17734.6	$z^1P_1^\circ-f^3D_1$	107
1	5628.35	(3)		17762.3	$z^1P_1^\circ-e^5F_1$	127
1	5625.28	4	V	17772.0	$z^1P_1^\circ-f^1D_2$	128
1	5614.78	5	V	17805.2	$y^3D_3^\circ-f^3F_3$	113
2	5607.05	(1)		17829.8	$z^1D_2^\circ-f^3D_3$	129
1	5600.13	(4)		17851.8	$z^1P_1^\circ-e^3F_2$	130
1	5593.71	4	III	17872.3	$z^1D_2^\circ-e^3F_3$	131
1	5592.25	8	II	17876.9	$a^3P_1-y^3F_2^\circ$	120
1	5592.15	(1)		17877.3	$y^3D_2^\circ-f^3F_2$	113
1	5589.32	2	IV?	17886.3	$z^1D_2^\circ-f^3D_2$	129
1	5587.85	5	I	17891.0	$a^3P_2-y^3D_3^\circ$	132
1	5578.71	5	I	17920.3	$b^1D_2-z^1D_2^\circ$	133
1	5553.69	2	IV?	18001.1	$a^3P_2-y^3F_2^\circ$	120
2	5537.11	(1)		18055.0	$z^1F_3^\circ-e^5F_4$	134
2	5521.44	(1)		18106.2	$z^3G_4^\circ-e^5F_4$	135
2	5514.8	(1)		18128.0	$z^1F_3^\circ-e^3P_2$	136
1	5509.99	4	IV?	18143.8	$z^1F_3^\circ-e^3G_4$	137
1	5504.13	(2)		18163.1	$z^3G_5^\circ-e^5F_4$	135
3	5499.4	(1)		18178.8	$z^3G_4^\circ-e^3G_5$	119
1	5494.90	2	V	18193.7	$y^3F_3^\circ-f^3F_3$	118
1	5483.38	(2)		18231.9		
1	5480.88	(2)		18240.2	$z^1F_3^\circ-f^3D_3$	138
1	5476.91	50	I	18253.4	$a^1S_0-z^1P_1^\circ$	139
3	5475.57	(1)		18257.9	$z^3D_1^\circ-e^3P_1$	140
1	5468.14	(2)		18282.7	$z^1F_3^\circ-e^3F_3$	141
1	5462.48	4	V	18301.6	$z^1F_3^\circ-e^3F_4$	141

TABLE V (*Continued*)

Source	I.A.	Int.	Temp. Class	ν (vac)	Designation	Multiplet
3	5453.30	(2)		18332.4	$y^3F_4^\circ - f^3F_3$	118
3	5452.80	(1)		18334.1	$z^3G_4^\circ - e^3F_3$	122
1	5435.87	5	II	18391.2	$a^3P_0 - y^3D_1^\circ$	132
3	5430.3	(1)		18410.1	$z^3G_5^\circ - e^3F_4$	122
3	5428.85	(1)		18415.0	$z^3D_1^\circ - f^3D_2$	142
1	5424.65	4	II	18429.3	$a^3P_1 - y^3D_2^\circ$ $(y^3F_2^\circ - f^3F_2)$	132 118
1	5411.20	4	V	18475.1	$z^1P_1^\circ - e^1S_0$	143
1	5392.37	(2)		18539.6	$y^3D_3^\circ - f^3F_2$	113
1	5388.37	(2)		18553.3	$a^3P_2 - y^3D_2^\circ$	132
6	5371.45	4	IV	18611.8	$y^1F_3^\circ - g^3F_3$	144
3	5353.42	3	II?	18674.5	$a^3P_1 - y^3D_1^\circ$	132
⊙	5351.84	(−2)		18680.0	$z^3G_3^\circ - f^3F_4$	145
3	5347.62	(1)		18694.7	$z^3F_2^\circ - e^3F_3$	146
⊙	5328.74	(−3)		18761.0	$z^3P_0^\circ - e^3S_1$	147
3	5281.68	(2)		18928.1	$y^3F_3^\circ - f^3F_2$	118
1	5268.35	2	V	18976.0	$y^1D_2^\circ - f^1F_3$	148
1	5265.72	(2)		18985.5	$z^3F_4^\circ - e^5F_5$	149
3	5259.55	(1)		19007.8	$z^5F_2^\circ - e^3P_1$	150
3	5248.99	(1)		19046.0	$z^3G_3^\circ - e^1F_3$	151
3	5248.39	(1)		19048.2	$z^3G_3^\circ - e^3F_2$	122
3	5245.61	(1)		19058.3	$z^1P_1^\circ - f^3F_2$	152
3	5243.77	(1)		19065.0	$z^3D_2^\circ - e^3S_1$	153
1	5235.38	2	V	19095.5	$z^1D_2^\circ - e^1P_1$?	154
6	5220.37	2	V	19150.5	$z^5F_2^\circ - e^3F_3$	155
1	5216.51	2	V	19164.6	$z^5F_2^\circ - f^3D_2$	156
1	5197.17	2	V	19235.9	$z^1D_2^\circ - e^3G_3$	157
6	5192.54	2	V	19253.1	$z^5F_3^\circ - e^5F_4$	158
3	5187.86	(1)		19270.4	$z^3D_3^\circ - e^3P_2$	140
3	5186.57	(2)		19275.2	$z^1D_2^\circ - f^3D_1$	129
1	5184.59	4	IV	19282.6	$z^3D_2^\circ - e^3P_1$	140
3	5179.13	(2)		19302.9	$z^1D_2^\circ - e^5F_1$	159
1	5176.56	5	V	19312.5	$z^1D_2^\circ - f^1D_2$	160
1	5168.66	6	III	19342.0	$z^5F_3^\circ - e^3G_4$	161
1	5158.01	(2)		19381.9	$z^5F_4^\circ - e^5F_5$	158
1	5155.76	9	V	19390.4	$z^1D_2^\circ - e^1F_3$	162
1	5155.16	4	V	19392.7	$z^1D_2^\circ - e^3F_2$	131
3	5148.65	(1)		19417.2	$z^3D_3^\circ - e^5F_4$	163
1	5146.48	12	V	19425.4	$z^3D_2^\circ - e^3F_3$	164
1	5142.77	10	V	19439.4	$z^3D_2^\circ - f^3D_2$ $(z^5F_3^\circ - f^3D_3)$	142 156
3	5139.26	3	V	19452.7	$z^3P_1^\circ - e^3S_1$	147
1	5137.10	8	I	19460.8	$b^1D_2 - z^1P_1^\circ$	165
1	5131.77	3	V	19481.0	$z^5F_3^\circ - e^3F_3$	155
1	5130.39	(2)		19486.3	$z^3G_4^\circ - f^3F_4$	145
1	5129.39	5	V	19490.1	$z^3D_3^\circ - e^3P_2$	140
3	5128.03	(1)		19495.3	$z^5F_3^\circ - f^3D_2$	156
1	5125.19	4	IV?	19506.1	$z^3D_3^\circ - e^3G_4$	166
1	5121.60	(3)		19519.7	$z^3G_3^\circ - f^3F_3$	145
1	5115.43	8	V	19543.3	$z^3G_5^\circ - f^3F_4$	145
1	5102.99	(4)		19590.9	$b^1D_2 - y^3F_3^\circ$	167
1	5099.98	10	V	19602.5	$z^3D_3^\circ - f^3D_3$	142
1	5099.36	5	V	19604.9	$z^3F_4^\circ - e^5F_4$	149
1	5096.89	2	V	19614.4	$z^5F_2^\circ - e^5F_3$	158
1	5094.42	(2)		19623.9	$z^3D_1^\circ - e^1P_1$	168
1	5088.97	(2)		19644.9	$z^3D_3^\circ - e^3F_3$	164
1	5088.55	(2)		19646.5	$z^1F_3^\circ - e^3G_3$	137
3	5085.45	(2)		19658.5	$z^3P_1^\circ - e^3P_2$	169
1	5084.07	15	III	19663.8	$z^3D_3^\circ - e^3F_4$	164
1	5082.38	(4)		19670.4	$z^3P_1^\circ - e^3P_1$	169
1	5081.12	25	III	19675.2	$z^1F_3^\circ - e^1G_4$	170
1	5080.53	30	III	19677.5	$z^3F_4^\circ - e^3G_5$	171
1	5079.98	(3)		19679.7	$a^1S_0 - y^3D_1^\circ$	172
3	5076.33	(2)		19693.8	$z^3F_4^\circ - e^3G_4$	171
3	5068.80	(2)		19723.1		
3	5067.82	(1)		19726.9	$z^3F_2^\circ - e^5F_2$	149
6	5058.04	(2)		19765.0	$z^3F_3^\circ - e^5F_4$	149
3	5053.27	(1)		19783.7	$z^3G_5^\circ - e^1G_4$	173
6	5051.56	(2U)		19790.4	$z^3F_4^\circ - f^3D_3$	174
1	5048.85	4	V	19801.0	$z^1F_3^\circ - e^1F_3$	175
1	5048.09	(1)		19804.0	$z^3D_1^\circ - f^3D_1$	142
1	5042.18	4	V	19827.2	$z^3P_1^\circ - f^3D_2$	176
3	5041.03	(2)		19831.7	$z^3D_1^\circ - e^5F_1$	163
1	5039.27	(2r)		19838.6	$z^3F_3^\circ - e^3P_2$	177

TABLE V (*Continued*)

Source	I.A.	Int.	Temp. Class	ν (vac)	Designation	Multiplet
1	5038.59	(4)		19841.3	$z^3D_1^\circ - f^1D_2$	178
1	5035.96	(3U)		19851.7	$z^3F_4^\circ - e^3F_4$	146
1	5035.36	12	III	19854.0	$z^3F_3^\circ - e^3G_4$	171
1	5032.77	(1u)		19864.3	$z^1D_2^\circ - f^3F_3$	179
3	5026.50	(1)		19889.0	$z^3D_2^\circ - e^5F_3$	163
1	5018.30	3	IV	19921.5	$z^3D_1^\circ - e^3F_2$	164
1	5017.61	10	III?	19924.3	$z^5F_5^\circ - e^5F_5$	158
1	5014.25	(1)		19937.6	$y^1F_3^\circ - f^1F_3$	180
1	5012.47	2	III	19944.7	$z^5F_3^\circ - e^5F_3$	158
1	5010.97	(3u)		19950.7	$z^3F_3^\circ - f^3D_3$	174
1	5010.05	(2)		19954.3	$z^5F_1^\circ - e^5F_2$	158
1	5003.75	(2)		19979.5	$b^1D_2 - y^3D_3^\circ$	181
1	5000.34	4	III	19993.1	$z^3F_3^\circ - e^3F_3$	146
1	4998.25	2	III	20001.4	$z^5F_4^\circ - e^5F_4$	158
1	4996.85	(2u)		20007.0	$z^3F_3^\circ - f^3D_2$	174
⊙	4995.66	(−1)		20011.8	$z^3F_3^\circ - e^3F_4$	146
1	4984.12	10	III	20058.1	$z^3F_2^\circ - e^3G_3$	171
1	4980.17	12	III	20074.1	$z^5F_4^\circ - e^3G_5$	161
⊙	4976.70	(−2)		20088.1	$y^3D_2^\circ - g^3F_3$	182
1	4976.34	(2)		20089.5	$b^1D_2 - y^3F_2^\circ$	167
1	4976.14	(1u)		20090.3	$z^5F_4^\circ - e^3G_4$	161
1	4971.34	2	V	20109.7	$y^1D_2^\circ - f^3P_2$?	183
1	4967.55	(1)		20125.1	$z^3F_2^\circ - e^5F_1$	149
3	4965.14	(1)		20134.8	$z^3F_2^\circ - f^1D_2$	184
1	4953.23	3	V?	20183.2	$z^5F_2^\circ - e^5F_2$	158
1	4952.33	(1u)		20186.9	$z^5F_4^\circ - f^3D_3$	156
1	4946.03	(3)		20212.6	$z^3F_2^\circ - e^1F_3$	185
1	4945.47	2	IV	20214.9	$z^3F_2^\circ - e^3F_2$	146
⊙	4941.91	(−3)		20229.5	$z^5F_4^\circ - e^3F_3$	155
1	4937.33	4	III	20248.2	$z^5F_4^\circ - e^3F_4$	155
1	4935.85	4	IV	20254.3	$z^3G_3^\circ - f^3F_2$	145
1	4934.01	(2u)		20261.9		
1	4930.82	(1)		20275.0	$z^1F_3^\circ - f^3F_3$	186
1	4925.58	2	III	20296.5	$z^3F_4^\circ - e^5F_3$	149
6	4918.69	(2)		20325.0	$z^5F_1^\circ - f^3D_1$	156
1	4918.37	4	III	20326.3	$z^3G_4^\circ - f^3F_3$	145
1	4913.96	3	III	20344.5	$z^3P_0^\circ - e^1P_1$	187
1	4912.03	2	V	20352.5	$z^5F_1^\circ - e^5F_1$	158
1	4904.40	10	III	20384.2	$z^3P_2^\circ - e^3S_1$	147
3	4900.97	(1)		20398.5	$z^5G_4^\circ - e^5F_5$	188
⊙	4890.44	(−3)		20442.4	$z^5F_1^\circ - e^3F_2$	155
1	4887.00	(3)		20456.8	$z^3F_3^\circ - e^5F_3$	149
⊙	4886.72	(−2)		20457.9	$z^3D_2^\circ - e^5F_2$	163
1	4874.80	(2)		20508.0	$z^5G_3^\circ - e^5F_4$	188
1	4873.45	4	III	20513.6	$z^5F_3^\circ - e^5F_2$	158
⊙	4873.26	(0)		20514.4	$z^5F_2^\circ - e^3G_3$	161
1	4870.84	2	V	20524.6	$z^3P_0^\circ - f^3D_1$	176
1	4866.28	10	III	20543.9	$z^5F_5^\circ - e^5F_4$ $(y^1F_3^\circ - f^1G_4)$	158
1	4864.29	(2u)		20552.3	$z^3P_0^\circ - e^5F_1$	189
1	4863.91	(2u)		20553.9	$z^5F_2^\circ - f^3D_1$	156
1	4857.39	2	IV	20581.5	$z^5F_2^\circ - e^5F_1$	158
1	4855.42	15	III	20589.8	$z^3P_2 - e^3P_2$	169
3	4853.74	(1)		20596.9	$z^5G_3^\circ - e^3G_4$	190
1	4852.57	(2u)		20601.9	$z^3P_2^\circ - e^3P_1$	169
3	4845.17	(1)		20633.4	$z^5F_3^\circ - f^3F_4$	191
⊙	4843.51	(−1)		20640.4	$y^3F_2^\circ - g^3F_3$	192
1	4843.16	(2)		20641.9	$b^1D_2 - y^3D_2^\circ$	181
3	4842.01	(1)		20646.8	$z^1G_4^\circ - g^3F_4$	193
⊙	4841.68	(−3)		20648.2	$z^3D_2^\circ - e^1P_1$	168
1	4838.67	(4)		20661.1	$z^1G_4^\circ - g^3F_3$	193
1	4838.53	2	V	20661.7		
3	4836.27	(1)		20671.3	$z^5F_2^\circ - e^3F_2$	155
1	4832.70	2	V	20686.6	$z^3F_2^\circ - f^3F_3$	194
1	4831.19	10	III	20693.1	$z^5F_4^\circ - e^5F_3$ $(z^5G_3^\circ - f^3D_3)$	158 195
1	4829.04	15	III	20702.3	$z^3P_2^\circ - f^3D_3$	176
1	4824.52	(1)		20721.7	$z^1P_1^\circ - g^3D_1$	196
1	4821.14	(2)		20736.2	$y^3D_3^\circ - g^3F_4$	182
1	4817.83	(2)		20750.5	$y^3D_3^\circ - g^3F_3$	182
3	4815.92	(1)		20758.7	$z^3P_2^\circ - f^3D_2$	176
6	4814.59	(2)		20764.4	$z^5G_2^\circ - e^5F_3$	188
1	4812.95	(2)		20771.5	$z^1P_1^\circ - g^1D_2$	197
6	4811.97	(2)		20775.7	$z^3P_1^\circ - e^3P_0$	169

TABLE V (*Continued*)

Source	I.A.	Int.	Temp. Class	ν (vac)	Designation	Multiplet
6	4808.87	(2)		20789.1	$z^3D_2^\circ - e^3G_3$	166
3	4808.52	(1)		20790.6	$z^5F_5^\circ - e^3F_4$	155
1	4806.99	4	III	20797.2	$z^3D_3^\circ - f^3F_4$	198
3	4799.83	1	III	20828.3	$z^3D_2^\circ - f^3D_1$	142
3	4799.47	(1)		20829.8	$z^1D_2^\circ - g^3D_2$	199
3	4795.84	(1)		20845.6	$z^3P_1^\circ - e^5F_2$	189
3	4793.47	(1)		20855.9	$z^3D_2^\circ - e^5F_1$	163
6	4792.80	(2)		20858.8		
3	4790.99	(1)		20866.7	$a^3P_1 - y^1D_2^\circ$	200
1	4786.54	15	II	20886.1	$z^5G_5^\circ - e^5F_5$	188
1	4786.28	(2)		20887.2	$b^1D_2 - y^3D_1^\circ$	181
6	4773.36	(2)		20943.8	$z^3D_2^\circ - e^1F_3$	201
3	4772.89	(1)		20945.8	$z^3D_2^\circ - e^3F_2$	164
1	4763.95	4	III	20985.1	$z^3F_4^\circ - f^3F_4$	194
1	4762.63	3	II A	20991.0	$a^3P_2 - y^1D_2^\circ$	200
3	4758.42	(1)		21009.5	$z^1F_3^\circ - f^3F_2$	186
6	4756.52	10	III	21017.9	$z^5G_4^\circ - e^5F_4$	188
1	4754.78	3	V	21025.6	$z^3F_3^\circ - e^5F_2$	149
1	4752.41	4	III	21036.1	$z^3P_1^\circ - e^1P_1$	187
1	4752.11	(3)		21037.4	$z^3D_3^\circ - e^1G_4$	202
⊙	4741.36	(−3)		21085.1	$z^3D_3^\circ - f^1D_2$	178
3	4740.13	(2)		21090.6	$z^5G_4^\circ - e^3G_5$	190
3	4736.50	(1)		21106.8	$z^5G_4^\circ - e^3G_4$	190
1	4732.47	3	V	21124.7	$y^3F_3^\circ - g^3F_4$	192
1	4731.80	3	IV?	21127.7	$z^3D_1^\circ - f^3F_2$	198
6	4729.32	(2)		21138.8	$y^3F_3 - g^3F_3$	192
3	4728.42	(1)		21142.8	$z^5F_2^\circ - f^3F_3$	191
3	4727.84	(2)		21145.4	$z^3F_3^\circ - f^3F_4$	194
1	4727.46	(2)		21147.1		
3	4723.82	(1)		21163.4	$z^3D_3^\circ - e^1F_3$	201
⊙	4723.35	(−2)		21165.5	$z^3D_3^\circ - e^3F_2$	164
1	4715.76	8	II	21199.6	$z^5G_3^\circ - e^5F_3$	188
1	4714.42	25	II	21205.6	$z^5G_6^\circ - e^5F_5$	188
1	4712.06	(2)		21216.2	$z^3P_1^\circ - f^3D_1$	176
3	4705.93	(1)		21243.9	$z^3P_1^\circ - e^5F_1$	189
3	4705.51	(1)		21245.8	$z^5G_4^\circ - e^3F_3$	203
1	4703.79	4	V	21253.5	$z^3P_1^\circ - f^1D_2$	204
1	4701.54	3	V	21263.7	$y^3F_4^\circ - g^3F_4$	192
6	4701.35	(2)		21264.6	$z^5G_4^\circ - e^3F_4$	203
3	4698.43	(2)		21277.8	$y^3F_4^\circ - g^3F_3$	192
1	4686.21	5	III	21333.3	$z^5G_2^\circ - e^5F_2$	188
⊙	4681.05	(−?)		21356.8	$z^3F_3^\circ - e^3G_3$	171
6	4675.63	(2)		21381.5	$z^5F_4^\circ - f^3F_4$	191
3	4674.73	(2)		21385.6		
3	4668.63	(1)		21413.6	$y^3D_2^\circ - f^1F_3$	205
1	4667.76	3	V	21417.6	$z^3D_2^\circ - f^3F_3$	198
1	4666.99	2	III?	21421.1	$z^3F_2^\circ - f^3F_2$	194
⊙	4664.33	(−1N)		21433.3	$z^3F_3^\circ - f^1D_2$	184
3	4657.38	(1)		21465.3	$y^3D_1^\circ - g^3F_2$	182
6	4655.68	(2)		21473.2	$z^5F_5^\circ - f^3F_3$	191
1	4648.66	15	III	21505.6	$z^5G_5^\circ - e^5F_4$	188
3	4647.36	(1)		21511.6	$z^3F_3^\circ - e^1F_3$	185
⊙	4646.97	(−2N)		21513.4	$z^3F_3^\circ - e^3F_2$	146
⊙	4629.95	(−2d?)		21592.5	$z^1P_1^\circ - f^3S_1$	206
3	4620.38	(1)		21637.2	$z^3D_3^\circ - f^3F_3$	198
3	4617.94	(1)		21648.6	$z^5F_1^\circ - f^3F_2$	191
3	4614.58	(1)		21664.4	$z^5G_2^\circ - e^3G_3$	190
1	4606.22	3	V	21703.7	$z^5G_2^\circ - f^3D_1$	195
1	4604.99	12	III	21709.5	$z^5G_4^\circ - e^5F_3$	188
1	4600.36	6	V	21731.4	$z^5G_2^\circ - e^5F_1$	188
1	4595.93	(4v)		21752.3	$z^5G_5^\circ - e^3F_4$	203
1	4594.90	(5u)		21757.2		
1	4592.53	10	III	21768.4	$z^5G_3^\circ - e^5F_2$	188
1	4580.61	(3)		21825.1	$z^3F_4^\circ - f^3F_3$	194
3	4574.03	(1)		21856.5	$z^5D_2^\circ - f^3D_3$	207
1	4567.42	(1)		21888.1	$z^5G_3^\circ - f^3F_4$	208
⊙	4565.13	(−1N)		21899.1	$z^5D_2^\circ - e^3F_3$	209
1	4559.94	(3)		21924.0	$z^5F_5^\circ - f^3F_4$	191
1	4553.16	(3)		21956.6	$z^3P_1^\circ - e^1S_0$	210
1	4551.23	(3)		21966.0	$y^3F_2^\circ - f^1F_3$	211
1	4547.23	3	V	21985.3	$z^3F_3^\circ - f^3F_3$	194
1	4546.94	5	III	21986.7	$z^1G_4^\circ - f^1F_3$	212
⊙	4523.75	(−2N)		22099.4	$z^5G_3^\circ - e^3G_3$	190
1	4521.92	(1)		22108.3	$z^5F_2^\circ - g^3D_2$	213

TABLE V (*Continued*)

Source	I.A.	Int.	Temp. Class	ν (vac)	Designation	Multiplet
1	4519.99	4	II	22117.8	$b^1D_2-y^1F_3^\circ$	214
3	4517.81	(1)		22128.4	$z^5G_3^\circ-e^1G_4$	215
⊙	4513.91	(−2)		22147.6	$z^3P_2^\circ-f^3D_1$	176
1	4513.01	(3)		22152.0	$z^3D_2^\circ-f^3F_2$	198
1	4506.30	(1)		22185.0	$z^3P_2^\circ-f^1D_2$	204
1	4501.69	(1)		22207.7	$z^5F_3^\circ-f^3F_2$	191
3	4492.34	(1)		22253.9	$z^5G_3^\circ-e^1F_3$	216
1	4490.53	(3)		22262.9	$z^3P_2^\circ-e^1F_3$ $y^3F_2^\circ-g^3F_2$	217 192
3	4484.54	(1)		22292.6	$z^5G_2^\circ-f^3F_3$	208
3	4481.23	(2u)		22309.1	$z^3D_2^\circ-g^3D_3$	218
1	4480.58	(3)		22312.3	$z^1D_2^\circ-g^1D_2$	219
1	4470.49	15	III	22362.7	$z^5D_2^\circ-e^5F_3$	220
1	4467.94	(2)		22375.4		
1	4466.90	(2)		22380.6		
1	4466.40	(3)		22383.1	$z^3D_2^\circ-g^3D_2$	218
1	4463.42	(3)		22398.1	$z^5G_4^\circ-f^3F_4$	208
1	4462.46	10	III	22402.9	$z^5D_1^\circ-e^5F_2$	220
1	4459.05	20	III	22420.0	$z^5D_2^\circ-e^5F_4$	220
6	4450.28	(2)		22464.2	$y^3F_3^\circ-f^1F_3$	211
6	4450.13	(2)		22465.0	$z^3G_3^\circ-g^3F_3$	221
1	4442.43	(4)		22503.9	$z^5D_0^\circ-f^3D_1$	207
6	4441.48	(2)		22508.7	$z^5D_3^\circ-e^3G_4$	222
1	4437.58	2	V	22528.5	$z^3D_3^\circ-g^3D_3$	218
1	4436.98	5	V	22531.6	$z^5D_0^\circ-e^5F_1$	220
3	4435.34	(1)		22539.9	$z^3P_1^\circ-f^3F_2$	223
3	4424.84	(1)		22593.4	$z^1G_4^\circ-f^1G_4$	224
1	4423.00	(3)		22602.8	$z^3D_3^\circ-g^3D_2$	218
1	4410.50	4	III	22666.8	$z^5D_3^\circ-e^3F_4$	209
1	4401.55	30	III	22712.9	$z^5D_4^\circ-e^5F_5$	220
1	4400.87	3	V	22716.4	$z^3F_4^\circ-g^3D_3$	225
3	4400.26	(1)		22719.6	$z^3F_3^\circ-f^3F_2$	194
1	4399.61	3	V	22722.9	$z^1F_3^\circ-g^1D_2$	226
1	4398.63	3	V	22728.0	$z^5G_3^\circ-f^3F_3$	208
3	4396.89	(1)		22737.0	$z^3P_2^\circ-f^3F_3$	223
1	4390.33	(2u)		22771.0	$z^3P_1^\circ-g^3D_2$	227
1	4389.86	3	V	22773.4	$z^5D_1^\circ-f^3D_1$	207
1	4386.47	(2u)		22791.0	$z^5D_1^\circ-g^3D_1$	218
1	4384.54	5	V	22801.0	$z^5D_1^\circ-e^5F_1$	220
1	4382.90	(1)		22809.6	$z^1D_2^\circ-g^3F_3$	228
3	4375.88	(2)		22846.2		
1	4370.05	(3)		22876.6	$z^3F_3^\circ-g^3D_3$	225
1	4368.31	2	IV	22885.7	$z^5G_5^\circ-f^3F_4$	208
3‡	4367.3	(1)		22891.0	$z^5D_1^\circ-e^3F_2$	209
1	4359.59	10	V	22931.5	$z^5D_2^\circ-e^5F_2$	220
3‡	4357.8	(1)		22940.9	$y^3D_2^\circ-i^3D_3$	229
1	4355.91	3	II A	22950.9	$z^3F_3^\circ-g^3D_2$	225
1	4331.64	12	II	23079.5	$b^1D_2-y^1D_2^\circ$	230
1	4330.72	2	V	23084.4	$z^3F_2^\circ-g^3D_1$	225
1	4325.61	6	V	23111.7	$z^5D_3^\circ-e^5F_3$	220
1	4325.37	2	V	23112.9	$z^5F_4^\circ-g^3D_3$	213
1	4307.28	(3)		23210.0	$y^3D_3^\circ-f^3P_2$	231
6	4298.78	(2)		23255.9	$a^1D_2-z^5D_3^\circ$	232
1	4298.52	(3)		23257.3	$z^3G_4^\circ-g^3F_4$	221
6	4296.99	(2)		23265.6	$y^3D_3^\circ-i^3F_4$	233
1	4295.90	8	V	23271.5	$z^3G_4^\circ-g^3F_3$	221
1	4288.01	15	V	23314.3	$z^3G_5^\circ-g^3F_4$	221
⊙	4285.21	(−1)		23329.5	$z^5D_2^\circ-e^5F_1$	220
1	4284.68	6	V	23332.4	$z^5D_4^\circ-e^5F_4$	220
⊙	4271.39	(0)		23405.0	$z^5D_4^\circ-e^3G_5$	222
6	4252.10	(2)		23511.2	$z^3P_0^\circ-g^3D_1$	227
1	4236.38	(2)		23598.4	$y^3F_3^\circ-f^3P_2$	234
⊙	4235.52	(−2)		23603.2	$y^3D_3^\circ-i^3D_3$	229
3¶	4235.29	(1)		23604.4	$y^3D_2^\circ-f^3P_1$	231
1	4231.05	5	V	23628.2	$z^3P_2^\circ-g^3D_3$	227
6	4221.71	(2)		23680.4	$z^5D_3^\circ-e^5F_2$	220
1	4202.15	(2)		23790.7	$z^3G_3^\circ-f^1F_3$	235
1	4201.73	5	I	23793.0	$y^3F_4^\circ-i^3F_4$	236
1	4200.47	5	I	23800.2	$z^5D_3^\circ-f^3F_4$	237
1	4199.64	(1)		23804.9	$y^3D_2^\circ-i^3F_3$	233
1	4195.53	4	V	23828.2	$y^3F_4^\circ-g^3G_5$	238
1	4184.47	(4)		23891.2	$z^5D_2^\circ-f^3F_3$	237
1	4166.96	(3u)		23991.6	$y^3F_3^\circ-i^3D_3$	239
1	4164.64	1	II A	24004.9	$a^1D_2-z^5D_2^\circ$	232

TABLE V (*Continued*)

Source	I.A.	Int.	Temp. Class	ν (vac)	Designation	Multiplet
⊙	4161.31	(−2)		24024.1	$z^5D_4^\circ - e^5F_5$	220
⊙	4158.54	(−1)		24040.2	$y^3D_1^\circ - f^3P_0$	231
1	4150.37	(2u)		24087.5	$z^3G_3^\circ - g^3F_2$	221
6	4142.97	(2)		24130.5	$y^3F_4^\circ - i^3D_3$	239
6	4142.32	(4)		24134.3		
6	4142.19	(2)		24135.0	$z^1D_2^\circ - f^1F_3$	240
6	4138.52	(2)		24156.4	$y^3F_2^\circ - f^3P_1$	234
1	4123.79	(2)		24242.7		
1	4115.98	(3)		24288.7	$y^3D_3^\circ - g^3G_4$	241
6	4104.22	(2)		24358.3		
⊙	4102.76	(−1N)		24367.0	$y^3D_2^\circ - g^3G_3$	241
6	4086.15	(2)		24466.0		
6	4075.60	(3u)		24529.4		
1	4074.90	2	II A	24533.6	$a^1D_2 - z^5D_1^\circ$	232
6	4072.93	(2)		24545.4	$z^1F_3^\circ - f^1F_3$	242
6	4069.24	(2)		24567.7		
1	4064.38	2	V	24597.1	$z^3G_4^\circ - f^1F_3$	235
6	4057.30	(2)		24640.0	$z^5D_3^\circ - f^3F_3$	237
⊙	4051.19	(−1d?)		24677.2	$y^3F_3^\circ - g^3G_4$	238
6	4046.76	(2)		24704.2	$y^3F_4^\circ - e^3H_5$	243
⊙	4038.28	(0)		24756.1	$z^3F_4^\circ - g^3F_4$	244
1	4027.64	(1U)		24821.4	$z^1D_2^\circ - g^1F_3$	245
1	4025.44	(1U)		24835.0	$z^5F_3^\circ - f^3G_4$	246
6	4025.11	(3)		24837.1	$y^3F_4^\circ - f^5F_4$	247
1	4023.99	(W)		24844.0	$z^3D_2^\circ - h^3D_2$?	248
6	4022.05	(2)		24855.9	$y^3F_3^\circ - i^3F_3$ $y^3F_4^\circ - e^5G_5$	236 249
1	4019.06	(3)		24874.4	$a^3P_2 - 2_2^\circ$	
1	4017.56	6n	V	24883.7	$z^3D_2^\circ - h^3F_3$	250
6	4009.99	(3)		24930.7	$z^3F_3^\circ - g^3F_3$	244
1	4006.14	3	V	24954.7		
1	3993.97	3n	V	25030.7	$z^3D_3^\circ - h^3D_3$	248
1	3987.09	(2)		25073.9	$z^3P_1^\circ - f^3S_1$	251
1	3986.82	(2)		25075.6		
1	3984.17	8n	V	25092.3	$z^3D_3^\circ - h^3F_4$	250
1	3974.68	10n	V	25152.2	$z^1F_3^\circ - f^1G_4$	252
1	3973.55	25	II	25159.3	$a^1D_2 - z^3P_2^\circ$	253
1	3972.16	10	I	25168.1	$a^1D_2 - z^5G_3^\circ$	254
1	3970.49	10n	V	25178.7	$z^3F_4^\circ - f^3G_5$	255
1	3962.10	3n	V	25232.0	$z^1F_3^\circ - g^1F_3$	256
1	3954.53	(W)		25280.3	$z^3F_4^\circ - h^3F_4$	257
1	3944.10	12n	V	25347.2	$z^3F_3^\circ - f^3G_4$	255
3	3941.86	(1)		25361.6	$z^3D_1^\circ - h^3F_2$	250
⊙	3938.74	(−1)		25381.7	$y^3F_2^\circ - f^5F_2$	247
⊙	3924.18	(1)		25475.8	$y^3F_3^\circ - f^5F_3$	247
6	3914.51	(2)		25538.8		
1	3912.98	5	I	25548.8	$a^3D_3 - z^5D_4^\circ$	258
1	3912.31	8n	V	25553.1	$z^3F_2^\circ - f^3G_3$	255
1	3908.93	8n	V	25575.2	$z^5F_4^\circ - f^3G_5$	246
⊙	3904.63	(0)		25603.4	$a^1D_2 - z^5G_2^\circ$	254
1	3889.67	15	II	25701.9	$a^3D_1 - z^5D_2^\circ$ $(z^3G_5^\circ - e^3H_6)$	258 259
⊙	3885.87	(0)		25727.0	$a^3F_2 - z^5D_1^\circ$	260
6	3871.60	(3)		25821.8	$z^3G_4^\circ - g^3G_5$	261
6	3863.08	(5)		25878.8	$z^3G_5^\circ - g^3G_5$	261
1	3858.28	40r	II	25911.0	$a^1D_2 - z^3F_3^\circ$	262
6	3844.58	(3)		26003.3	$z^3G_3^\circ - g^3G_4$	261
6	3844.27	(3U)		26005.4	$z^3P_2^\circ - f^3S_1$	251
1	3832.87	5	I	26082.7	$a^3F_3 - z^5D_2^\circ$	260
1	3831.69	20	II	26090.8	$a^1D_2 - z^3P_1^\circ$	253
6	3811.32	(2)		26230.2	$a^3D_1 - z^5D_1^\circ$	258
1	3807.14	35r	II	26259.0	$a^1D_2 - z^3D_3^\circ$	263
1	3793.60	8	I	26352.7	$a^3F_2 - z^3P_2^\circ$	264
1	3792.33	5	I	26361.6	$a^3F_2 - z^5G_3^\circ$ $(z^5D_0^\circ - f^3S_1)$	265
1	3790.21	(2)		26376.3		
1	3783.52	30r	II	26422.9	$a^1D_2 - z^5F_3^\circ$	266
1	3778.05	5	I	26461.2	$a^3D_3 - z^5D_3^\circ$	258
1	3775.56	30r	II	26478.6	$a^1D_2 - z^3D_2^\circ$	263
1	3772.52	6	I	26500.0	$a^3D_1 - z^5D_0^\circ$	258
1	3762.62	(3)		26569.7		
1	3749.04	8	I	26665.9	$a^3F_3 - z^5D_3^\circ$	260
1	3744.56	5	V	26697.9	$z^3G_4^\circ - e^3H_5$	259
1	3739.79	3n	V	26731.9	$z^3G_3^\circ - e^3H_4$	259

TABLE V (*Continued*)

Source	I.A.	Int.	Temp. Class	ν (vac)	Designation	Multiplet
1	3729.23	10	I	26735.9	$a^3F_3-z^5G_4^\circ$	265
1	3736.81	15	II	26753.2	$a^1D_2-z^5F_2^\circ$	266
1	3730.75	4	I	26796.7	$a^3F_2-z^5G_2^\circ$	265
1	3728.92	(2)		26809.8	$z^3G_4^\circ-g^3G_4$	261
1	3724.82	4	V	26839.3	$z^3G_5^\circ-e^5H_6$	267
⊙	3724.26	(−2)		26843.4	$z^3G_3^\circ-e^5G_3$	268
⊙	3723.39	(−1)		26849.6	$z^3G_4^\circ-e^5G_5$	268
1	3722.48	15	II	26856.2	$a^3D_1-z^3P_2^\circ$	269
1	3715.50	2	V	26906.7	$z^3G_5^\circ-e^5G_5$	268
1	3713.70	1	IV	26919.7	$a^3P_1-y^3P_2^\circ$	270
1	3713.34	(2)		26922.3	$a^3P_1-y^3P_1^\circ$	270
⊙	3705.11	(−2)		26982.1	$a^1D_2-z^5F_1^\circ$	266
1	3696.90	3	V	27042.0	$z^3D_3^\circ-f^3P_2$	271
⊙	3696.66	(0)		27043.8	$a^3P_2-y^3P_2^\circ$	270
⊙	3696.30	(0)		27046.4	$a^3P_2-y^3P_1^\circ$	270
1	3693.93	8	I	27063.8	$a^3D_2-z^5D_1^\circ$	258
1	3689.31	2	V	27097.7	$z^3D_3^\circ-i^3F_4$	272
1	3688.41	15	II	27104.3	$a^3F_2-z^3F_3^\circ$	273
6	3683.51	(2)		27140.3		
1	3674.11	10 / 15	I / II	27209.8	$a^3D_3-z^5D_2^\circ$ / $a^1D_2-z^3F_2^\circ$	258 / 262
1	3670.42	20	II	27237.1	$a^3F_3-z^3P_2^\circ$	264
1	3669.23	12	II	27245.9	$a^3F_3-z^5G_3^\circ$	265
1	3668.20	3	V	27253.6	$z^3G_3^\circ-e^5H_4$	267
1	3665.92	2	III	27270.5		
1	3664.09	20	II	27284.2	$a^3F_2-z^3P_1^\circ$	264
1	3661.94	8	I	27300.2	$a^3D_1-z^5G_2^\circ$	274
1	3657.70	2	V	27331.8	$z^3G_3^\circ-e^5G_2$	268
1	3656.53	(1)		27340.6	$z^3F_4^\circ-e^5P_3$	275
⊙	3651.66	(1)		27377.0	$z^3F_4^\circ-e^5D_4$	276
3	3647.71	2	II	27406.7		
1	3643.94	2n	V	27435.0	$z^3D_3^\circ-i^3D_3$	277
1	3642.38	2	V	27446.8	$a^3P_0-y^1P_1^\circ$	278
1	3641.63	4	I	27452.4	$a^3F_2-z^3D_3^\circ$	279
1	3634.94	12	I	27503.0	$a^1D_2-z^3D_1^\circ$	263
⊙	3630.24	(0)		27538.6	$z^3G_4^\circ-e^3H_4$	259
1	3629.89	5	V	27540.5	$z^3G_4^\circ-e^5H_5$	267
1	3624.73	15	II	27580.4	$a^3F_4-z^5G_5^\circ$ / $(z^5F_2^\circ-e^5D_3)$	265 / 280
1	3619.39	150R	II	27621.1	$a^1D_2-z^1F_3^\circ$	281
1	3612.73	30R	II	27672.0	$a^3F_2-z^3D_2^\circ$	279
⊙	3611.56	(−1)		27681.0	$a^3F_3-z^5G_2^\circ$	265
1	3611.42	(1)		27682.1	$z^5F_4^\circ-i^3F_4$	282
1	3610.45	60R	II	27689.5	$a^3D_2-z^3P_2^\circ$	269
1	3609.31	15	II	27698.3	$a^3D_2-z^5G_3^\circ$ / $(z^3D_2^\circ-e^5P_2)$	274
1	3606.85	4	V	27717.1	$z^3D_1^\circ-i^3F_2$ / $z^5F_4^\circ-g^3G_5$	272 / 283
3	3604.27	1	III A	27737.0	$z^5F_4^\circ-e^5P_3$	284
1	3602.28	15	II	27752.3	$a^3F_3-z^5F_4^\circ$	285
1	3599.53	(1)		27773.5	$z^5F_4^\circ-e^5D_4$	280
1	3597.70	50R	II	27787.6	$a^3D_1-z^3P_1^\circ$	269
1	3587.93	12	II	27863.3	$a^3D_3-z^5G_4^\circ$	274
1	3585.15	(2)		27884.9		
6	3577.23	2	IA	27946.6	$a^3F_2-z^5F_2^\circ$	285
3	3575.94	2	V	27956.7	$z^5F_3^\circ-g^3G_4$	283
⊙	3573.28	(−3)		27977.5	$z^5F_3^\circ-f^5F_4$	286
1	3571.87	50R	II	27988.6	$a^3F_3-z^3F_3^\circ$	273
1	3566.37	100R	II	28031.7	$a^1D_2-z^1D_2^\circ$	287
⊙	3564.68	(−2)		28045.0	$a^3P_2-x^3F_3^\circ$	288
1	3561.75	10	II	28068.1	$a^3F_4-z^5G_4^\circ$	265
1	3559.93	2	V	28082.5	$z^5F_5^\circ-e^3H_6$	289
1	3553.48	7	I	28133.4	$a^3D_2-z^5G_2^\circ$ / $(z^5F_1^\circ-e^5P_1)$	274 / 284
1	3551.54	8	I	28148.8	$a^3F_3-z^3F_4^\circ$	273
1	3548.19	20r	II	28175.4	$a^3F_2-z^5F_1^\circ$ / $a^3D_1-z^3D_2^\circ$	285 / 290
3	3545.16	(1)		28199.5	$a^3P_1-x^1D_2^\circ$	291
3	3542.00	(1)		28224.6	$z^5F_5^\circ-i^3F_4$	282
1	3537.63	(1)		28259.5	$z^5F_5^\circ-g^3G_5$	283
1	3537.24	(1)		28262.6	$z^3F_4^\circ-e^5D_3$	276
1	3530.59	4	III	28315.8	$z^5F_5^\circ-e^5D_4$	280
1	3529.63	(1)		28323.5	$a^3P_2-x^1D_2^\circ$	291
1	3528.89	(3)		28329.5	$z^3F_4^\circ-f^5F_4$	292

TABLE V (*Continued*)

Source	I.A.	Int.	Temp. Class	ν (vac)	Designation	Multiplet
1	3528.62	3	V	28331.6	$y^3D_3^\circ - j^3F_4$	293
1	3527.99	15	II	28336.7	$a^3F_3 - z^3D_3^\circ$	279
3	3526.53	3	V	28348.4	$z^3F_4^\circ - e^5G_5$	294
1	3524.54	200R	II	28364.4	$a^3D_3 - z^3P_2^\circ$	269
1	3523.45	10	II	28373.2	$a^3D_3 - z^5G_3^\circ$	274
					$(z^3F_2^\circ - f^5F_2)$	292
1	3523.08	4	I	28376.2	$a^1D_2 - z^3G_3^\circ$	295
1	3519.78	20R	II	28402.8	$a^3F_2 - z^3F_2^\circ$	273
1	3518.64	8	III	28412.0	$z^5F_5^\circ - e^5G_6$	296
⊙	3517.03	(−3)		28425.0	$z^5F_2^\circ - f^5F_3$	286
1	3516.22	8	III	28431.5	$z^5F_5^\circ - f^5F_5$	286
1	3515.06	150R	II	28440.9	$a^3D_2 - z^3F_3^\circ$	297
1	3513.95	15	II	28449.9	$a^3D_1 - z^5F_2^\circ$	298
1	3513.48	(2)		28453.7		
3	3511.94	(1)		28466.2	$z^5F_2^\circ - e^5G_3$	296
1	3511.61	2	III	28468.9	$z^3F_3^\circ - g^3G_4$?	299
1	3510.34	80R	II	28479.2	$a^3D_1 - z^3P_0^\circ$	269
1	3507.70	8	I	28500.6	$a^3F_3 - z^5F_3^\circ$	285
1	3502.60	8	I	28542.1	$a^3F_4 - z^5F_5^\circ$	285
1	3500.85	25R	II	28556.4	$a^3F_3 - z^3D_2^\circ$	279
1	3496.35	5	V	28593.1	$z^5F_4^\circ - e^3H_5$	289
1	3494.70	(1)		28606.6	$z^3F_2^\circ - f^5F_1$	292
1	3492.97	150R	II	28620.8	$a^3D_2 - z^3P_1^\circ$	269
1	3488.29	2	V	28659.2	$z^5F_4^\circ - e^5D_3$	280
1	3485.89	10	II	28678.9	$a^3D_1 - z^5F_1^\circ$	298
1	3485.11	2n	V	28685.3	$z^5F_3^\circ - e^3H_4$	289
1	3483.78	25R	II	28696.3	$a^3F_2 - z^3D_1^\circ$	279
⊙	3483.63	(−2)		28697.5	$z^5F_3^\circ - g^3G_3$	283
3	3482.73	(1)		28704.9	$z^5F_4^\circ - g^3G_4$	283
1	3480.17	4	V	28726.0	$z^5F_4^\circ - f^5F_4$	286
					$z^5F_1^\circ - e^5G_2$	296
1	3479.26	3	V	28733.6	$z^5G_4^\circ - g^3G_5$	300
1	3478.30	3	IV	28741.5	$z^3D_2^\circ - i^3F_2$	272
1	3477.88	2	V	28745.0	$z^5F_4^\circ - e^5G_5$	296
3	3476.66	2n	V	28755.0	$z^5F_3^\circ - f^5F_3$	286
1	3472.55	70R	II	28789.1	$a^3D_2 - z^3D_3^\circ$	290
⊙	3471.62	(−2)		28796.8	$z^5F_3^\circ - e^5G_3$	296
1	3469.48	15	II	28814.5	$a^3F_2 - z^1F_3^\circ$	301
1	3467.73	4	V	28829.1	$z^5F_2^\circ - f^5F_2$	286
1	3467.51	12	II	28830.9	$a^3F_3 - z^5F_2^\circ$	285
3	3467.12	(1)		28834.2	$z^5F_1^\circ - f^5F_1$	286
3	3464.12	(1)		28859.1	$y^3F_4^\circ - j^3F_4$	302
6	3462.82	(2?)		28870.0	$y^3F_4^\circ - h^3G_5$	303
1	3461.66	125R	II	28879.6	$a^3D_3 - z^5F_4^\circ$	298
1	3458.47	125R	II	28906.3	$a^3D_1 - z^3F_2^\circ$	297
1	3452.89	40R	II	28953.0	$a^3D_2 - z^5F_3^\circ$	298
1	3446.26	100R	II	29008.7	$a^3D_2 - z^3D_2^\circ$	290
1	3444.25	5	V	29025.6	$z^5F_2^\circ - e^5H_3$	304
3	3443.00	(1)		29036.2	$z^5G_4^\circ - i^3D_3$?	305
1	3442.93	2n	V	29036.7		
1	3442.54	4n	V	29040.0	$z^5F_3^\circ - e^5G_4$	296
1	3442.02	5	III	29044.4	$z^5G_5^\circ - e^3H_6$	306
1	3437.28	30R	II	29084.5	$a^3F_4 - z^5F_4^\circ$	285
1	3435.50	2	II	29099.5	$b^1D_2 - x^3D_3^\circ$	307
1	3433.57	70R	II	29115.9	$a^3D_3 - z^3F_3^\circ$	297
					$(z^5F_5^\circ - e^3H_5)$	289
⊙	3428.43	(1)		29159.5	$z^5F_3^\circ - f^5F_2$	286
1	3423.71	50R	II	29199.7	$a^3D_1 - z^3D_1^\circ$	290
1	3422.87	4	V	29206.9	$z^5F_3^\circ - e^5H_4$	304
1	3422.33	4	V	29211.5	$z^5G_3^\circ - g^3G_4$	300
1	3421.34	7	III	29220.0	$z^5F_5^\circ - e^5H_6$	304
9	3421.22	(4)		29221.0	$z^5G_5^\circ - g^3G_5$	300
1	3420.74	5	I	29225.1	$a^3F_2 - z^1D_2^\circ$	308
⊙	3415.68	(0)		29268.4	$z^5F_5^\circ - f^5F_4$	286
1	3414.77	150R	II	29276.2	$a^3D_3 - z^3F_4^\circ$	297
1	3413.94	12r	II	29283.3	$a^3D_2 - z^5F_2^\circ$	298
1	3413.48	25R	II	29287.3	$a^3F_3 - z^3F_2^\circ$	273
					$(z^5F_5^\circ - e^5G_5)$	296
⊙	3412.46	(−3)		29296.0	$z^5D_2^\circ - f^3P_2$	309
1	3409.58	8	II	29320.7	$a^3F_4 - z^3F_3^\circ$	273
⊙	3405.51	(−3)		29355.8	$z^5F_3^\circ - e^5H_3$	304
1	3403.43	8	III	29373.7	$z^5G_5^\circ - e^5G_6$	310
1	3401.16	8	III	29393.3	$z^5G_5^\circ - f^5F_5$	311
1	3397.28	(2)		29426.9		

TABLE V (*Continued*)

Source	I.A.	Int.	Temp. Class	ν (vac)	Designation	Multiplet
⊙	3396.51	(−2)		29433.6	$z^5F_4^\circ - e^3H_4$	289
1	3396.17	6	V	29436.5	$z^5F_4^\circ - e^5H_5$	304
1	3392.99	100R	II	29464.1	$a^3D_3 - z^3D_3^\circ$	290
1	3391.05	50R	II	29481.0	$a^3F_4 - z^3F_4^\circ$	273
1	3388.18	(2)		29505.9		
1	3387.47	3	I	29512.1	$a^3D_2 - z^5F_1^\circ$	298
1	3380.89	15r	II	29569.6	$a^3F_2 - z^3G_3^\circ$	312
1	3380.58	80R	II	29572.3	$a^1D_2 - z^1P_1^\circ$	313
1	3376.33	4	V	29609.5	$z^5G_4^\circ - e^3H_5$	306
1	3375.56	2n	V	29616.2	$z^5G_2^\circ - e^5G_3$	310
1	3374.64	15	II	29624.3	$z^5G_6^\circ - e^5H_7$	314
1	3374.23	15r	II	29627.9	$a^3D_3 - z^5F_3^\circ$	298
1	3372.00	15r	II	29647.5	$a^3F_3 - z^3G_4^\circ$	312
1	3369.58	80R	II	29668.8	$a^3F_4 - z^3D_3^\circ$	279
1	3367.89	8	II	23683.7	$a^3D_3 - z^3D_2^\circ$	290
⊙	3367.30	(−1)		29688.9	$z^5D_2^\circ - i^3D_3$	315
1	3366.81	10	III	29693.2	$z^5G_6^\circ - e^5G_6$	310
1	3366.17	20R	II	29698.9	$a^3F_3 - z^1F_3^\circ$	301
1	3365.77	15r	II	29702.4	$a^1D_2 - y^3F_3^\circ$	316
1	3364.59	5	IV	29712.8	$z^5G_6^\circ - f^5F_5$	311
1	3363.61	4	IV	29721.5	$z^5G_4^\circ - g^3G_4$	300
1	3362.81	6	I	29728.5	$a^3D_1 - z^1D_2^\circ$	317
1	3361.56	20R	II	29739.6	$a^3D_2 - z^3F_2^\circ$	297
1	3361.24	5	II	29742.4	$z^5G_4^\circ - f^5F_4$	311
1	3359.10	8	IV	29761.4	$z^5G_4^\circ - e^5G_5$	310
⊙	3351.07	(−1)		29832.7	$a^3F_4 - z^5F_3^\circ$	285
1	3339.05	4n	V	29940.1	$z^5G_3^\circ - e^3H_4$	306
1	3338.76	3	III	29942.7	$b^1D_2 - y^1P_1^\circ$	318
⊙	3337.34	(−3)		29955.4	$z^5F_4^\circ - e^5H_4$	304
1	3337.02	4	I	29958.3	$a^3D_3 - z^5F_2^\circ$	298
3	3335.59	2n	V	29971.1		
1	3332.19	6n	V	30001.7		
⊙	3331.26	(−1N)		30010.1	$z^5G_3^\circ - f^5F_3$	311
1	3328.72	5	I	30033.0	$a^3D_2 - z^3D_1^\circ$	290
1	3327.40	4	V	30044.9	$z^5D_3^\circ - f^3P_2$	309
1	3326.67	4	IV	30051.5	$z^5G_3^\circ - e^5G_3$	310
1	3322.32	15r	II	30090.8	$a^1D_2 - y^3D_3^\circ$	319
1	3321.24	2	V	30100.6	$z^5D_3^\circ - i^3F_4$	320
1	3320.79	6	V	30104.7	$z^5G_2^\circ - e^5G_2$	310
1	3320.26	20R	II	30109.5	$a^3F_3 - z^1D_2^\circ$	308
1	3315.67	30R	II	30151.2	$a^3D_2 - z^1F_3^\circ$	321
1	3312.99	4	V	30175.6	$z^5G_2^\circ - e^5H_3$	314
1	3312.32	10	III	30181.7	$z^5G_5^\circ - e^5H_6$	314
1	3310.21	5	I	30200.9	$a^1D_2 - y^3F_2^\circ$	316
1	3309.44	2n	V	30207.9		
⊙	3309.33	(−3N)		30208.9	$z^5G_5^\circ - g^3G_4$	300
⊙	3308.94	(−3N)		30212.5	$z^5G_2^\circ - f^5F_1$	311
1	3307.01	2	V	30230.1	$z^5G_5^\circ - f^5F_4$	311
1	3304.95	6	IV	30249.0	$z^5G_5^\circ - e^5G_5$	310
⊙	3298.01	(−3)		30312.6	$z^5D_0^\circ - e^5P_1$	322
1	3296.26	(1)		30328.7	$z^5D_2^\circ - e^5D_3$	323
1	3293.67	(1)		30352.6	$z^3D_2^\circ - f^3P_1$	309
1	3287.23	2	III	30412.0	$b^1D_2 - x^1D_2^\circ$	324
1	3286.95	8	II	30414.6	$a^3D_3 - z^3F_2^\circ$ $(z^5G_3^\circ - f^5F_2)$	297 311
1	3284.43	(1)		30438.0	$z^5D_3^\circ - i^3D_3$	315
1	3284.34	4	IV	30438.8		
1	3282.82	5	V	30452.9	$z^5G_4^\circ - e^5H_5$	314
1	3282.70	8	II	30454.0	$a^3F_3 - z^3G_3^\circ$	312
1	3281.88	5	V	30461.6	$z^5G_3^\circ - e^5H_4$	314
3	3277.23	(1)		30504.8	$z^5D_1^\circ - f^3P_0$	309
⊙	3275.59	(−2)		30520.1	$z^5G_4^\circ - f^5F_3$	311
3	3273.50	(1)		30539.6	$z^5G_3^\circ - e^5G_2$	310
1	3271.12	10	II	30561.8	$a^3D_2 - z^1D_2^\circ$ $(z^5G_4^\circ - e^5G_3)$	317 310
3	3268.96	2n	V	30582.0	$z^5D_1^\circ - e^5P_1$	322
1	3268.09	4n	V	30590.1		
3	3264.44	2n	V	30624.3		
1	3250.75	9	II	30753.3	$a^1D_2 - y^3D_2^\circ$	319
1	3249.44	6	I	30765.7	$a^3F_2 - z^1P_1^\circ$	325
3	3248.44	8	II	30775.2	$a^3D_3 - z^3G_4^\circ$	326
3	3245.35	4n	V	30804.5	$z^5G_4^\circ - e^5G_4$	310
1	3243.06	25R	I	30826.2	$a^3D_3 - z^1F_3^\circ$	321
1	3235.76	4	I	30895.8	$a^3F_2 - y^3F_3^\circ$	327

TABLE V (*Continued*)

Source	I.A.	Int.	Temp. Class	ν (vac)	Designation	Multiplet
1	3234.66	10r	II	30906.3	$a^3D_2-z^3G_3^\circ$	326
3	3233.88	2	V	30913.7		
1	3233.17	4	IV?	30920.5	$z^5D_3^\circ-e^5P_2$ $z^3G_5^\circ-h^3G_5$	322 328
1	3232.95	25R	II	30922.6	$a^3F_4-z^3G_5^\circ$	312
⊙	3231.08	(−3)		30940.5	$z^5G_5^\circ-e^5H_5$	314
1	3226.99	5	II	30979.7	$a^3F_4-z^3G_4^\circ$	312
1	3225.03	10r	II	30998.5	$a^1D_2-y^3D_1^\circ$	319
1	3223.54	3	IV	31012.9	$z^5D_4^\circ-i^3F_4$ $z^5D_0^\circ-f^5F_1$	320 329
1	3221.66	10r	II	31031.0	$a^3F_4-z^1F_3^\circ$	301
1	3221.28	5	V	31034.6	$z^3G_5^\circ-f^3H_6$?	330
1	3219.81	3	V	31048.8	$z^5D_1^\circ-f^5F_2$	329
1	3217.83	8	III	31067.9	$z^5D_4^\circ-e^5P_3$	322
1	3216.82	5	IV	31077.7	$z^5D_2^\circ-e^5D_3$	323
1	3214.06	7	III	31104.3	$z^5D_4^\circ-e^5D_4$	323
1	3213.44	5n	V	31110.3	$z^5D_2^\circ-e^5P_1$	322
1	3209.91	5	V	31144.6	$z^5D_3^\circ-f^5F_4$	329
1	3206.96	4n	V	31173.2	$z^5D_2^\circ-f^5F_3$	329
1	3202.15	5	IV	21220.0	$z^5D_4^\circ-f^5F_5$	329
1	3220.43	5	II	31236.8	$a^3D_3-z^1D_2^\circ$	317
1	3199.36	3n	V	31247.3		
1	3197.12	10r	II	31269.1	$a^3D_1-z^1P_1^\circ$	331
1	3195.58	6	II	31284.2	$a^3F_2-y^3D_3^\circ$	332
⊙	3194.77	(−2)		31292.1	$z^5G_5^\circ-e^5G_4$	310
⊙	3193.74	(−1N)		31302.2	$z^5D_3^\circ-i^3F_3$	320
1	3191.89	2	V	31320.4	$z^5F_5^\circ-g^5F_5$	333
1	3184.37	8	II	31394.3	$a^3F_2-y^3F_2^\circ$	327
1	3183.26	4	II	31405.3	$a^3P_1-v^3D_2^\circ$	334
1	3183.05	3	III	31407.4	$a^3P_0-v^3D_1^\circ$	334
1	3181.75	5	II	31420.2	$a^3P_2-v^3D_3^\circ$	334
1	3176.30	2	IV	31474.1	$a^3P_1-x^3P_1^\circ$?	335
1	3170.73	2	IV	31529.4	$a^3P_2-v^3D_2^\circ$	334
1	3165.51	3	I	31581.4	$a^3D_3-z^3G_3^\circ$	326
1	3164.17	2	IV	31594.8	$a^3P_1-4_2^\circ$	
1	3159.52	3	I	31641.3	$a^3F_3-y^3F_4^\circ$	327
1	3154.58	2	IV	31690.8	$a^3P_1-v^3D_1^\circ$	334
1	3151.29	4n	V	31723.9		
1	3145.71	8	II	31780.2	$a^3F_3-y^3F_3^\circ$	327
1	3145.12	3	I	31786.1	$a^3F_4-z^3G_3^\circ$	312
1	3134.11	60R	II	31897.8	$a^3D_1-y^3F_2^\circ$ $(b^1D_2-w^3F_2^\circ)$	336
⊙	3131.71	(0)		31922.2		
1	3129.31	7	I	31946.7	$a^3F_2-y^3D_2^\circ$	332
⊙	3118.56	(−1)		32056.8	$z^5D_4^\circ-f^5F_4$	329
1	3116.70	2	V	32076.0	$z^5D_4^\circ-e^5G_5$	337
1	3114.13	20R	II	32102.4	$a^3D_2-z^1P_1^\circ$	331
1	3107.72	4	I	32168.6	$a^3F_3-y^3D_3^\circ$	332
1	3105.47	15r	II	32191.9	$a^3F_2-y^3D_1^\circ$	332
1	3101.88	40R	II	32229.2	$a^1D_2-y^1F_3^\circ$	338
1	3101.56	100R	II	32232.5	$a^3D_2-y^3F_3^\circ$	336
1	3099.12	12r	II	32257.9	$a^3F_3-z^1G_4^\circ$	339
1	3097.12	15r	II	32278.7	$a^3F_3-y^3F_2^\circ$	327
1	3096.80	(1r)		32282.1	$z^5G_5^\circ-g^5F_5$	340
1	3080.76	20R	II	32450.1	$a^3D_1-y^3D_2^\circ$	341
1	3075.91	(2)		32501.3		
1	3066.46	3	IV	32601.5	$z^5G_6^\circ-g^5F_5$	340
1	3064.63	25R	II	32620.9	$a^3D_2-y^3D_3^\circ$	341
1	3063.42	(3)		32633.8		
1	3057.65	50R	II	32695.4	$a^3D_1-y^3D_1^\circ$	341
1	3054.32	50R	II	32731.0	$a^3D_2-y^3F_2^\circ$	336
1	3050.83	100R	II	32768.5	$a^3D_3-y^3F_4^\circ$	336
1	3045.01	10r	II	32831.1	$a^3F_3-y^3D_2^\circ$	332
1	3037.94	60R	II	32907.5	$a^3D_3-y^3F_3^\circ$	336
1	3031.87	10r	II	32973.4	$a^3F_4-y^3F_4^\circ$	327
1	3029.30	3	IV	33001.4	$b^1D_2-x^3P_2^\circ$ $a^3P_1-w^3P_2^\circ$	342 343
1	3019.15	20R	II	33112.3	$a^3F_4-y^3F_3^\circ$	327
1	3017.96	(1)		33125.3	$a^3P_2-w^3P_2^\circ$	343
1	3012.01	75R	II	33190.8	$a^1D_2-y^1D_2^\circ$	344
1	3003.63	60R	II	33283.4	$a^3D_2-y^3D_2^\circ$	341
1	3002.49	100R	II	33296.0	$a^3D_3-y^3D_3^\circ$	341
1	2994.46	25R	II	33385.3	$a^3D_3-z^1G_4^\circ$ $(a^3P_0-w^3P_1^\circ)$	345 343

TABLE V (*Continued*)

Source	I.A.	Int.	Temp. Class	ν (vac)	Designation	Multiplet
1	2992.60	20R	II	33406.0	$a^3D_3-y^3F_2^\circ$	336
3	2992.12	(2)		33411.4		
1	2991.10	4	II	33422.8	$a^3F_2-y^1F_3^\circ$ $a^3P_2-6_3^\circ$	346
1	2984.13	12R	II	33500.9	$a^3F_4-y^3D_3^\circ$	332
1	2983.42	4	III	33508.8	$b^1D_2-v^3D_3^\circ$	347
1	2981.65	20R	II	33528.7	$a^3D_2-y^3D_1^\circ$	341
1	2973.73	(1)		33618.0	$b^1D_2-v^3D_2^\circ$	347
1	2969.20	(1)		33669.3	$a^3P_1-w^3P_1^\circ$	343
1	2958.29	(1)		33793.5	$a^3P_2-w^3P_1^\circ$	343
1	2949.22	(3)		33897.4		
1	2943.92	25	A	33958.4	$a^3D_3-y^3D_2^\circ$	341
1	2932.63	(2)		34089.1		
1	2930.93	(1)		34108.9	$z^5D_4^\circ-g^5F_5$	348
1	2917.53	(1u)		34265.6	$z^5F_5^\circ-f^5G_6$	349
1	2916.85	(1u)		34273.6	$z^5F_5^\circ-h^5F_5$?	350
1	2914.01	(2)		34307.0	$a^3F_3-y^1F_3^\circ$	346
1	2907.46	(3)		34384.2	$a^3F_2-y^1D_2^\circ$	351
1	2905.76	(1)		34404.4	$a^3P_1-w^3P_0^\circ$	343
1	2868.76	(1)		34848.1	$a^3P_2-x^1P_1^\circ$	352
1	2865.51	1	A	34887.6	$a^3D_1-y^1D_2^\circ$	353
1	2849.84	(1)		35079.4	$a^3P_2-w^1D_2^\circ$	354
1	2838.97	(2)		35213.7	$b^1D_2-w^3P_2^\circ$	355
1	2834.55	(3)		35268.6	$a^3F_3-y^1D_2^\circ$	351
1	2821.30	15	A	35434.3	$a^3D_3-y^1F_3^\circ$	356
1	2814.37	(3)		35521.5	$z^5G_6^\circ-f^5H_7$	357
1	2812.37	(1u)		35546.8	$z^5G_6^\circ-f^5G_6$	358
1	2805.08	(3)		35639.1	$a^3F_4-y^1F_3^\circ$	346
1	2803.15	(1)		35663.7	$b^1D_2-u^3D_2^\circ$	359
1	2802.28	(3)		35674.7		
1	2798.65	10	A	35721.0	$a^3D_2-y^1D_2^\circ$	353
1	2746.75	5	A	36395.9	$a^3D_3-y^1D_2^\circ$	353
1	2705.47	(1)		36951.2	$a^1D_2-1_3^\circ$	
1	2696.50	(2)		37074.1	$a^1D_2-2_2^\circ$	
1	2578.48	(1)		38770.9	$a^3D_1-2_2^\circ$	
1	2561.43	(1)		39029.0	$a^3F_3-1_3^\circ$	
1	2553.38	(1)		39152.0	$a^3F_3-2_2^\circ$	
1	2547.42	(1)		39243.6	$a^1D_2-y^3P_2^\circ$	360
1	2540.03	1?	A	39357.8	$a^1D_2-w^3D_3^\circ$	361
1	2532.09	(1)		39481.2	$a^3D_2-1_3^\circ$	
1	2528.07	(1)		39544.0	$a^2D_2-x^3D_2^\circ$	362
1	2524.22	5	A	39604.3	$a^3D_2-2_2^\circ$	
1	2501.13	3	A	39969.9		
1	2491.18	4	A	40129.5		
1	2490.69	4	A	40137.4		
3	2489.51	(1)		40156.4	$a^3D_3-1_3^\circ$	
1	2488.15	6	A	40178.4		
1	2484.04	5	A	40244.9	$a^1D_2-x^3F_3^\circ$	363
1	2483.29	10	A	40257.0		
1 1	2479.77 2479.49	3	A	40314.1 40318.7		
1	2476.88	3	A	40361.2	$a^3F_4-1_3^\circ$	
1	2472.92	4	A	40425.8		
1	2472.24	(1)		40436.9	$a^3F_2-y^3P_2^\circ$	364
1	2472.07	6	A	40439.7	$a^3F_2-y^3P_1^\circ$	364
1	2466.97	(1)		40523.3	$a^1D_2-x^1D_2^\circ$	365
1	2465.28	2	A	40551.1	$a^3F_2-w^3D_3^\circ$	366
1	2454.00	4	A	40737.5	$a^3F_2-x^3D_2^\circ$	367
1	2450.48	(1)		40796.0	$a^1D_2-x^1F_3^\circ$?	368
1	2441.83	10	A	40940.5	$a^3D_1-y^3P_2^\circ$	369
3	2441.68	(2)		40943.0	$a^3D_1-y^3P_1^\circ$	369
1	2434.43	2	A	41064.9	$a^1D_2-w^3D_2^\circ$	361
1	2432.22	2	A	41102.2		
1	2429.11	(1)		41154.8	$a^1D_2-w^3F_3^\circ$	370
1	2424.03	5	A	41241.1	$a^3D_1-x^3D_2^\circ$	371
1	2423.66	4	A	41247.4	$a^3F_2-y^1P_1^\circ$	372
1	2423.33	4	A	41253.0	$a^3F_3-x^3F_4^\circ$	373
1	2421.23	7	A	41288.8	$a^3F_3-x^3D_3^\circ$	367
1	2419.31	20	A	41321.5	$a^3F_3-y^3P_2^\circ$	364
1	2412.65	10	A	41435.6	$a^3F_3-w^3D_3^\circ$	366
1	2401.85	20	A	41621.9	$a^3F_3-x^3D_2^\circ$	367
1	2396.64	3	A	41712.4	$a^1D_2-w^3D_1^\circ$	361
1	2396.39	3	A	41716.7	$a^3F_2-x^1D_2^\circ$	374
1	2393.12	(1)		41773.7	$a^3D_2-y^3P_2^\circ$	369

TABLE V (*Continued*)

Source	I.A.	Int.	Temp. Class	ν (vac)	Designation	Multiplet
1	2392.96	15	A	41776.5	$a^3D_2-y^3P_1^\circ$	369
1	2387.56	4	A	41871.0	$a^1D_2-y^3G_3^\circ$	375
1	2386.59	10	A	41888.0	$a^3D_2-w^3D_3^\circ$	376
1	2385.02	3	A	41915.6		
1	2384.40	6	A	41926.5	$a^3F_3-w^3F_4^\circ$	377
1	2380.79	2	A	41990.0	$a^3F_2-x^1F_3^\circ$	378
1	2379.73	(1)		42008.7	$a^1D_2-w^3F_2^\circ$	370
1	2376.02	7	A	42074.3	$a^3D_2-x^3D_2^\circ$	371
1	2365.68	(1)		42258.2	$a^3F_2-w^3D_2^\circ$	366
1	2362.06	10	A	42323.0	$a^3F_3-x^3F_3^\circ$	373
1	2360.64	10	A	42348.4	$a^3F_2-w^3F_3^\circ$	377
1	2358.87	8	A	42380.2	$a^3D_3-x^3F_4^\circ$	379
1	2356.87	10	A	42416.2	$a^3D_3-x^3D_3^\circ$	371
1	2355.06	10	A	42448.8	$a^3D_3-y^3P_2^\circ$	369
1	2348.74	2	A	42563.0	$a^3D_3-w^3D_3^\circ$	376
1	2347.53	15	A	42584.9	$a^3F_4-x^3F_4^\circ$	373
1	2346.64	4	A	42601.1	$a^3F_3-x^1D_2^\circ$	374
1	2345.55	30	A	42620.9	$a^3F_4-x^3D_3^\circ$	367
1	2338.50	2	A	42749.3	$a^3D_3-x^3D_2^\circ$	371
1	2337.82	(1)		42761.8	$a^3D_1-w^3D_2^\circ$	376
1	2337.49	50	A	42767.8	$a^3F_4-w^3D_3^\circ$	366
1	2337.10	(1)		42774.9	$a^3D_2-x^3F_3^\circ$	379
1	2331.70	2	A	42874.0	$a^3F_3-x^1F_3^\circ$	378
1	2329.97	50	A	42905.8	$a^3F_2-w^3D_1^\circ$	366
1	2325.80	50	A	42982.7	$a^3F_3-y^3G_4^\circ$	380
1	2324.65	(2)		43004.0	$a^3F_3-3^\circ$	
1	2322.69	(2)		43040.3		
1	2321.96	(1)		43053.8	$a^3D_3-w^3F_4^\circ$	381
1	2321.39	60	A	43064.4	$a^3F_2-y^3G_3^\circ$	380
1	2320.03	100	A	43089.6	$a^3F_4-y^3G_5^\circ$	380
1	2318.78	(1)		43112.9	$a^1D_2-x^3P_2^\circ$	382
1	2317.16	50	A	43143.0	$a^3F_3-w^3D_2^\circ$	366
1	2313.98	100	A	43202.3	$a^3F_2-w^3F_2^\circ$	377
1	2313.66	(2u)		43208.3		
1	2312.34	50	A	43232.9	$a^3F_3-w^3F_3^\circ$	377
1	2310.96	100	A	43258.7	$a^3F_4-w^3F_4^\circ$	377
1	2307.35	3	A	43326.4	$a^3D_2-x^1F_3^\circ$	383
1††	2302.97	10	A	43408.8	$a^3D_1-w^3D_1^\circ$	376
1	2301.57	(2u)		43435.2		
1	2300.77	20	A	43450.3	$a^3D_3-x^3F_2^\circ$	379
1	2293.11	5	A	43595.4	$a^3D_2-w^3D_2^\circ$	376
1	2289.98	20	A	43655.0	$a^3F_4-x^3F_3^\circ$	373
1	2288.39	4	A	43685.3	$a^3D_2-w^3F_3^\circ$	381
1	2287.32	(1)		43705.8	$a^3D_1-w^3F_2^\circ$	381
1	2277.76	2	A	43889.2		
1	2274.65	(1u)		43949.2	$a^3F_3-y^3G_3^\circ$	380
1	2271.94	6	A	44001.6	$a^3D_3-x^1F_3^\circ$	383
1	2267.55	2	A	44086.8	$a^3F_3-w^3F_2^\circ$	377
7	2266.40	3	A	44109.2	$a^3D_3-y^3G_4^\circ$	384
1	2261.41	10	A	44206.5	$a^3F_4-x^1F_3^\circ$	378
1	2259.55	7	A	44242.9	$a^3D_2-w^3D_1^\circ$	376
1	2258.13	6	A	44270.7	$a^3D_3-w^3D_2^\circ$	376
7	2255.89	(2)		44314.6	$a^3F_4-y^3G_4^\circ$	380
1	2254.80	8	A	44336.1	$a^3F_4-3^\circ$	
1	2253.55	(1)		44360.7	$a^3D_3-w^3F_3^\circ$	381
1	2251.47	3	A	44401.6	$a^3D_2-y^3G_3^\circ$	384
5	2244.55	3	A	44538.5		
5	2244.47	(0N)		44540.1	$a^3D_2-w^3F_2^\circ$	381
5	2243.22	(tr)		44564.9	$a^3F_4-w^3F_3^\circ$	377
5	2242.90	(tr)		44571.3		
5	2230.97	3	A	44809.5	$a^3D_1-x^3P_2^\circ$	385
5	2225.35	(1)		44922.8	$a^3F_2-v^3D_2^\circ$	386
5**	2221.96	5	A	44991.2	$a^3F_2-x^3P_1^\circ$	387
5	2217.77	(3)		45076.2	$a^3D_3-y^3G_3^\circ$	384
5	2213.87	(tr)		45155.7		
5	2212.18	2	A	45190.2	$a^3F_3-x^3P_2^\circ$	387
5	2211.32	2	A	45207.8	$a^3F_2-v^3D_1^\circ$	386
5	2211.03	(3)		45213.7	$a^3D_3-w^3F_2^\circ$	381
5	2208.99	(tr) Bd?		45255.4		
5	2208.69	(tr) Bd?		45261.6	$a^1D_2-v^3F_3^\circ$	388
5	2207.74	(tr)		45281.1	$a^3F_4-y^3G_3^\circ$	380
5	2207.48	(tr)		45286.4		
5	2201.59	8	A	45407.5	$a^1D_2-5_1^\circ,_2$	
5	2200.71	4	A	45425.6	$a^3D_1-v^3D_2^\circ$	389

TABLE V (*Continued*)

Source	I.A.	Int.	Temp. Class	ν (vac)	Designation	Multiplet
5	2197.38	20	A	45494.4	$a^3D_1-x^3P_1^\circ$	385
5	2196.47	(0)		45513.3		
5	2196.34	(tr)		45516.1		
5	2196.06	(0)		45521.9		
5	2192.10	(tr)		45604.0		
5	2191.86	(0)		45609.0		
5	2191.56	(tr?)		45615.2	$a^3D_1-4_2^\circ$	
5	2191.21	(3)		45622.6	$a^1D_2-6_3^\circ$	
5	2190.24	15	A	45642.8	$a^3D_2-x^3P_2^\circ$	385
5	2187.60	(1)		45698.0	$a^3F_3-v^3D_3^\circ$	386
5	2187.20	(0)		45706.3		
5	2186.94	(2)		45711.7	$a^3D_1-v^3D_1^\circ$	389
5	2186.49	(0)		45721.0		
5	2183.91	2	A	45775.1	$a^1D_2-u^3D_2^\circ$	390
5**	2183.37	2	A	45786.3		
5	2182.38	7	A	45807.1	$a^3F_3-v^3D_2^\circ$	386
5	2178.08	(1)		45897.6		
5	2174.48	10	A	45973.6	$a^3D_1-x^3P_0^\circ$	385
5	2173.54	(4)		45993.5	$a^1D_3-w^3P_1^\circ$	391
5	2169.57	(0)		46077.6		
5	2166.76	(2)		46137.3		
5	2166.15	5	A	46150.3	$a^3D_2-v^3D_3^\circ$	389
5	2161.04	6	A	46259.4	$a^3D_2-v^3D_2^\circ$	389
5	2158.31	30	A	46317.9	$a^3D_3-x^3P_2^\circ$	385
5	2157.83	10	A	46328.2	$a^3D_2-x^3P_1^\circ$	385
5	2152.23	(3)		46448.7	$a^3D_2-4_2^\circ$	
5	2151.93	3	A	46455.2	$a^3F_2-v^3F_3^\circ$	392
5§	2147.80	40	A	46544.6	$a^3D_2-v^3D_1^\circ$	389
5	2145.17	(trN)		46601.7	$a^3F_2-5_{1,2}^\circ$	
5	2140.09	(trN)		46712.3		
5	2135.34	(3)		46816.1	$a^3F_2-6_3^\circ$	
5	2134.93	20	A	46825.2	$a^3D_3-v^3D_3^\circ$	389
5	2130.78	(3)		46916.2		
5	2129.96	10	A	46934.3	$a^3D_3-v^3D_2^\circ$	389
5**	2128.41	3	A	46968.5	$a^3F_2-u^3D_2^\circ$	393
5	2127.91	(2)		46979.5		
5	2125.62	5	A	47030.1	$a^3F_4-v^3D_3^\circ$	386
5	2124.80	3	A	47048.3	$a^1D_2-x^1P_1^\circ$	394
5	2124.10	(0)		47063.7		
5	2122.25	(1)		47104.9	$a^3D_1-5_1^\circ,_2$	
5	2121.40	(8)		47123.8	$a^3D_3-4_2^\circ$	
5	2120.71	(tr)		47139.0		
5	2118.57	(0N)		47186.7	$a^3F_2-w^3P_1^\circ$	395
5	2114.43	(4)		47279.1	$a^1D_2-w^1D_2^\circ$	396
5	2111.73	(5)		47339.5	$a^3F_3-v^3F_3^\circ$	392
5	2109.79	(2)		47383.1	$a^3F_3-v^3F_4^\circ$	392
5	2107.21	(0)		47441.0	$a^1D_2-u^3D_1^\circ$	390
5	2105.85	(1)		47471.6	$a^3D_1-u^3D_2^\circ$	397
5	2095.75	(4)		47700.4	$a^3F_3-6_3^\circ$	
5	2095.53	(3)		47705.4		
5	2095.13	(4)		47714.5	$a^1D_2-u^3F_3^\circ$	398
5	2091.69	(0)		47793.0	$a^3D_2-v^3F_3^\circ$	399
5	2090.42	(2)		47822.1	$a^3F_2-v^3F_2^\circ$	392
5	2089.09	(4)		47852.5	$a^3F_3-u^3D_2^\circ$	393
5	2088.98	(4)		47855.0	$a^3D_2-w^3P_2^\circ$	400
5	2087.75	(tr)		37883.1		
5	2085.57	(1)		47933.2	$a^1D_2-u^3F_2^\circ$	398
5	2085.37	(4)		47937.8	$a^3D_2-5_{1,2}^\circ$	
5	2084.14	(0)		47966.1		
5	2082.87	(8)		47995.4	$a^3F_3-u^3D_3^\circ$	393
5	2077.22	(0)		48125.9		
5	2076.07	(2)		48152.6	$a^3D_2-6_3^\circ$	
5	2075.09	(tr)		48175.3		
5	2074.61	(0N)		48186.4		
5	2072.26	(3)		48241.0	$a^3F_2-x^1P_1^\circ$	401
5	2069.52	(8)		48305.0	$a^3D_2-u^3D_2^\circ$	397
5	2069.04	(10)		48316.0		
5	2068.62	(4)		48325.8	$a^3D_1-v^3F_2^\circ$	399
5	2068.35	(tr)		48332.2		
5	2064.39	(8)		48425.0	$a^3D_1-w^3P_0^\circ$	400
5	2063.42	(10)		48447.7	$a^3D_2-u^3D_3^\circ$	397
5	2062.37	(5)		48472.4	$a^3F_2-w^1D_2^\circ$	402
5	2060.76	(1)		48510.3	$a^3D_3-v^3F_4^\circ$	399
5	2060.20	(8)		48523.3	$a^3D_2-w^3P_1^\circ$	400

TABLE V (*Continued*)

Source	I.A.	Int.	Temp. Class	ν (vac)	Designation	Multiplet
5	2059.92	(12)		48530.0	$a^3D_3-w^3P_2^\circ$	400
5	2055.50	(15)		48634.4	$a^3F_2-u^3D_1^\circ$	393
5	2053.91	(1)		48671.9	$a^3F_4-v^3F_3^\circ$	392
5	2052.45	(2)		48706.7	$a^3F_3-v^3F_2^\circ$	392
5	2052.04	(12)		48715.2	$a^3F_4-v^3F_4^\circ$	392
5	2050.84	(5)		48744.8	$a^3D_1-x^1P_1^\circ$	403
5	2048.33	(0)		48804.6		
5	2047.80	(tr)		48817.1		
5	2047.35	(10)		48827.8	$a^3D_3-6_3^\circ$	
5	2044.41	(tr)		48898.2		
5	2042.17	(tr)		48951.8		
5	2041.16	(2)		48975.9	$a^3D_1-w^1D_2^\circ$	404
‖	2038.81	(1)		49032.4	$a^3F_4-6_3^\circ$	
5	2035.07	(20)		49122.6	$a^3D_3-u^3D_3^\circ$	397
5	2034.90	(5)		49126.6	$a^3F_2-u^3F_2^\circ$	405
5	2034.44	(10)		49137.8	$a^3D_1-u^3D_1^\circ$	397
5	2033.56	(2?)		49159.0	$a^3D_2-v^3F_2^\circ$	399
5	2029.88	(0N)		49248.0		
5	2029.29	(3)		49262.5	$a^3D_2-w^1F_3^\circ$	406
5	2026.62	(20)		49327.2	$a^3F_4-u^3D_3^\circ$	393
5	2026.41	(1)		49332.5		
5	2025.84	(0)		49346.2		
5	2025.40	(10)		49356.9	$a^3F_3-w^1D_2^\circ$	402
5	2024.37	(0N)		49382.2		
5	2021.32	(0)		49456.7	$a^3F_3-u^3F_4^\circ$	405
5	2016.36	(tr)		49578.2	$a^3D_2-x^1P_1^\circ$	403
5	2014.25	(12)		49630.2	$a^3D_1-u^3F_2^\circ$	407
5	2007.69	(4)		49792.3	$a^3F_3-u^3F_3^\circ$	405
5	2007.01	(7)		49809.2	$a^3D_2-w^1D_2^\circ$	404
5	2001.83	(4)		49938.0	$a^3D_3-w^1F_3^\circ$	406
5	2000.49	(1)		49971.5	$a^3D_2-u^3D_1^\circ$	397
	I.A. Vac.					
5	1999.53	(0)		50011.7	$a^3F_3-u^3F_2^\circ$	405
5	1994.29	(2)		50143.2	$a^3F_4-w^1F_3^\circ$	408
5	1990.25	(4N)		50244.8	$a^3D_2-u^3F_3^\circ$	407
5	1981.61	(2)		50464.1	$a^3D_2-u^3F_2^\circ$	407
5	1976.87	(3N)		50585.0	$a^3D_3-u^3F_4^\circ$	407
5	1968.90	(1)		50789.7	$a^3F_4-u^3F_4^\circ$	405
5	1963.85	(1)		50920.3	$a^3D_3-u^3F_3^\circ$	407

Notes on Table V.

1 Hamm—*Zeitschrift für Wissenschaftliche Photographie* **13,** 105, 1913.
2 Meggers and Kiess—*Scientific Papers of the Bureau of Standards* **14,** 649 (No. 324), 1918.
3 Exner and Haschek, in Kayser, *Handbuch der Spectroscopie* **6,** 178, 1912.
4 Randall and Barker—*Astrophysical Journal* **49,** 55, 1919.
5 Miss Moore, Unpublished material.
6 Hasselberg, in Kayser, *Handbuch der Spectroscopie* **6,** 178, 1912.
7 Piña, *Annales Sociedad de Española Fiscia y Quimica* **16,** 338, 1918.
8 Stüting, in Kayser, *Handbuch der Spectroscopie* **6,** 178, 1912.
9 Rowland, *Preliminary Table of Solar Spectrum Wave-lengths.*
⊙ Lines predicted and found in the solar spectrum; wave-lengths from *Carnegie Institution of Washington, Publication* No. 396, 1928.
† Existence of line doubtful; found only once.
* Intensity by Randall and Barker used.
§ Too strong for present assignments in multiplets.
‡ Solar lines here agree closely with predicted positions.
¶ Found only in spark by Exner and Haschek.
†† Blend with Ni II.
** Piña's measures discordant but line probably the same as measured here.
‖ Measured in the spectrum of Ni II by Shenstone.