Table III. Entropies of $Hg^{+2}(aq)$ and $Hg_2^{+2}(aq)$

(ΔS°_{298} and $\overline{S}^\circ_2$ in cal. deg.$^{-1}$ mole^{-1})

Reaction	ΔS°_{298}	$\overline{S}^\circ_{Hg^{+2}}$
$HgCl_2 = Hg^{+2} + 2Cl^-$	−10.9	−3.4
$HgBr_2 = Hg^{+2} + 2Br^-$	−8.8	−7.5
$HgI_2 = Hg^{+2} + 2I^-$	5.1	−5.7
$HgO + 2H^+ = Hg^{+2} + H_2O$	−5.4	−4.9
Av.		−5.4 ± 1.5
Latimer, 2nd ed. (*14*)		−5.4
Value adopted		−5.4 ± 1.5
		$\overline{S}^\circ_{Hg_2^{+2}}$
$Hg_2^{+2} = Hg^{+2} + Hg(liq)$	−6.0	18.8 ± 2.0
Latimer, Pitzer, and Smith (*15*)		17.7 ± 3.0
Value adopted		18.3 ± 2.0

For Cd^{+2} ion the values based on the dissolution of the sulfate and iodide have been weighted more heavily in averaging to $\overline{S}^\circ_{Cd^{+2}} = -18.9 \pm 1.8$ cal. deg.$^{-1}$ mole^{-1}. This value is more negative then those given by Latimer, Pitzer, and Smith (*15*) or Bates (*2*) but overlaps the former within the combined uncertainties. We adopt $\overline{S}^\circ_{Cd^{+2}} = -18.0 \pm 2.5$ cal. deg.$^{-1}$ mole^{-1}. Latimer gives $E^\circ = 0.403$ volt for the Cd/Cd^{+2} potential, leading to $\Delta G^\circ_f = -18.59 \pm 0.08$ kcal. mole^{-1} and $\Delta H^\circ_f = 18.3_4 \pm 0.7_8$ kcal. mole^{-1} for Cd^{+2} ion.

The mean value for $\overline{S}^\circ_{Hg^{+2}}$ is −5.4 ± 1.5 cal. deg.$^{-1}$ mole^{-1}, in accord with that given by Latimer (*14*). That derived for Hg_2^{+2}, 18.8 ± 2.0 cal. deg.$^{-1}$ mole^{-1}, is in agreement with the value determined by Latimer, Pitzer, and Smith (*15*). We adopt 18.3 ± 2.0 cal. deg.$^{-1}$ mole^{-1} for Hg_2^{+2}. Recent values for the $Hg(liq)/Hg_2^{+2}$ potential (*26*) center about $E^\circ = -0.791$ volt, leading to $\Delta G^\circ_f = 36.48 \pm 0.10$ kcal. mole^{-1}, and with the entropy adopted above, to $\Delta H^\circ_f = 40.08 \pm 0.7_5$ kcal. mole^{-1}, for the Hg_2^{+2} ion. Hietanen and Sillen (*7*) have reviewed data for the disproportionation of Hg_2^{+2} and give $K_{24} = 88 \pm 4$. From this result we calculate $\Delta G^\circ_f = 39.13 \pm 0.1_3$ kcal. mole^{-1} and $\Delta H^\circ_f = 41.25 \pm 0.6_4$ kcal. mole^{-1} for the Hg^{+2} ion.

ACKNOWLEDGMENT

Acknowledgment is made to the donors of the Petroleum Research Fund, administered by the American Chemical Society, for partial support of this research. The partial financial support of the National Aeronautics and Space Administration through Sustaining Grant NGR-46-001-008 to the University of Vermont (to CAW). The author thanks Loren G. Hepler for assistance and for the use of facilities at Carnegie Institute of Technology supported by the National Science Foundation.

LITERATURE CITED

(1) Barieau, R.E., Giauque, W.F., *J. Am. Chem. Soc.* **72**, 5676 (1950).
(2) Bates, R.G., *Ibid.*, **61**, 522 (1939).
(3) Bichowsky, F.R., Rossini, F.D., "Thermochemistry of the Chemical Substances," Reinhold, New York, 1936.
(4) Feitknecht, W., Schindler, P., *Pure Appl. Chem.* **6**, 131 (1963).
(5) Gregor, L.V., Pitzer, K.S., *J. Am. Chem. Soc.* **84**, 2671 (1962).
(6) Hepler, L.G., Wulff, C.A., "Transition Metal Elements, Their Oxidation Potentials, Thermochemistry, and Aqueous Equilibria," to be published.
(7) Hietanen, S., Sillen, L.B., *Arkiv Kemi* **10**, 103 (1956).
(8) Ishikawa, F., Kumura, G., Morooka, T., *Sci. Repts. Tohoku Imp. Univ.*, 1st Ser., **21**, 455 (1932); *CA* **27**, 1264.
(9) Ishikawa, F., Yoshida, T., *Sci. Repts. Tohoku Imp. Univ.* 1st Ser., **21**, 474 (1932); *CA* **27**, 1264.
(10) Itskevich, E.S., Strelkov, P.G., *Zh. Fiz. Khim.* **33**, 1575 (1959).
(11) Jena, P.K., Prasad, B., *J. Indian Chem. Soc.* **31**, 480 (1954).
(12) Kelley, K.K., King, E.G., Bur. Mines Bull. **592** (1961).
(13) King, E.J., "Acid-Base Chemistry," Macmillan, New York, 1965.
(14) Latimer, W. M., "Oxidation Potentials," Prentice-Hall, Englewood Cliffs, N.J., 1st ed. 1938, 2nd ed. 1952.
(15) Latimer, W.M., Pitzer, K.S., Smith, W.V., *J. Am. Chem. Soc.* **60**, 1829 (1938).
(16) Mah, A.D., *Ibid.*, **76**, 3363 (1954).
(17) Paoletti, P., *Trans. Faraday Soc.* **61**, 219 (1965).
(18) Papadopoulous, M.N., Giauque, W.F., *J. Am. Chem. Soc.* **77**, 2240 (1955).
(19) Robinson, R.A., Stokes, R.H., "Electrolyte Solutions," 2nd ed., Butterworth, London, 1959.
(20) Rossini, F.D., Wagman, D.D., Evans, W.H., Levine, S., Jaffe, I., Natl. Bur. Stds. Circ. **500** (1952).
(21) Schindler, P., Althaus, H., Feitknecht, W., *Helv. Chim. Acta* **47**, 982 (1964).
(22) Schwartzenbach, G., Anderegg, G., *Ibid.*, **37**, 1289 (1954).
(23) Shchukarev, S.A., Lilich, L.S., Latysheva, V.A., *Dokl. Akad. Nauk USSR* **91**, 273 (1953).
(24) Shchukarev, S.A., Lilich, L.S., Latysheva, V.A., Andreeva, D.K., *Zh. Neorg. Khim.* 4, 2198 (1959).
(25) Shchukarev, S.A., Lilich, L.S., Latysheva, V.A., Chuburkova, I.I., *Vestnik Leningrad Univ.*, **14**, No. 10, *Ser. Fiz. i Khim.*, No. 2, 66 (1959); *CA* **53**, 17657.
(26) Sillen, L.G., Martell, A.E., "Stability Constants of Metal-Ion Complexes," Chemical Society, London, 1964.
(27) Singh, D., *J. Sci. Res., Banaras Hindu Univ.* **10**, 22 (1959–60).
(28) Stephens, H., Stephens, T., "Solubilities of Inorganic and Organic Compounds," Vol. **I**, Macmillan, New York, 1963.
(29) Stephenson, C.C., personal communication.
(30) Thomsen, J., "Thermochemische Untersuchungen," Johann Ambrosius Barth Verlag, Leipzig, 1883.

RECEIVED for review June 6, 1966. Accepted September 21, 1966. Division of Physical Chemistry, 151st meeting, ACS, Pittsburgh, Pa., March 1966.

Ideal Gas Thermodynamic Functions of Terbium, Erbium, Thulium, and Plutonium

ROY C. FEBER and C. C. HERRICK

Los Alamos Scientific Laboratory, University of California, Los Alamos, N. M.

Improved ideal gas thermodynamic functions are calculated for monatomic terbium, erbium, thulium, and plutonium using recent energy level data. The functions are tabulated from 100° to 6000° K. at 100° intervals.

THE IDEAL GAS thermodynamic functions of monatomic terbium, erbium, thulium, and plutonium, which were previously calculated from 100° to 6000° K. at 100° intervals (*9*), are improved by recalculation with more extensive energy level data. The reference temperature is 298.15° K., and the gases are assumed to be ideal at 1 atm. pressure.

The number of levels, the range of energies of the levels, and the term designation of the lowest level are given for each element. All available experimentally established levels and some predicted levels are included in the computations. Continuing analyses of the complex spectra of these elements can be expected to establish additional levels in the future and possibly revise some of the presently existing assignments. No attempt was made to determine the temperature and density at which the classical partition function becomes inadequate. In general, thermal ionization starts around 3500° K. for the rare earth elements.

Table I. Physical Constants

Gas constant, R = 1.98717 cal./degree mole
Planck constant, $h = 6.6256 \times 10^{-27}$ erg second
Thermochemical calorie = 4.1840×10^{7} erg
Boltzmann constant, $k = 1.38054 \times 10^{-16}$ erg/degree
$\alpha = hc/k$ = 1.43879 cm./degree

The atomic weight of Pu is that used by Benton (4). The atomic weights of the remaining elements are those based on C^{12} = 12.0000 and adopted by the International Union of Pure and Applied Chemistry (7). The physical constants used are given in Table I. Thermodyamic functions are tabulated in Tables II to V.

TERBIUM $4f^8 5d6s^2\ ^8G_{13/2}$

The relative positions of the low-lying $4f^9 6s^2$ and $4f^8 5d6s^2$ configurations are based on the atomic-beam magnetic resonance results of Bender, Penselin, and Schlüpmann (3). The lowest level of the $4f^8 5d6s^2$ configuration is $^8G_{13/2}$ as suggested by Klinkenberg (10). The experimental data of

Table II. Thermodynamic Functions for Monatomic Terbium, Gas

$H°_{298.15} - H°_0$ = 1778.6 Cal./G.F.W. G.F.W. = 158.924

T,° K.	$-(F° - H°_{298.15})/T$, Cal./G.F.W./ Degree	$H° - H°_{298.15}$, Kcal./G.F.W.	$S°$, Cal./G.F.W./ Degree	$C_p°$, Cal./G.F.W./ Degree
100.00	53.9663	−1.2218	41.7487	6.4621
200.00	49.0967	−0.5883	46.1553	6.1262
298.15	48.5515	0.	48.5515	5.8946
300.00	48.5516	0.0109	48.5879	5.8919
400.00	48.7812	0.5943	50.2669	5.7897
500.00	49.2120	1.1712	51.5543	5.7582
600.00	49.6926	1.7477	52.6055	5.7810
700.00	50.1742	2.3287	53.5009	5.8446
800.00	50.6401	2.9176	54.2871	5.9362
900.00	51.0852	3.5166	54.9925	6.0455
1000.00	51.5085	4.1270	55.6355	6.1642
1100.00	51.9110	4.7495	56.2288	6.2865
1200.00	52.2941	5.3843	56.7810	6.4079
1300.00	52.6594	6.0310	57.2986	6.5253
1400.00	53.0083	6.6891	57.7862	6.6365
1500.00	53.3424	7.3580	58.2477	6.7399
1600.00	53.6627	8.0368	58.6857	6.8346
1700.00	53.9706	8.7246	59.1027	6.9202
1800.00	54.2668	9.4205	59.5005	6.9965
1900.00	54.5524	10.1236	59.8806	7.0638
2000.00	54.8279	10.8330	60.2444	7.1226
2100.00	55.0942	11.5479	60.5932	7.1737
2200.00	55.3518	12.2675	60.9280	7.2177
2300.00	55.6013	12.9912	61.2497	7.2558
2400.00	55.8432	13.7185	61.5592	7.2887
2500.00	56.0778	14.4488	61.8573	7.3175
2600.00	56.3056	15.1819	62.1448	7.3433
2700.00	56.5271	15.9174	62.4224	7.3668
2800.00	56.7424	16.6552	62.6907	7.3890
2900.00	56.9521	17.3952	62.9504	7.4107
3000.00	57.1562	18.1374	63.2020	7.4326
3100.00	57.3552	18.8817	63.4461	7.4553
3200.00	57.5493	19.6285	63.6832	7.4793
3300.00	57.7386	20.3777	63.9137	7.5051
3400.00	57.9236	21.1296	64.1382	7.5330
3500.00	58.1043	21.8843	64.3570	7.5633
3600.00	58.2809	22.6423	64.5705	7.5961
3700.00	58.4538	23.4037	64.7791	7.6315
3800.00	58.6229	24.1687	64.9831	7.6695
3900.00	58.7886	24.9376	65.1828	7.7101
4000.00	58.9509	25.7108	65.3786	7.7531
4100.00	59.1100	26.4883	65.5706	7.7983
4200.00	59.2661	27.2705	65.7590	7.8457
4300.00	59.4192	28.0575	65.9442	7.8948
4400.00	59.5696	28.8495	66.1263	7.9454
4500.00	59.7173	29.6467	66.3054	7.9973
4600.00	59.8624	30.4490	66.4818	8.0501
4700.00	60.0051	31.2567	66.6555	8.1034
4800.00	60.1455	32.0697	66.8267	8.1571
4900.00	60.2835	32.8881	66.9954	8.2107
5000.00	60.4194	33.7118	67.1618	8.2639
5100.00	60.5533	34.5409	67.3260	8.3164
5200.00	60.6851	35.3751	67.4880	8.3680
5300.00	60.8149	36.2144	67.6478	8.4183
5400.00	60.9429	37.0587	67.8057	8.4671
5500.00	61.0691	37.9078	67.9615	8.5141
5600.00	61.1936	38.7614	68.1153	8.5592
5700.00	61.3164	39.6195	68.2671	8.6020
5800.00	61.4375	40.4818	68.4171	8.6425
5900.00	61.5570	41.3480	68.5652	8.6806
6000.00	61.6751	42.2178	68.7114	8.7159

Table III. Thermodynamic Functions for Monatomic Erbium, Gas

$H°_{298.15} - H°_0$ = 1481.2 Cal./G.F.W. G.F.W. = 167.26

T, °K.	$-(F° - H°_{298.15})/T$, Cal./G.F.W./Degree	$H° - H°_{298.15}$, Kcal./G.F.W.	$S°$, Cal./G.F.W./Degree	$C_p°$, Cal./G.F.W./Degree
100.00	50.7641	−0.9844	40.9202	4.9679
200.00	46.8017	−0.4876	44.3637	4.9679
298.15	46.3473	0.	46.3473	4.9679
300.00	46.3474	0.0092	46.3780	4.9679
400.00	46.5422	0.5060	47.8072	4.9679
500.00	46.9102	1.0028	48.9158	4.9681
600.00	47.3222	1.4996	49.8216	4.9691
700.00	47.7354	1.9967	50.5879	4.9731
800.00	48.1344	2.4945	51.2525	4.9835
900.00	48.5142	2.9938	51.8406	5.0047
1000.00	48.8737	3.4959	52.3696	5.0417
1100.00	49.2138	4.0028	52.8527	5.0995
1200.00	49.5359	4.5167	53.2998	5.1829
1300.00	49.8417	5.0404	53.7189	5.2957
1400.00	50.1329	5.5769	54.1164	5.4407
1500.00	50.4113	6.1296	54.4977	5.6194
1600.00	50.6783	6.7019	54.8670	5.8319
1700.00	50.9353	7.2971	55.2277	6.0767
1800.00	51.1837	7.9182	55.5827	6.3510
1900.00	51.4244	8.5681	55.9340	6.6507
2000.00	51.6586	9.2491	56.2832	6.9711
2100.00	51.8872	9.9629	56.6314	7.3066
2200.00	52.1107	10.7107	56.9792	7.6512
2300.00	52.3299	11.4932	57.3270	7.9991
2400.00	52.5454	12.3104	57.6747	8.3446
2500.00	52.7575	13.1619	58.0223	8.6823
2600.00	52.9667	14.0465	58.3692	9.0075
2700.00	53.1732	14.9628	58.7150	9.3161
2800.00	53.3773	15.9090	59.0591	9.6049
2900.00	53.5791	16.8830	59.4008	9.8713
3000.00	53.7788	17.8825	59.7396	10.1137
3100.00	53.9765	18.9049	60.0749	10.3309
3200.00	54.1723	19.9478	60.4059	10.5226
3300.00	54.3661	21.0086	60.7324	10.6889
3400.00	54.5581	22.0848	61.0536	10.8305
3500.00	54.7482	23.1739	61.3693	10.9484
3600.00	54.9364	24.2737	61.6791	11.0440
3700.00	55.1228	25.3820	61.9828	11.1187
3800.00	55.3072	26.4968	62.2801	11.1742
3900.00	55.4898	27.6163	62.5709	11.2123
4000.00	55.6704	28.7387	62.8551	11.2347
4100.00	55.8490	29.8627	63.1326	11.2431
4200.00	56.0257	30.9869	63.4035	11.2392
4300.00	56.2003	32.1102	63.6678	11.2247
4400.00	56.3730	33.2316	63.9256	11.2009
4500.00	56.5436	34.3501	64.1770	11.1694
4600.00	56.7122	35.4652	64.4221	11.1312
4700.00	56.8788	36.5762	64.6610	11.0877
4800.00	57.0434	37.6826	64.8939	11.0398
4900.00	57.2059	38.7841	65.1211	10.9885
5000.00	57.3665	39.8802	65.3425	10.9345
5100.00	57.5250	40.9709	65.5585	10.8785
5200.00	57.6815	42.0559	65.7692	10.8211
5300.00	57.8361	43.1351	65.9748	10.7629
5400.00	57.9886	44.2084	66.1754	10.7042
5500.00	58.1393	45.2759	66.3713	10.6455
5600.00	58.2880	46.3375	66.5626	10.5871
5700.00	58.4348	47.3933	66.7494	10.5291
5800.00	58.5797	48.4434	66.9320	10.4718
5900.00	58.7228	49.4871	67.1106	10.4153
6000.00	58.8641	50.5265	67.2852	10.3597

Klinkenberg (*10, 11*) for a total of 314 levels to 33100 cm.$^{-1}$ are used in the calculation plus 38 levels of the $4f^8 5d6s^2$ configuration predicted by Arnoult and Gerstenkorn (*1*) and 12 low-lying levels of the $4f^9 6s^2$ configuration predicted by Conway and Wybourne (*8*).

ERBIUM $4f^{12}6s^2\ {}^3H_6$

Thermodynamic functions are computed with data for 201 levels to 47000 cm.$^{-1}$. Data for 168 experimental levels are taken from Spector (*15*). The seven lowest-lying levels of the $4f^{12}6s^2$ configuration are from Marquet and Davis (*12*). Racah, Goldschmidt, and Toaff (*13*) gave data for nine additional experimental levels and 17 predicted levels.

THULIUM $4f^{13}6s^2\ {}^2F°_{7/2}$

Data for 123 experimental levels to 41300 cm.$^{-1}$ are taken from Blaise and Camus (*5, 6*).

Table IV. Thermodynamic Functions for Monatomic Thulium, Gas

$H^\circ_{298.15} - H^\circ_0$ = 1481.2 Cal./G.F.W. G.F.W. = 168.934

T, °K.	$-(F^\circ - H^\circ_{298.15})/T$, Cal./G.F.W./ Degree	$H^\circ - H^\circ_{298.15}$, Kcal./G.F.W.	S°, Cal./G.F.W./ Degree	C_p°, Cal./G.F.W./ Degree
100.00	49.8290	−0.9844	39.9851	4.9679
200.00	45.8666	−0.4876	43.4286	4.9679
298.15	45.4122	0.	45.4122	4.9679
300.00	45.4123	0.0092	45.4429	4.9679
400.00	45.6071	0.5060	46.8721	4.9679
500.00	45.9751	1.0028	47.9807	4.9679
600.00	46.3871	1.4996	48.8864	4.9679
700.00	46.8003	1.9964	49.6522	4.9679
800.00	47.1992	2.4931	50.3156	4.9680
900.00	47.5786	2.9900	50.9007	4.9682
1000.00	47.9374	3.4868	51.4242	4.9687
1100.00	48.2763	3.9837	51.8978	4.9700
1200.00	48.5963	4.4808	52.3304	4.9725
1300.00	48.8991	4.9783	52.7285	4.9768
1400.00	49.1860	5.4763	53.0976	4.9835
1500.00	49.4583	5.9751	53.4417	4.9932
1600.00	49.7175	6.4750	53.7644	5.0066
1700.00	49.9646	6.9765	54.0684	5.0244
1800.00	50.2006	7.4801	54.3562	5.0473
1900.00	50.4266	7.9862	54.6299	5.0761
2000.00	50.6433	8.4955	54.8911	5.1118
2100.00	50.8516	9.0088	55.1415	5.1556
2200.00	51.0521	9.5270	55.3826	5.2087
2300.00	51.2455	10.0509	55.6155	5.2725
2400.00	51.4323	10.5819	55.8414	5.3485
2500.00	51.6131	11.1211	56.0615	5.4383
2600.00	51.7883	11.6700	56.2768	5.5435
2700.00	51.9585	12.2303	56.4883	5.6658
2800.00	52.1240	12.8038	56.6968	5.8067
2900.00	52.2853	13.3924	56.9033	5.9677
3000.00	52.4426	13.9981	57.1086	6.1498
3100.00	52.5964	14.6231	57.3136	6.3542
3200.00	52.7471	15.2697	57.5188	6.5814
3300.00	52.8948	15.9401	57.7251	6.8319
3400.00	53.0399	16.6368	57.9331	7.1055
3500.00	53.1827	17.3620	58.1433	7.4019
3600.00	53.3234	18.1179	58.3562	7.7200
3700.00	53.4624	18.9067	58.5723	8.0585
3800.00	53.5997	19.7302	58.7919	8.4156
3900.00	53.7357	20.5903	59.0153	8.7891
4000.00	53.8705	21.4885	59.2427	9.1762
4100.00	54.0044	22.4259	59.4741	9.5741
4200.00	54.1374	23.4035	59.7097	9.9793
4300.00	54.2698	24.4219	59.9493	10.3883
4400.00	54.4016	25.4812	60.1928	10.7975
4500.00	54.5331	26.5813	60.4400	11.2030
4600.00	54.6642	27.7216	60.6906	11.6011
4700.00	54.7951	28.9011	60.9443	11.9881
4800.00	54.9259	30.1187	61.2006	12.3605
4900.00	55.0566	31.3726	61.4591	12.7150
5000.00	55.1872	32.6610	61.7194	13.0485
5100.00	55.3179	33.9816	61.9809	13.3586
5200.00	55.4485	35.3319	62.2431	13.6431
5300.00	55.5792	36.7093	62.5055	13.9000
5400.00	55.7099	38.1109	62.7675	14.1282
5500.00	55.8406	39.5339	63.0286	14.3267
5600.00	55.9713	40.9752	63.2883	14.4950
5700.00	56.1019	42.4319	63.5461	14.6331
5800.00	56.2324	43.9009	63.8016	14.7414
5900.00	56.3629	45.3792	64.0543	14.8205
6000.00	56.4932	46.8640	64.3038	14.8713

PLUTONIUM $5f^67s^2\ ^7F_0$

A total of 314 experimental levels to 40000 cm.$^{-1}$ are employed in the calculation. Richards and Ridgeley (*14*) confirmed 284 levels reported from previous investigations. An additional 30 levels reported by Bauche, Blaise, and Fred (*2*), although not substantiated with the techniques employed by Richards and Ridgeley, have been included.

Table V. Thermodynamic Functions for Monatomic Plutonium, Gas

$H^{\circ}_{298.15} - H^{\circ}_{0}$ = 1481.6 Cal./G.F.W. G.F.W. = 239.06

T, °K.	$-(F^{\circ} - H^{\circ}_{298.15})/T$, Cal./G.F.W./ Degree	$H^{\circ} - H^{\circ}_{298.15}$, Kcal./G.F.W.	S°, Cal./G.F.W./ Degree	C°_{p}, Cal./G.F.W./ Degree
100.00	46.7363	−0.9848	36.8878	4.9679
200.00	42.7716	−0.4881	40.3314	4.9681
298.15	42.3166	0.	42.3166	4.9842
300.00	42.3167	0.0092	42.3474	4.9850
400.00	42.5132	0.5124	43.7941	5.1034
500.00	42.8893	1.0357	44.9607	5.3925
600.00	43.3210	1.5956	45.9803	5.8233
700.00	43.7685	2.2027	46.9152	6.3246
800.00	44.2172	2.8610	47.7935	6.8416
900.00	44.6613	3.5707	48.6287	7.3484
1000.00	45.0983	4.3302	49.4285	7.8399
1100.00	45.5272	5.1382	50.1983	8.3189
1200.00	45.9476	5.9936	50.9423	8.7881
1300.00	46.3597	6.8955	51.6639	9.2465
1400.00	46.7637	7.8424	52.3655	9.6890
1500.00	47.1600	8.8325	53.0484	10.1074
1600.00	47.5489	9.8628	53.7132	10.4924
1700.00	47.9306	10.9296	54.3598	10.8354
1800.00	48.3053	12.0282	54.9877	11.1296
1900.00	48.6732	13.1537	55.5962	11.3708
2000.00	49.0341	14.3006	56.1844	11.5577
2100.00	49.3882	15.4635	56.7517	11.6916
2200.00	49.7354	16.6373	57.2978	11.7761
2300.00	50.0757	17.8172	57.8223	11.8163
2400.00	50.4090	18.9992	58.3253	11.8182
2500.00	50.7353	20.1798	58.8073	11.7885
2600.00	51.0547	21.3561	59.2686	11.7337
2700.00	51.3672	22.5259	59.7101	11.6601
2800.00	51.6728	23.6877	60.1326	11.5734
2900.00	51.9715	24.8403	60.5371	11.4785
3000.00	52.2635	25.9833	60.9246	11.3797
3100.00	52.5489	27.1163	61.2961	11.2806
3200.00	52.8279	28.2395	61.6527	11.1840
3300.00	53.1006	29.3532	61.9955	11.0920
3400.00	53.3670	30.4581	62.3253	11.0064
3500.00	53.6276	31.5547	62.6432	10.9281
3600.00	53.8823	32.6439	62.9501	10.8579
3700.00	54.1314	33.7266	63.2467	10.7960
3800.00	54.3751	34.8034	63.5339	10.7426
3900.00	54.6135	35.8754	63.8123	10.6973
4000.00	54.8469	36.9432	64.0827	10.6598
4100.00	55.0753	38.0076	64.3455	10.6296
4200.00	55.2991	39.0693	64.6013	10.6059
4300.00	55.5184	40.1289	64.8507	10.5881
4400.00	55.7332	41.1871	65.0939	10.5754
4500.00	55.9439	42.2442	65.3315	10.5671
4600.00	56.1505	43.3006	65.5637	10.5623
4700.00	56.3532	44.3567	65.7908	10.5602
4800.00	56.5522	45.4127	66.0131	10.5602
4900.00	56.7475	46.4688	66.2309	10.5616
5000.00	56.9393	47.5251	66.4443	10.5636
5100.00	57.1277	48.5815	66.6535	10.5657
5200.00	57.3129	49.6382	66.8587	10.5673
5300.00	57.4949	50.6950	67.0600	10.5680
5400.00	57.6739	51.7517	67.2575	10.5672
5500.00	57.8499	52.8083	67.4514	10.5647
5600.00	58.0230	53.8646	67.6417	10.5601
5700.00	58.1934	54.9203	67.8286	10.5531
5800.00	58.3611	55.9751	68.0120	10.5436
5900.00	58.5262	57.0289	68.1922	10.5312
6000.00	58.6888	58.0813	68.3690	10.5160

LITERATURE CITED

(1) Arnoult, C., Gerstenkorn, S., *J. Opt. Soc. Am.* **56**, 177 (1966).
(2) Bauche, J., Blaise, J., Fred, M., *Compt. Rend.* **257**, 2260 (1963).
(3) Bender, I., Penselin, S., Schlüpmann, K., *Z. Physik* **179**, 4 (1964).
(4) Benton, A., *J. Chem. Eng. Data* **9**, 198 (1964).
(5) Blaise, J., Camus, P., *Compt. Rend.* **260**, 4693 (1965).
(6) Camus, P., Blaise, J., *Ibid.*, **261**, 4359 (1965).
(7) *Chem. Eng. News* **39** (47), 43 (1961).
(8) Conway, J.G., Wybourne, B.G., *Phys. Rev.* **130**, 2325 (1963).
(9) Feber, R., Herrick, C.C., *U. S. Atomic Energy Comm. Rept.* **LA-3184**, 1965.
(10) Klinkenberg, P.F.A., *Z. Physik* **180**, 174 (1964).
(11) Klinkenberg, P.F.A., *Physica* **32**, 1113 (1966).
(12) Marquet, L.C., Davis, S.P., *J. Opt. Soc. Am.* **55**, 471 (1965).
(13) Racah, G., Goldschmidt, Z.B., Toaff, S., *Ibid.*, **56**, 407 (1966).
(14) Richards, E.W.T., Ridgeley, A., *Spectrochim. Acta.* **21**, 1449 (1966).
(15) Spector, N., *J. Opt. Soc. Am.* **55**, 471 (1965).

RECEIVED for review June 13, 1966. Accepted September 26, 1966. This work was performed under the auspices of the United States Atomic Energy Commission.