TERM VALUES IN THE ARC SPECTRUM OF SELENIUM*

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Abstract

A number of new lines in the spectrum of Se I have been observed and classified, and term values are given with respect to the lowest level of Se II, $4p^3\ {}^4S$. The first ionizing potential of the selenium atom in its lowest energy state ($4p^4\ {}^3P_2$) is 78,659 ± 2 cm^{-1} or 9.70 volts.

The lines of the arc spectrum of selenium, classified by Runge and Paschen,[1] and appearing in Fowler's Report on Line Spectra, yield two series which determine the first ionization potential of the atom above the excited $4p^3 5p\,{}^5P_1$ level, with an error of less than one frequency number. (The terms are listed in Fowler as triplets, but should be quintets.) The term

Table I.

Intens.	λ(vac.)	λ(vac.)	Classification
12	2164.82	46193.2	$4p\ {}^3P_1 - 5s\ {}^5S_2$
15	2075.42	48183.0	${}^3P_2 -\ {}^5S_2$
15	2063.42	48463.2	${}^3P_0 -\ {}^3S_1$
20	2040.48	49008.1	${}^3P_1 -\ {}^3S_1$
20	1960.87	50997.8	${}^3P_2 -\ {}^3S_1$
8	1919.20	52105.0	${}^1D_2 - 4d\ {}^3D_1$
9	1913.81	52251.8	${}^1D_2 -\ {}^3D_2$
8	1898.57	52671.2	${}^1D_2 -\ {}^3D_3$
6	1690.72	59146.4	${}^3P_0 -\ {}^3D_1$
6	1675.28	59691.5	${}^3P_1 -\ {}^3D_1$
4	1671.18	59838.0	${}^3P_1 -\ {}^3D_2$
3	1621.26	61680.4	${}^3P_2 -\ {}^3D_1$
6	1617.40	61827.6	${}^3P_2 -\ {}^3D_2$
6	1606.51	62246.7	${}^3P_2 -\ {}^3D_3$
2	8054.2	12415.9	$5p\ {}^5P_1 - 7s\ {}^5S_2$
4	8083.6	12370.7	${}^5P_2 -\ {}^5S_2$
4	8153.0	12265.4	${}^5P_3 -\ {}^5S_2$
3	8921.5	11208.8	$5s\ {}^5S_2 - 5p\ {}^5P_3$
2	9004.5	11105.4	${}^5S_2 -\ {}^5P_2$
1	9041.3	11060.3	${}^5S_2 -\ {}^5P_1$

value of the $4p^3 5s\,{}^5S_2$ level given there was computed from a Rydberg formula, the second member only of the ${}^5S - {}^5P$ series having been observed. The first member of this series has now been observed by us (near λ9000) and the term value of the ${}^5S_2$ level thus definitely fixed. This now permits the levels estab-

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[1] C. Runge and F. Paschen, Astro-Phys. Jour. **8**, 70 (1898).

lished by McLennan, McLay and McLeod,[2] from observations in the vacuum region, to be given term values with respect to the limit determined by the Runge-Paschen series.

During our investigation the entire region from λ1,000 to λ10,000 was photographed on various grating and prism instruments and many new lines

TABLE II. *Se I Terms.*

	$4p$	$^3P_2$:78659 $^3P_1$:76670 $^3P_0$:76125	$^1D_2$:69083	$^1S_0$:55289 (McLennan[3])
		$4s^23d^{10}4p^3$:^4S	$4s^23d^{10}4p^3$:^2D	$4s^23d^{10}4p^3$:^2P
	$5s$	$^5S_2$:30476 $^3S_1$:27661	^1D ^3D	^1P ^3P
	$5p$	$^5P_1$:19416 $^5P_2$:19371 $^5P_3$:19268 $^3P_{012}$	$^1(PDF)$ $^3(PDF)$	$^1(SPD)$ $^3(SPD)$
$4s^23d^{10}4p^3$	$4d$	$^5D_{01234}$ $^3D_1$:16979 $^3D_2$:16832 $^3D_3$:16412	$^1(SPDFG)$ $^3(SPDFG)$	$^1(PDF)$ $^3(PDF)$
	$6s$	$^5S_2$ $^3S_1$		
	$6p$	$^5P_1$:9393 $^5P_2$:9379 $^5P_3$:9342 $^3P_{012}$		
	$5d$	$^5D_{01234}$: $^3D_{123}$		
	$7s$	$^5S_2$:7001 $^3S_1$		
	$6d$	$^5D_{01234}$:5112 $^3D_{012}$		
	$8s$	$^5S_2$:4449 $^3S_1$		

observed, some of which fit into the term scheme so far developed, but many of which do not. Most of the new lines which fit, lie in the vacuum region, and our values for those observed first by McLennan are somewhat more accurate than his. A six-foot grating vacuum spectrograph was used in this region and the spectrum was excited by a spark between cored aluminum electrodes. At the longer wave-lengths, two six-foot gratings in Rowland mountings were used for accurate measurements, and an electrodeless discharge, as well as a vacuum spark, was used for the excitation of the selenium.

In a letter to Nature, McLennan and Crawford[3] refer to the $4p^4$ $^1D_2$ and

[2] J. C. McLennan, A. B. McLay, and J. H. McLeod, Phil. Mag. **4**, 486 (1927).

[3] J. C. McLennan and M. F. Crawford, Nature **124**, 874 (1929).

$4p^4\ {}^1S_0$ levels of selenium and give their positions with reference to the low $4p^4\ {}^3P_{210}$ levels. Our data confirm the ${}^1D_2$ assignment but neither confirm nor contradict that of the ${}^1S_0$.

A list of all the classified ultraviolet lines and other new lines which have been classified is given in Table I.

Table II gives all the known terms, starting from the deepest up to and including the first of the ${}^5S$ and ${}^5D$ terms tabulated in Fowler.

The investigation is being continued.