for supposing that the normal E and F layers are produced to a considerable extent by atomic rather than by blackbody radiation, and this must be attributed largely to hydrogen and helium. If this is so, the absence of any large disturbance of the E and F regions during fade-outs indicates independently that hydrogen or helium radiation *cannot* be responsible for fade-outs. It is then difficult to see to what type of radiation we can attribute fade-outs, unless we consider the possibility of x-rays. However, no independent evidence for the production of x-rays in eruptive areas of the sun seems to be suggested by our present incomplete theories of conditions in the chromosphere and of delayed disturbances in the earth's upper atmosphere following solar eruptions.

I particularly wish to express my appreciation to Professor Otto Oldenberg for many helpful discussions of the subject of this article.

Note: Just before the submission of this article for publication an article appeared by S. E. Williams (Nature **145** 68 (1940)). Williams investigated the absorption of Lyα in oxygen, and found a coefficient approximately 50 times larger than that reported in the present paper. Lacking details of his experimental method, no explanation can be suggested for this huge difference. Nearly any impurity in his absorbing gas, particularly H_2O or CO_2, would result in too large a value for the absorption coefficient.

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The Arc Spectrum of Silver*

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Among all the simpler arc spectra, that of silver has been for years the best example of a badly analyzed spectrum. This is the result of inadequate observation of the spectrum by the many workers who have measured it. The reason for the incompleteness of the observations now appears to be the fact that instruments of too great dispersion were used for the detection of very diffuse lines. Such lines are numerous in silver and attain widths as great as 500 wave numbers.

New observations have been carried out in Princeton with various forms of arc. A preliminary report has been published.[1] The form of arc, which was found by R. Haskins in his senior thesis problem to be the most suitable for observations in the visible and infra-red, was as follows. The electrodes consisted of silver buttons about 5 mm in diameter screwed firmly to water-cooling tubes. The arc was run at 6 to 8 amperes in air or oxygen with the anode down, the cathode being focused on the slit of the spectrograph. Under these conditions the cathode disintegrates by sputtering and the anode increases in weight. The unusual procedure of observing arc lines at the cathode is effective in this case, I believe, because of the high excitation of most of the new lines. It has the added advantage of eliminating the band lines which occur rather strongly at the anode. In the infra-red some exposures were taken with a 20-ampere graphite arc and in the Schumann region small graphite arcs in pure nitrogen were used.[2] This type of arc was necessitated by the fact that silver arcs will hardly run at all in pure nitrogen. The arc observations were made on the following instruments. λ10,000–5000 Steinheil three-prism glass spectrograph; λ5000–2100, Hilger El quartz spectrograph; λ2100–1250, a 30,000 line 2-meter vacuum spectrograph.

In addition the spectra from a hollow cathode argon-filled tube were observed with the 30,000 line 21-ft. grating. The tube was run with the silver in the cathode molten, and very good pictures were obtained in less than an hour.

* When this paper was in preparation there appeared a letter in Phys. Rev. **57**, 243 (1940) from Ebbe Rasmussen in which some of the new levels of AgI, notably $s^2\,{}^2D$, were given.

[1] A. G. Shenstone, Phys. Rev. **56**, 209 (1939).

[2] A. G. Shenstone, Trans. Roy. Soc. **237**, 453 (1938).

TABLE I. *Even levels of* AgI.

ORIGIN	NAME	LEVEL	n^*	ORIGIN	NAME	LEVEL	n^*
$4d^{10}5s$	$5s\,^2S_{\frac{1}{2}}$	61106.50	1.34089	$4d^{10}11d$	$11d\,^2D_{1\frac{1}{2}}$	1355.35?	8.99800
$4d^95s^2$	$5s^2\,^2D_{2\frac{1}{2}}$	30864.40	1.25182	$4d^{10}11d$	$11d\,^2D_{2\frac{1}{2}}$	1354.99?	8.99933
$4d^95s^2$	$5s^2\,^2D_{1\frac{1}{2}}$	26392.5		$4d^{10}12d$	$12d\,^2D$	1098.9	9.994
$4d^{10}6s$	$6s\,^2S_{\frac{1}{2}}$	18550.35	2.43220	$4d^95s(^3D)6s$	$5s6s\,^4D_{3\frac{1}{2}}$	-18306.4	2.293
$4d^{10}5d$	$5d\,^2D_{1\frac{1}{2}}$	12362.50	2.97932	$4d^95s(^3D)6s$	$5s6s\,^4D_{2\frac{1}{2}}$	-19058	2.336
$4d^{10}5d$	$5d\,^2D_{2\frac{1}{2}}$	12342.28	2.98181	$4d^95s(^3D)6s$	$5s6s\,^4D_{1\frac{1}{2}}$	-20159	
$4d^{10}7s$	$7s\,^2S_{\frac{1}{2}}$	9219.52	3.4500	$4d^95s(^3D)6s$	$e\,^2D_{2\frac{1}{2}}$	-20964	
$4d^{10}6d$	$6d\,^2D_{1\frac{1}{2}}$	6903.37	3.98700	$4d^95s(^3D)6s$	$5s6s\,^4D_{\frac{1}{2}}$	-22876.3	
$4d^{10}6d$	$6d\,^2D_{2\frac{1}{2}}$	6892.90	3.99003	$4d^95s(^3D)6s$	$e\,^2D_{1\frac{1}{2}}$	-23487	
$4d^{10}8s$	$8s\,^2S_{\frac{1}{2}}$	5525.21	4.45660	$4d^95s(^1D)6s$	$f\,^2D_{2\frac{1}{2}}$	-25378	
$4d^{10}7d$	$7d\,^2D_{1\frac{1}{2}}$	4406.71	4.99022	$4d^95s(^3D_3)5d$	$11_{3\frac{1}{2},4\frac{1}{2}}$	-25789	2.864
$4d^{10}7d$	$7d\,^2D_{2\frac{1}{2}}$	4400.96	4.99344	$4d^95s(^3D_3)5d$	$12_{3\frac{1}{2},4\frac{1}{2}}$	-26015.5	2.889
$4d^{10}5g$	$5g\,^2G$	4395.4	4.99665	$4d^95s(^3D_3)5d$	$13_{2\frac{1}{2},3\frac{1}{2}}$	-26037	2.891
$4d^{10}9s$	$9s\,^2S_{\frac{1}{2}}$	3681.39	5.45971	$4d^95s(^3D_3)5d$	$14_{2\frac{1}{2}}$	-26116	2.900
$4d^{10}8d$	$8d\,^2D_{1\frac{1}{2}}$	3056.49	5.99190	$4d^95s(^3D_3)5d$	$15_{3\frac{1}{2}}$	-26205.5	2.910
$4d^{10}8d$	$8d\,^2D_{2\frac{1}{2}}$	3053.02	5.99530	$4d^95s(^3D_3)5d$	$16_{3\frac{1}{2},4\frac{1}{2}}$	-26250.1	2.915
$4d^{10}10s$	$10s\,^2S_{\frac{1}{2}}$	2628.37	6.46150	$4d^95s(^3D_2)5d$	$17_{2\frac{1}{2},3\frac{1}{2},4\frac{1}{2}}$	-27487	2.877
$4d^{10}9d$	$9d\,^2D_{1\frac{1}{2}}$	2244.04	6.99400	$4d^95s(^3D_2)5d$	$18_{2\frac{1}{2}}$	-27632	2.893
$4d^{10}9d$	$9d\,^2D_{2\frac{1}{2}}$	2241.84	6.99650	$4d^95s(^3D_2)5d$	$19_{2\frac{1}{2},3\frac{1}{2}}$	-27710	2.902
$4d^{10}11s$	$11s\,^2S_{\frac{1}{2}}$	1970.51	7.46260	$4d^95s(^3D_3)7s$	$5s7s\,^4D_{3\frac{1}{2}}$	-29260	3.329
$4d^{10}10d$	$10d\,^2D_{1\frac{1}{2}}$	1717.53	7.99360	$4d^95s$?	$20_{1\frac{1}{2},2\frac{1}{2}}$	-29506	3.371
$4d^{10}10d$	$10d\,^2D_{2\frac{1}{2}}$	1715.78	7.99725	$4d^95s\,^3D_3$	AgII	-39164	
$4d^{10}12s$	$12s\,^2S_{\frac{1}{2}}$	1531.94	8.46375				

TABLE II. *Odd levels of* AgI.†

ORIGIN	NAME	LEVEL	n^*	ORIGIN	NAME	LEVEL	n^*	ORIGIN	NAME	LEVEL	n^*
$4d^{10}5p$	$5p\,^2P_{\frac{1}{2}}$	31554.45	1.86486	$4d^95s(^3D)5p$	$5s5p\,^4P_{1\frac{1}{2}}$	2601.8		$4d^95s(^3D)5p$	$5s5p\,^4D_{\frac{1}{2}}$	$-3469.$	
$4d^{10}5p$	$5p\,^2P_{1\frac{1}{2}}$	30633.79	1.89268	$4d^95s(^3D)5p$	$5s5p\,^4F_{3\frac{1}{2}}$	2316.8		$4d^95s(^3D)5p$	$5s5p\,^2F_{3\frac{1}{2}}$	-4531.1	
$4d^{10}6p$	$6p\,^2P_{\frac{1}{2}}$	12809.31	2.92694	$4d^95s(^3D)5p$	$5s5p\,^4F_{4\frac{1}{2}}$	2204.6		$4d^95s(^3D)5p$	$5s5p\,^2P$	-4880	
$4d^{10}6p$	$6p\,^2P_{1\frac{1}{2}}$	12605.90	2.95047	$4d^95s(^3D)5p$	$5s5p\,^4F_{2\frac{1}{2}}$	1785.4		$4d^95s(^3D)5p$	$5s5p\,^2D_{1\frac{1}{2}}$	-5234	
$4d^{10}7p$	$7p\,^2P_{\frac{1}{2}}$	7065.1	3.94111	$4d^95s(^3D)5p$	$5s5p\,^4P_{\frac{1}{2}}$	569.0		$4d^95s(^3D)5p$	$5s5p\,^2D_{2\frac{1}{2}}$	-5865.5	
$4d^{10}7p$	$7p\,^2P_{1\frac{1}{2}}$	6985.6	3.96347	$4d^95s(^3D)5p$	$5s5p\,^4F_{1\frac{1}{2}}$	-135.4		$4d^95s(^1D)5p\,^2F_3$	1°	-11228	
$4d^{10}4f$	$4f\,^2F$	6901.9	3.98743	$4d^95s(^3D)5p$	$5s5p\,^4D_{2\frac{1}{2}}$	-1075.1		$4d^95s(^1D)5p\,^2P_1$	2°	-12364 ?	
$4d^95s(^3D)5p$	$5s5p\,^4P_{2\frac{1}{2}}$	4883.2		$4d^95s(^3D)5p$	$5s5p\,^2F_{2\frac{1}{2}}$	-1827.2		$4d^95s(^1D)5p\,^2D_2$	3°	-12421	
$4d^{10}8p$	$8p\,^2P_{\frac{1}{2}}$	4488.2	4.94472	$4d^95s(^3D)5p$	$5s5p\,^4D_{1\frac{1}{2}}$	-2424.2		$4d^95s\,^3D_3$		-39164	
$4d^{10}8p$	$8p\,^2P_{1\frac{1}{2}}$	4446.1	4.96806								
$4d^{10}5f$	$5f\,^2F$	4397.1 ?	4.99567								
$4d^{10}9p$	$9p\,^2P_{1\frac{1}{2}}$	3079.6	5.96940								

† The symbol for "odd level" has been omitted wherever the prefix based on electron configuration gives the parity.

These observations were chiefly useful in differentiating between types of lines and in determining the series limits very exactly.

The line list, Table III, includes all the lines from λ40,000 to λ1250 which I think can be safely attributed to AgI. There are 243 lines of which 148 are new. Some of the old lines were observed by Kayser, but not again until the present survey was made. The observations of Paul[3] on absorption lines in the Schumann region include, I believe, some impurity lines. My reason for this statement is that Paul failed to observe many certain $5\,^2S$ combinations and yet observed other absorptions in the same region. The emission spectrum down to λ1250 definitely includes only three of Paul's lines. Some of his shorter lines may be due to silver but there is no conclusive evidence. I cannot accept his proposed series as real.

[3] F. W. Paul, Phys. Rev. **52**, 923 (1937).

The most important term to find is $4d^95s^2\,^2D$, which had been placed, by comparison with similar spectra, almost directly on top of $4d^{10}5p$.[4] This has now proved to be correct, the $^2D_{2\frac{1}{2}}$ being between the components of ^2P and therefore metastable and the $^2D_{1\frac{1}{2}}$ being higher by 4472 cm^{-1}, and therefore not metastable. The correct difference was found by McLennan and McLay[5] in 1928 from three pairs of lines, one pair being very probably fortuitous. The most important combination of the $s^2\,^2D_{2\frac{1}{2}}$ term is that with $6p\,^2P_{1\frac{1}{2}}$ at λ5475. This line is very strong in both arc and Schuler tube and can easily be

[4] H. A. Blair, Phys. Rev. **36**, 1531 (1930).

[5] J. C. McLennan and A. B. McLay, Trans. Roy. Soc. Can. **22**, 1 (1928).

TABLE III. *Wave-lengths, intensity, and classification of all the lines from* λ*40000 to* λ*1250 attributed to* AgI. *A letter n in column one indicates a new line. In column one the symbols have the following meaning: P—F. Paschen, Ann. d. Physik* **33**, *717 (1910); R—H. H. Randall, Astrophys. J.* **34**, *1 (1911); M—W. F. Meggers, letter; S—new observation; H—Hetzler, Bouman and Burns, Phys. Rev.* **48**, *656 (1935); W—F. M. Walters, Sci. Papers, Nat. Bur. Stand. No. 411, 1921; T—*M. I. T. *Wave-length Tables; Av—average of best values; B—H. A. Blair, Phys. Rev.* **36**, *1531 (1930). The wave-length* λ *was measured on Schuler tube plates where possible. I(arc) and I(ST) are the intensities in the arc and Schuler tube, respectively.*

AUTHORITY (*n* INDICATES NEW LINE)	λ	$I_{(\text{ARC})}$	$I_{(ST)}$	ν	CLASSIFICATION
P	39951	8		2502.4	$4^2F-7d^2D_{2\frac{1}{2}}$
P	39889	5		2506.3	4^2F-5^2G
R	18382.3	15		5438.6	$5d^2D_{1\frac{1}{2}}-4f^2F$
R	18307.9	15		5460.7	$5d^2D_{2\frac{1}{2}}-4f^2F$
R	17416.7	20		5740.0	$6s^2S_{\frac{1}{2}}-6p^2P_{\frac{1}{2}}$
R	16819.5	60		5943.9	$6s^2S_{\frac{1}{2}}-6p^2P_{1\frac{1}{2}}$
R	12551.0	10		7965.4	$5d^2D_{1\frac{1}{2}}-5f^2F$
M *n*	9001.1	1*U*		11106.7	
S *n*	8745.7	1*U*		11431.	
S *n*	8704.85	10*u*		11484.7	$6s^2S_{\frac{1}{2}}-7p^2P_{\frac{1}{2}}$
S *n*	8645.70	30*u*		11563.3	$6s^2S_{\frac{1}{2}}-7p^2P_{1\frac{1}{2}}$
H	8273.519	1000		12083.44	$5p^2P_{1\frac{1}{2}}-6s^2S_{\frac{1}{2}}$
H	7687.779	500		13004.10	$5p^2P_{\frac{1}{2}}-6s^2S_{\frac{1}{2}}$
S *n*	7402.96	0		13504.4	
S *n*	7359.96	20	10	13583.3	$5s^2\,{}^2D_{1\frac{1}{2}}-6p^2P_{\frac{1}{2}}$
S *n*	7297.8	0*U*		13699.	$3^\circ-14_{2\frac{1}{2}}$
S *n*	7251.53	5	5	13786.4	$5s^2\,{}^2D_{1\frac{1}{2}}-6p^2P_{1\frac{1}{2}}$
S *n*	7109.5	1*U*		14062.	$6s^2S_{\frac{1}{2}}-8p^2P_{\frac{1}{2}}$
S *n*	7088.10	5*U*	5	14104.3	$6s^2S_{\frac{1}{2}}-8p^2P_{1\frac{1}{2}}$
S *n*	6861.0	5*UU*		14571.	$1^\circ-11$
S *n*	6754.5	5*UU*		14801.	$1^\circ-13$
S *n*	6706.67	5		14904.2	
S *n*	6655.5	5*UU*		15021.	$1^\circ-16$
S *n*	6621.08	20		15099.1	$5s5p^2D_{2\frac{1}{2}}-e^2D_{2\frac{1}{2}}$
S *n*	6571.7	2*U*		15212.6	$3^\circ-18_{2\frac{1}{2}}$
S *n*	6537.6	2*U*		15292.	$5s5p^2P-5s6s^4D_{1\frac{1}{2}}$?
					$3^\circ-19$?
S *n*	6461.80	0*U*	2	15471.3	$6s^2S_{\frac{1}{2}}-9p^2P_{1\frac{1}{2}}$
S *n*	6268.50	10*u*	20	15948.4	$6s^2S_{\frac{1}{2}}-5s5p^4P_{1\frac{1}{2}}$
S *n*	6230.63	1		16045.3	
S *n*	6218.0	2*U*		16078.	$5s5p^2P-e^2D_{2\frac{1}{2}}$?
S *n*	6191.8	0*U*		16146.	
S *n*	6141.64	2*u*		16277.8	
S *n*	6083.78	10*U*		16432.6	$5s5p^2F_{3\frac{1}{2}}-e^2D_{2\frac{1}{2}}$
S *n*	6047.6	2*U*		16531.	
S *n*	6010.1	5*U*		16634.	$5s5p^4D_{1\frac{1}{2}}-5s6s^4D_{2\frac{1}{2}}$
S *n*	5989.6	1*UU*		16691.	$5s5p^4D_{\frac{1}{2}}-5s6s^4D_{1\frac{1}{2}}$
S *n*	5801.92	5*U*		17230.9	$5s5p^4D_{2\frac{1}{2}}-5s6s^4D_{3\frac{1}{2}}$?
					$5s5p^2F_{2\frac{1}{2}}-5s6s^4D_{2\frac{1}{2}}$
S *n*	5673.15	5*u*		17622.0	$5s5p^2D_{2\frac{1}{2}}-e^2D_{1\frac{1}{2}}$
W	5667.34	100		17640.1	$5s5p^4D_{3\frac{1}{2}}-5s6s^4D_{3\frac{1}{2}}$
S *n*	5637.01	5*U*		17735.0	$5s5p^4D_{1\frac{1}{2}}-5s6s^4D_{1\frac{1}{2}}$
S *n*	5609.02	3*U*		17823.5	$5p^2P_{1\frac{1}{2}}-6p^2P_{\frac{1}{2}}$
S *n*	5559.58	10*U*		17982.0	$6s^2S_{\frac{1}{2}}-5s5p^4P_{\frac{1}{2}}$?
					$5s5p^4D_{2\frac{1}{2}}-5s6s^4D_{2\frac{1}{2}}$
W	5545.67	20*U*		18027.1	$5p^2P_{1\frac{1}{2}}-6p^2P_{1\frac{1}{2}}$
S *n*	5475.382	20	20	18258.50	$5s^2\,{}^2D_{2\frac{1}{2}}-6p^2P_{1\frac{1}{2}}$
S	5471.547	50	100	18271.29	$5p^2P_{1\frac{1}{2}}-5d^2D_{1\frac{1}{2}}$
S	5465.503	1000	1000	18291.51	$5p^2P_{1\frac{1}{2}}-5d^2D_{2\frac{1}{2}}$
S	5436.00	5*U*		18390.8	$5s5p^4D_{3\frac{1}{2}}-5s6s^4D_{2\frac{1}{2}}$
S	5403.22	1*u*		18502.0	$5s^2\,{}^2D_{2\frac{1}{2}}-5d^2D_{1\frac{1}{2}}$
S	5400.46	2*u*		18511.8	
S *n*	5397.11	0*u*		18523.3	$5s^2\,{}^2D_{2\frac{1}{2}}-5d^2D_{2\frac{1}{2}}$
S	5333.62	10*U*		18743.8	$5p^2P_{\frac{1}{2}}-6p^2P_{\frac{1}{2}}$
S *n*	5283.16	1*U*		18922.8	$5s5p^4F_{1\frac{1}{2}}-5s6s^4D_{2\frac{1}{2}}$
S	5276.36	5*U*		18947.2	$5p^2P_{\frac{1}{2}}-6p^2P_{1\frac{1}{2}}$
S *n*	5244.40	1*u*		19062.7	
S *n*	5238.35	5*U*		19084.7	$5s5p^4D_{2\frac{1}{2}}-5s6s^4D_{1\frac{1}{2}}$
S	5209.078	1000	1000	19191.93	$5p^2P_{\frac{1}{2}}-5d^2D_{1\frac{1}{2}}$
S *n*	5138.34	5*U*		19325.6	$5s^2\,{}^2D_{1\frac{1}{2}}-7p^2P_{\frac{1}{2}}$
S *n*	5151.80	2 ?		19405.3	$5s^2\,{}^2D_{1\frac{1}{2}}-7p^2P_{1\frac{1}{2}}$
S *n*	5129.30	3*U*		19490.4	$5s^2\,{}^2D_{1\frac{1}{2}}-4f^2F$
S	5123.50	15*u*		19512.5	$5s5p^2D_{2\frac{1}{2}}-f^2D_{2\frac{1}{2}}$
S *n*	5032.75	3*u*		19864.3	
S *n*	5026.40	3*U*		19889.4	$5s5p^4D_{2\frac{1}{2}}-e^2D_{2\frac{1}{2}}$
S	4992.89	20*U*		20022.9	$5s5p^4F_{1\frac{1}{2}}-5s6s^4D_{1\frac{1}{2}}$
S *n*	4974.38	1*U*		20097.4	
S *n*	4956.18	5		20171.2	$5s5p^2D_{2\frac{1}{2}}-13$
S *n*	4937.04	1		20249.4	$5s5p^2D_{2\frac{1}{2}}-14_{2\frac{1}{2}}$
S *n*	4935.75	10		20254.7	
S *n*	4934.07	5		20261.7	
S *n*	4925.25	3*U*		20297.9	$5s5p^4D_{3\frac{1}{2}}-e^2D_{2\frac{1}{2}}$
S *n*	4917.5	10*UU*		20330.	
S	4888.21	20		20451.7	$5s5p^4D_{1\frac{1}{2}}-5s6s^4D_{\frac{1}{2}}$
S *n*	4886.27	0		20459.8	
S	4874.100	100	10	20510.90	$5s5p^4F_{4\frac{1}{2}}-5s6s^4D_{3\frac{1}{2}}$
S	4847.82	30*u*(*r*)		20622.1	$5s5p^4F_{3\frac{1}{2}}-5s6s^4D_{3\frac{1}{2}}$
S *n*	4840.28	0*U*		20654.2	
S *n*	4822.79	5*UU*		20729.	$5s5p^4P_{\frac{1}{2}}-5s6s^4D_{1\frac{1}{2}}$
S	4796.2	20*UU*(*r*)		20844.	$5s5p^4F_{2\frac{1}{2}}-5s6s^4D_{2\frac{1}{2}}$
					$5s5p^2F_{3\frac{1}{2}}-f^2D_{2\frac{1}{2}}$
S *n*	4745.93	2*U*		21064.8	$5s5p^4D_{1\frac{1}{2}}-e^2D_{1\frac{1}{2}}$
S *n*	4702.3	2*UU*		21260.	
S	4677.60	30*U*(*r*)		21372.5	$5s5p^4F_{3\frac{1}{2}}-5s6s^4D_{2\frac{1}{2}}$
S	4668.478	500*u*	500	21414.28	$5p^2P_{1\frac{1}{2}}-7s^2S_{\frac{1}{2}}$
S	4615.69	30*U*		21659.2	$5s5p^4P_{1\frac{1}{2}}-5s6s^4D_2$
					$5s5p^2F_{2\frac{1}{2}}-e^2D_{1\frac{1}{2}}$
S *n*	4575.99	2		21847.1	$5s5p^2D_{2\frac{1}{2}}-19$
S *n*	4564.02	0*U*		21904.4	$5s^2\,{}^2D_{1\frac{1}{2}}-8p^2P_{\frac{1}{2}}$
S	4556.0	20*UU*		21943.	$5s5p^4F_{2\frac{1}{2}}-5s6s^4D_{1\frac{1}{2}}$
S *n*	4499.50	1*U*		22218.5	
S	4476.042	500*u*	500	22334.92	$5p^2P_{\frac{1}{2}}-7s^2S_{\frac{1}{2}}$
S	4396.23	20		22740.4	$5s5p^4F_{1\frac{1}{2}}-5s6s^4D_{\frac{1}{2}}$
S *n*	4394.37	1*u*		22750.0	$5s5p^4F_{2\frac{1}{2}}-e^2D_{2\frac{1}{2}}$
S *n*	4372.90	3*u*		22761.7	$5s5p^4P_{1\frac{1}{2}}-5s6s^4D_{1\frac{1}{2}}$
S *n*	4354.7	5*UU*		22957.	$5s5p^2F_{3\frac{1}{2}}-17$
T	4311.074	50		23189.58	$5s5p^4P_{2\frac{1}{2}}-5s6s^4D_{3\frac{1}{2}}$
S *n*	4294.27	5*u*		23280.3	$5s5p^4F_{3\frac{1}{2}}-e^2D_{2\frac{1}{2}}$
S *n*	4281.16	0*U*		23351.6	$5s5p^4F_{1\frac{1}{2}}-e^2D_{1\frac{1}{2}}$
S *n*	4263.78	1*U*		23446.8	$5s5p^4P_{\frac{1}{2}}-5s6s^4D_{\frac{1}{2}}$
S *n*	4242.19	5*u*		23566.1	$5s5p^4P_{1\frac{1}{2}}-e^2D_{2\frac{1}{2}}$
S *n*	4228.7	5*UU*		23641.	$5s5p^2D_{2\frac{1}{2}}-20$
S	4212.817	100	100	23730.42	$5p^2P_{1\frac{1}{2}}-6d^2D_{1\frac{1}{2}}$
S *n*	4212.520		5	23732.11	$5p^2P_{1\frac{1}{2}}-4f^2F$
S	4210.960	500	500	23740.89	$5p^2P_{1\frac{1}{2}}-6d^2D_{2\frac{1}{2}}$
S *n*	4186.637	5*u*	10	23878.81	$5s^2\,{}^2D_{2\frac{1}{2}}-7p^2P_{1\frac{1}{2}}$
S *n*	4175.78	3*u*		23940.9	$5s5p^4P_{2\frac{1}{2}}-5s6s^4D_{2\frac{1}{2}}$
S *n*	4172.016	3*u*	2	23962.50	$5s^2\,{}^2D_{2\frac{1}{2}}-4f^2F$
S *n*	4083.43	10*U*		24482.3	
S *n*	4062.71	5*u*		24607.2	$5s^2\,{}^2D_{2\frac{1}{2}}-5s5p^4F_2$
S *n*	4062.08	5*u*		24611.0	
S	4055.476	1000	500	24651.08	$5p^2P_{\frac{1}{2}}-6d^2D_{1\frac{1}{2}}$
S *n*	4055.196		10	24652.78	$5p^2P_{\frac{1}{2}}-4f^2F$
S *n*	4015.68	0*u*		24895.4	
S *n*	4012.99	0*u*		24912.1	
S	3992.15	10*U*		25042.1	$5s5p^4D_{2\frac{1}{2}}-14_{2\frac{1}{2}}$
S	3981.584	100*U*(*r*)	100	25108.56	$5p^2P_{1\frac{1}{2}}-8s^2S_{\frac{1}{2}}$
S *n*	3979.44	5*u*		25122.1	$5s5p^4D_{3\frac{1}{2}}-11$
S	3951.28	5*u*		25301.1	
S	3942.972	10*u*	1	25354.43	$5s5p^4D_{3\frac{1}{2}}-12$?
S	3940.43	10*U*		25370.8	$5s5p^4D_{3\frac{1}{2}}-13$
S *n*	3928.01	10*U*		25451.0	$5s5p^4D_{3\frac{1}{2}}-14_{2\frac{1}{2}}$
S *n*	3923.759	2	15 ?	25478.56	$5s5p^4P_{1\frac{1}{2}}-5s6s^4D_{\frac{1}{2}}$
S	3914.40	50*u*	3*U*	25539.15	$5s5p^4D_{3\frac{1}{2}}-15_{3\frac{1}{2}}$
S	3907.41	50*u*		25584.2	$5s5p^4D_{3\frac{1}{2}}-16$
S *n*	3847.849	15	50	25981.20	$5s^2\,{}^2D_{2\frac{1}{2}}-5s5p^4P_{2\frac{1}{2}}$
S	3840.745	100*u*	100	26029.25	$5p^2P_{\frac{1}{2}}-8s^2S_{\frac{1}{2}}$
S *n*	3811.775	50	50	26227.08	$5p^2P_{1\frac{1}{2}}-7d^2D_{1\frac{1}{2}}$
S	3810.940	200	200	26232.83	$5p^2P_{1\frac{1}{2}}-7d^2D_{2\frac{1}{2}}$
S *n*	3791.89	1*U*		26364.6	
S *n*	3784.183	0*U*	15	26418.30	$5s^2\,{}^2D_{2\frac{1}{2}}-8p^2P_{1\frac{1}{2}}$
S *n*	3771.07	1*U*		26510.2	
S *n*	3768.51	5*u*		26528.2	$5s^2\,{}^2D_{1\frac{1}{2}}-5s5p^4F_1$
S *n*	3764.53	3*U*		26556.2	$5s5p^4D_{2\frac{1}{2}}-18_{2\frac{1}{2}}$
S *n*	3753.14	20*U*		26636.8	$5s5p^4D_{2\frac{1}{2}}-19$
S *n*	3727.42	10*U*		26820.6	$5s5p^4D_{3\frac{1}{2}}-17$
S *n*	3723.59	2*u*		26848.2	
S	3714.28	3*u*		26915.5	
S	3709.196	50*u*	30	26952.38	$5p^2P_{1\frac{1}{2}}-9s^2S_{\frac{1}{2}}$
S *n*	3696.64	2*U*		27043.9	$5s5p^4D_{3\frac{1}{2}}-19$
S	3682.505	30	200	27147.73	$5p^2P_{\frac{1}{2}}-7d^2D_{1\frac{1}{2}}$
S *n*	3654.62	5*U*		27354.9	$5s5p^4F_{1\frac{1}{2}}-17$?
S *n*	3639.578	Pb? 5*u*		27467.91	$5s^2\,{}^2D_{1\frac{1}{2}}-5s5p^4D_{2\frac{1}{2}}$
S *n*	3625.132		5	27577.37	$5p^2P_{1\frac{1}{2}}-8d^2D_{1\frac{1}{2}}$
S	3624.684	50*u*	50	27580.78	$5p^2P_{1\frac{1}{2}}-8d^2D_{2\frac{1}{2}}$
S *n*	3623.49	10*u*		27589.5	
S *n*	3598.065	0*U*	2	27784.81	$5s^2\,{}^2D_{2\frac{1}{2}}-9p^2P_{1\frac{1}{2}}$
S	3586.672	20*u*(*r*)	30	27873.07	$5p^2P_{\frac{1}{2}}-9s^2S_{\frac{1}{2}}$
S *n*	3582.78	3*Ud*		27903.3	
S *n*	3571.13	0		27994.4	$5s5p^4F_{4\frac{1}{2}}-11$
S *n*	3569.722	2	10	28005.42	$5p^2P_{1\frac{1}{2}}-10s^2S_{\frac{1}{2}}$
S	3557.01	10*u*(*r*)		28105.5	$5s5p^4F_{3\frac{1}{2}}-11$
S	3547.16	10*u*		28183.5	$5s5p^4D_{2\frac{1}{2}}-5s7s^4D_{3\frac{1}{2}}$?
S	3542.608	50	100	28219.76	$5s^2\,{}^2D_{1\frac{1}{2}}-5s5p^2F_{2\frac{1}{2}}$?
					$5s5p^4F_{4\frac{1}{2}}-12$?
S *n*	3537.23	5		28262.7	$5s^2\,{}^2D_{2\frac{1}{2}}-5s5p^4P_{1\frac{1}{2}}$

TABLE III—*Continued.*

AUTHORITY (*n* INDICATES NEW LINE)	λ	$I_{(\text{ARC})}$	$I_{(ST)}$	ν	CLASSIFICATION
S n	3533.11	3*UU*		28296.	
S n	3528.534	3*U*	5	28332.31	$5s5p^4F_{3\frac{1}{2}}-12$?
S n	3526.01	1*u*		28352.6	$5s5p^4F_{3\frac{1}{2}}-13$
S n	3524.60	1		28363.9	
S n	3521.393		3	28389.77	$5p^2P_{1\frac{1}{2}}-9d^2D_{1\frac{1}{2}}$
S	3521.122	10	10	28391.95	$5p^2P_{1\frac{1}{2}}-9d^2D_{2\frac{1}{2}}$
S n	3518.900	5*u*	5	28409.88	$5s5p^4F_{4\frac{1}{2}}-15_{3\frac{1}{2}}$
S	3515.99	2*Ud*		28433.4	$5s5p^4D_{2\frac{1}{2}}-20$
S	3513.377	15*u*	3	28454.64	$5s5p^4F_{4\frac{1}{2}}-16$
S	3508.030	20	30	28497.91	$5p^2P_{\frac{1}{2}}-8d^2D_{1\frac{1}{2}}$
S	3505.015	5*u*	10	28522.42	$5s5p^4F_{3\frac{1}{2}}-15_{3\frac{1}{2}}$
S	3501.921	20*u*	30	28547.62	$5s^2\,^2D_{2\frac{1}{2}}-5s5p^4F_{3\frac{1}{2}}$
S	3499.668	5*u*	3	28565.99	
S n	3499.541		2	28567.03	$5s5p^4F_{3\frac{1}{2}}-16$
S	3487.790	5	3	28663.28	$5p^2P_{1\frac{1}{2}}-11s^2S_{\frac{1}{2}}$
S n	3481.22	3*u*		28717.4	$5s5p^4P_{1\frac{1}{2}}-14_{2\frac{1}{2}}$
S	3469.16	30		28817.2	$5s^2\,^2D_{1\frac{1}{2}}-5s5p^4D_{1\frac{1}{2}}$
S n	3457.276		1	28916.24	$5p^2P_{1\frac{1}{2}}-10d^2D_{1\frac{1}{2}}$
S	3457.066	5	5	28918.01	$5p^2P_{1\frac{1}{2}}-10\,^2D_{2\frac{1}{2}}$
S n	3456.102		5	28926.07	$5p^2P_{\frac{1}{2}}-10s^2S_{\frac{1}{2}}$
S n	3435.227		0*u*	29101.85	$5p^2P_{1\frac{1}{2}}-12s^2S_{\frac{1}{2}}$
S n	3434.665	1	2	29106.61	
S n	3420.41	0*U*		29227.9	
S n	3414.507		3	29278.44	$5p^2P_{1\frac{1}{2}}-11d^2D_{1\frac{1}{2}}$?
S	3414.464		3	29278.80	$5p^2P_{1\frac{1}{2}}-11d^2D_{2\frac{1}{2}}$?
S	3410.784	8	10	29310.39	$5p^2P_{\frac{1}{2}}-9d^2D_{1\frac{1}{2}}$
S n	3403.78	10*U*		29370.7	$5s5p^4F_{1\frac{1}{2}}-20$
S n	3398.38	1*U*		29417.4	$5s5p^4F_{2\frac{1}{2}}-18_{2\frac{1}{2}}$
Av.	3382.893	1000*R*	1000	29552.04	$5s^2S_{\frac{1}{2}}-5p^2P_{\frac{1}{2}}$
S n	3357.98	1		29771.3	
S	3354.63	5*u*		29801.0	$5s5p^4F_{3\frac{1}{2}}-17$
S	3350.590	3	3	29836.94	$5p^2P_{\frac{1}{2}}-10d^2D_{1\frac{1}{2}}$
S	3339.20	5*u*		29938.7	
S n	3329.48	0*u*		30026.2	$5s5p^4F_{3\frac{1}{2}}-19$
S	3327.70	5*u*		30042.2	
B	3310.51	2		30198.2	$5p^2P_{\frac{1}{2}}-11d^2D_{1\frac{1}{2}}$
S n	3306.70	1		30233.0	$5s5p^4P_{1\frac{1}{2}}-18_{2\frac{1}{2}}$
S	3305.672	10*u*		30242.36	$5s^2S_{\frac{1}{2}}-5s^2\,^2D_{2\frac{1}{2}}$
B	3282.53	3		30455.6	$5p^2P_{\frac{1}{2}}-12d^2D_{1\frac{1}{2}}$
Av.	3280.680	1000*R*	1000	30472.73	$5s^2S_{\frac{1}{2}}-5p^2P_{1\frac{1}{2}}$
S n	3265.72	5		30612.3	
S	3233.18	15		30920.4	$5s5p^4P_{2\frac{1}{2}}-13$
S	3225.15	10		30997.4	$5s5p^4P_{2\frac{1}{2}}-14_{2\frac{1}{2}}$
S	3215.67	15*u*		31088.8	$5s5p^4P_{2\frac{1}{2}}-15_{3\frac{1}{2}}$
S n	3188.36	2*U*		31355.0	
S	3186.19	3*u*		31376.4	
S n	3177.33	5		31463.9	$5s5p^4F_{4\frac{1}{2}}-5s7s^4D_{3\frac{1}{2}}$
T	3170.579	10*u*		31530.99	$5s^2\,^2D_{2\frac{1}{2}}-5s5p^4D_{3\frac{1}{2}}$

AUTHORITY (*n* INDICATES NEW LINE)	λ	$I_{(\text{ARC})}$	$I_{(ST)}$	ν	CLASSIFICATION
S	3130.02	30*U*		31939.5	$5s^2\,^2D_{2\frac{1}{2}}-5s5p^4D_{2\frac{1}{2}}$
S	3099.10	20		32258.1	$5s^2\,^2D_{1\frac{1}{2}}-5s5p^2D_{2\frac{1}{2}}$
S n	3034.99	3		32939.5	
S	2938.42	20*U*		34022.	
S n	2933.00	2*u*		34084.9	
S n	2928.95	5		34143.6	$5s5p^4P_{2\frac{1}{2}}-5s7s^4D_{3\frac{1}{2}}$
S n	2926.77	10*u*		34157.4	
S n	2920.70	1*u*		34228.4	
S n	2919.03	5*u*		34248.0	
S n	2911.37	0*U*		34338.	
S n	2909.51	1*U*		34360.	
S n	2832.27	1*U*		35297.	
S	2824.39	100*U*		35395.5	$5s^2\,^2D_{2\frac{1}{2}}-5s5p^2F_{3\frac{1}{2}}$
S	2796.77	3*U*		35745.	$5s^2\,^2D_{2\frac{1}{2}}-5s5p^2P$
S n	2778.04	1*U*		35986.	
S n	2775.88	3*U*		36014.	
S n	2768.88	1*U*		36105.	
S	2721.77	50		36729.9	$5s^2\,^2D_{2\frac{1}{2}}-5s5p^2D_{2\frac{1}{2}}$
S n	2715.85	3*UU*		36810.	
S	2595.51	2*U*		38516.6	
S	2575.63	50*U*		38813.8	$5s^2\,^2D_{1\frac{1}{2}}-3°$
S	2375.02	50*UU*		42092.	$5s^2\,^2D_{2\frac{1}{2}}-1°$
S	2312.60	10*UU*		43228.	$5s^2\,^2D_{2\frac{1}{2}}-2°$
S	2309.56	30*U*		43285.	$5s^2\,^2D_{2\frac{1}{2}}-3°$
	λ(vac)				
S n	2170.68	15		46068.5	
S n	2167.45	5		46137.2	
S n	2147.40	5*U*		46567.9	
S n	2143.50	5		46652.7	
S	2070.514	100	100	48297.19	$5s^2\,S_{\frac{1}{2}}-6p^2P_{\frac{1}{2}}$
S	2061.830	200	200	48500.60	$5s^2S_{\frac{1}{2}}-6p^2P_{1\frac{1}{2}}$
S n	2051.67	5*u*		48740.8	$5s^2S_{\frac{1}{2}}-5d^2D_{1\frac{1}{2}}$?
S n	1850.47	5		54040.3	$5s^2S_{\frac{1}{2}}-7p^2P_{\frac{1}{2}}$
S n	1847.73	20		54120.5	$5s^2S_{\frac{1}{2}}-7p^2P_{1\frac{1}{2}}$
S n	1766.20	10*u*		56618.7	$5s^2S_{\frac{1}{2}}-8p^2P_{\frac{1}{2}}$
S n	1763.69	0		56699.4	$5s^2S_{\frac{1}{2}}-7d^2D_{1\frac{1}{2}}$?
S n	1763.55	1		56703.8	$5s^2S_{\frac{1}{2}}-7d^2D_{2\frac{1}{2}}$?
S n	1759.68	5		56828.5	
S	1709.26	50		58504.9	$5s^2S_{\frac{1}{2}}-5s5p^4P_{1\frac{1}{2}}$
S n	1708.11	10		58544.2	
S n	1651.87	100*u*		60537.4	$5s^2S_{\frac{1}{2}}-5s5p^4P_{\frac{1}{2}}$
S n	1632.88	5		61241.5	$5s^2S_{\frac{1}{2}}-5s5p^4F_{1\frac{1}{2}}$
S n	1574.02	5		63531.6	$5s^2S_{\frac{1}{2}}-5s5p^4D_{1\frac{1}{2}}$
S	1548.58	50*RUU*		64575.	$5s^2S_{\frac{1}{2}}-5s5p^4D_{\frac{1}{2}}$
S	1515.63	100*RUU*		65979.	$5s^2S_{\frac{1}{2}}-5s5p^2P$
S	1507.37	50*RUU*		66341.	$5s^2S_{\frac{1}{2}}-5s5p^2D_{1\frac{1}{2}}$

observed visually. It appears in no published lists but was observed some years ago in this laboratory. It was so strong that, at that time, it was not thought that it could possibly be a silver line which had escaped previous observation.

The structure $4d^95s5p$ is partly positive and partly negative, and includes in its combinations with $4d^{10}5s$ the three widest lines I have ever observed. One of them is about 500 cm^{-1} wide with a central reversal about 100 cm^{-1} wide, and it serves as a continuum for the absorption of the lines of a nitrogen band.

The term $4d^95s6s^4D$ was found in its predicted position and it accounts for most of the strongest lines by its combinations with $4d^95s5p$. As in CuI, the outer components $4D_{3\frac{1}{2}}$ and $^4D_{\frac{1}{2}}$ give sharp lines and the inner two give diffuse lines. In addition one and possibly both of the ^2D terms from $4d^95s6s$ have been discovered, as well as a number of levels of $4d^95s5d$. A possible series member $4d^95s7s^4D_{3\frac{1}{2}}$ falls in the correct position. It is of interest to notice that the majority of the newly classified lines are between negative levels. It is surprising that the spectrum is as well developed as it is.

The numerical values of the levels are based on a new calculation of the ^2S series limit. From the accurate grating wave-lengths, the series was recalculated to fit the extended Ritz formula[6]

$$n^*=n+\mu+\alpha T+\beta T^2.$$

With the constants $\mu=-3.53427$, $\alpha=-1.600\times10^{-6}$, $\beta=-1.11\times10^{-12}$, all the levels except the lowest are represented quite accurately by

[6] A. G. Shenstone, Trans. Roy. Soc. **235**, 195 (1936).

the formula. The ^2D series is also nearly Ritzian but was not used because of the possibility of a perturbation due to $4s^2\,{}^2D$.

All the even levels are collected in Table I and all the odd in Table II. Their combinations are given in Table III.

There are a number of peculiarities in the spectrum which should be noticed. Perhaps the most important of these is the rather large intensity of several ordinarily prohibited combinations. The best known are the $5p^2P-6p^2P$ lines, which have been dealt with theoretically by Sambursky.[7] That theory should now be modified in the light of the more complete analysis available. Lines which contravene both the parity and J rules and yet appear in the practically field free Schuler tube are $5s^2S-5s^2\,{}^2D_{2\frac{1}{2}}$ and $5p^2P-4^2F$. The former line is, like its counterpart in HgII observed by Paschen,[8] a "nebular line." Other prohibited lines which appear faintly in the arc are $5s^2S-5d^2D$, $5s^2S-7d^2D$ and $5s^2\,{}^2D_{2\frac{1}{2}}-5d^2D$.

The intensities in the principal series show an unusual anomaly. The first two pairs of lines have about correct relative intensities, but in the third pair $5^2S-7^2P_{1\frac{1}{2}}$ is relatively much too strong. In the fourth pair, $5^2S-8^2P_{1\frac{1}{2}}$ is entirely missing and $5^2S-8^2P_{\frac{1}{2}}$ is stronger than the preceding $5^2S-7^2P_{\frac{1}{2}}$. It is possible but improbable that these anomalies are caused by absorption in the lines of the bands of nitrogen, because the series 6^2S-n^2P seems quite normal.

Attention should be drawn to the following doubtful points.

$5g^2G$. The value of ^2G depends on a new identification of the two longest of Paschen's infra-red lines.

[7] S. Sambursky, Zeits. f. Physik **68**, 774 (1931).

[8] F. Paschen, Berichte d. Preuss. Akad. d. Wiss. **32**, 536 (1928).

$11d^2D_{1\frac{1}{2}}$, $^2D_{2\frac{1}{2}}$. These levels may be incorrect by a fraction of a wave number. The lines from which they were calculated have wrong intensities and may be spurious.

$y^2D_{2\frac{1}{2}}$. This level may be spurious. It is based on two lines only and one of those is used elsewhere. It does, however, account for one strong line which has been tried as every other possible combination.

$5f^2F$ is doubtful. It is based on the combination $5d^2D_{1\frac{1}{2}}-5f^2F$ with no line to represent the stronger combination $5d^2D_{2\frac{1}{2}}-5f^2F$. If the line is assigned in the other way, 5^2F has a value far from the one expected.

$5s5p^4D_{\frac{1}{2}}$, ^2P, $^2D_{1\frac{1}{2}}$ are based on the three extraordinarily wide lines observed in the Schumann region. There is no doubt of the reality of the levels, but the naming is arbitrarily made to agree best with the equivalent levels in CuI.

The level $5s5p^2F_{3\frac{1}{2}}$ at 4531.1 is one that would be found from one of McLennan's three $s^2\,{}^2D$ differences. The two lines are, however, of completely different character and one of them is quite definitely assigned elsewhere. On that evidence it is not considered to be a combination with $s^2\,{}^2D_{1\frac{1}{2}}$.

1^0, 2^0, 3^0 are probably the equivalent of the levels 6278, 5964, 5656, in CuI. Whether it is correct to connect these levels with the limit ^1D rather than with ^3D is doubtful.

Attention has been called to the extreme width of many of the silver arc lines. This width is, of course, an effect due to auto-ionization, but why is it so extreme in silver? Auto-ionization should theoretically be greatest quite close to the ionization point which initiates it, but this does not seem to be true in silver. A thorough experimental examination of the line widths might be well worth while.