Self-reversal of Lines in the Explosion Spectrum of Tin.

By

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The explosion spectra of lead and tin, as elements belonging to the fourth group of the periodic table, were studied. The mode of the appearance of the reversed lines in the spectrum of the former element has already been described by one of us in a previous paper.[1]

The explosion spectrum of tin was studied in the same way as described in the experiment with lead. Almost all of the arc lines of tin whose wave-lengths are shorter than 3200 A were self-reversed. The order of the appearance of such lines was determined by varying the pressure of the air surrounding the exploded tin wire.

The spectrogram shows that all the lines were sharp when the explosion took place in vacuo, but on increasing gradually the pressure of the surrounding air certain lines became first broader and then self-reversed. The lines were therefore classified into four groups, as shown in the table, according to the stages in which the reversal appeared.

As the series relation of the arc lines of this element together with the other members of the fourth group are not yet completely established, it is not superfluous to compare our results with the series relations recently proposed by J. C. McLennan.[2]

The lines reversed in the first stage are λ 2429·6* ($2p_1 - 3d_1$), λ 2354·9

1 These Memoirs, **9**, 451 (1926).

2 Trans. R. Soc. Canada. **3** (1924).

$(2p_2-3d_3)$, λ 2317·3* (x_2-4d_1), λ 2269·0*,
λ 2246·2 $(2p_3-3d_2)$, and λ 2096·3;
the lines marked with * are not given in McLennan's list of the absorption spectrum of the normal vapour in a quartz cell.[1]

Thus, certain lines belonging to the diffuse series together with some non-series lines appeared as reversals in the first stage. The relation among the spectral terms p_1, p_2, p_3, and x_1, x_2, x_3, with respect to the order of the appearance of the reversal is not so obvious as in the case of lead, but the interesting fact is that the above mentioned series lines have the smallest wave-length in the lines belonging to the same diffuse term, e.g. λ 2354·8 $(2p_2-3d_3)$ is the most refrangible one in the lines x_n-3d_3 and $2p_n-3d_3$, and also λ 2429·5 $(2p_1-3d_1)$ is the most refrangible in the lines having the $3d_1$ term.

This lines reversed in the second stage are
λ 3034·2, λ 2863·4 $(2p_3-2_s)$, λ 2840·1, λ 2706·6 and λ 2421·8*.

The third and the fourth stage reversals were not so distinctly defined as the first and the second stage reversals.

Of the lines belonging to x_n-2s and $2p_n-2s$, the reversal appeared first in the line λ 2863·4 $(2p_3-2s)$ and then proceeded to the lines $2p_1-2s$ and $2p_2-2s$.

The lines belonging to $2p_n-3s$ reversed at a later stage than the lines $2p_n-2s$. This fact is quite in harmony with the result obtained by M. Kimura.

As in the case of lead, the width of lines belonging to $2p_n-ms$ is not symmetric with respect to the absorbed part, the red side of the absorption being more broadened.

The spark line λ 2209·6 is found to be reversed in the third stage.

The results are smmarised in the Table and the Plate. Thus we see that, in general, the relation between the spectral terms p_1, p_2, p_3 with respect to the order of the appearance of the reversal is not so regular as in the case of lead.[2]

Finally it is to be noticed that, besides the lines appearing in the absorption spectrum of the heated normal vapour, many lines which show no reversal in it reversed strongly in our explosion spectrum. This forces us to think that the reversal appearing in our explosion spectrum is originated not only by the mere absorption of the heated vapour, but by the absorp-

1 loc. cit.
2 loc. cit.

tion of the excited atoms in the strong electric field.[1]

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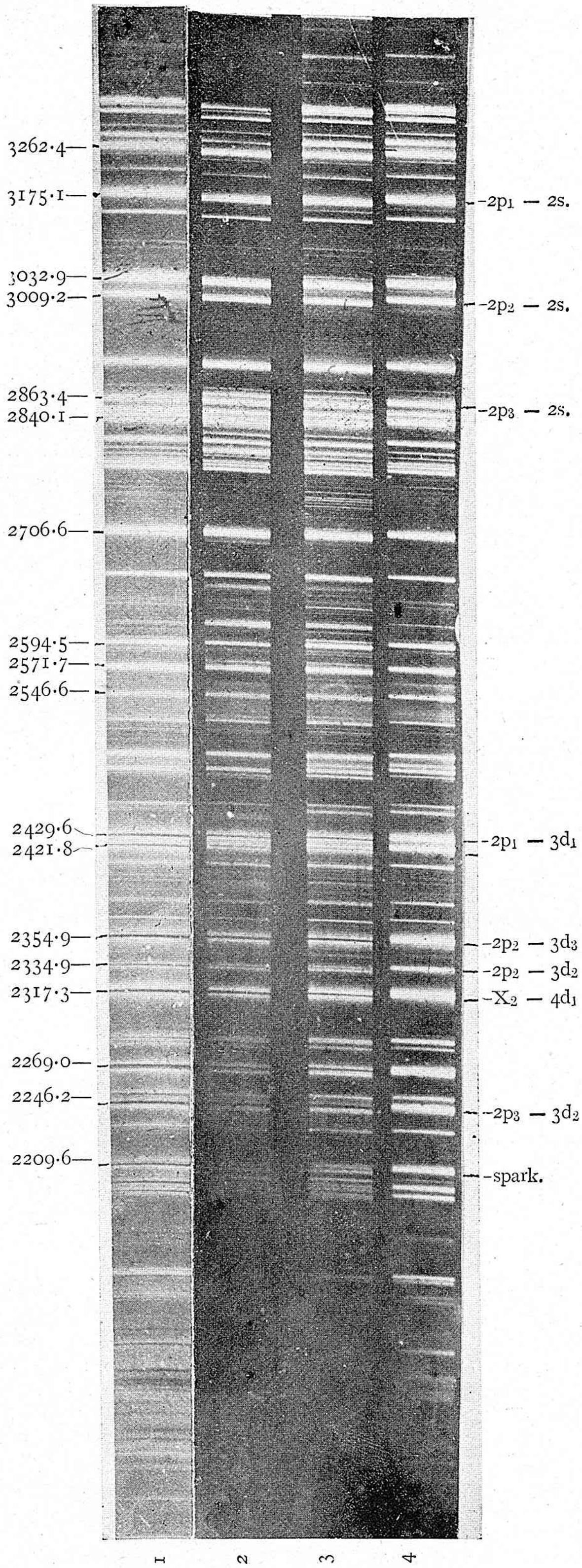
Table.

Absorption of normal Vapour in a Quartz Cell (McLennan) (I. A.)	Reversal in a heavy Arc (McLennan) (I. A.)		Reversal in an Explosion Spectrum (A and S)	Order of Reversal	Series
——			3262·4	3	——
3175·04			3175·1	2	$2p_1 - 2s$
3034·12			(3034·2		——
——			3032·9	2	——
3009·14			3009·2	3*	$2p_2 - 2s$
2863·32			2863·4	2	$2p_3 - 2s$
——			2850·7	4	——
2839·98			2840·1	2	——
2706·50			2706·6	2	——
——			2594·5	4	$X_1 - 6d_3$
			2571·7	3	——
2546·55			2546·6	3	
——			2495·8	4	——
2483·39			2483·5	4	——
——			2429·6	1	$2p_1 - 3d_1$
			2421·8	1	——
——			2354·9	1	$2p_2 - 3d_3$
2354·84			2334·9	2	$2p_2 - 3d_2$
2334·80			2317·3	1	$X_2 - 4d_1$
——			2286·8	3	——
			2282·4	4	——
			2269·0	1	——
	——	——	2267·3	3	——
——	2251·12	4R	2251·3	4	$X_2 - 4s$
2246·02	2245·95	10R	2246·2	1	$2p_3 - 3d_2$
2231·68	2231·73	4R	2231·8	4	$2p_1 - 3s$
2220·84?					
2209·60	2209·62	6R	2209·6	3	Spark

1 loc. cit.

Absorption of normal Vapour in a Quartz Cell (McLennan) (I. A.)	Reversals in a heavy Arc (McLennan) (I. A.)		Reversals in an Explosion Spectrum (A and S)	Order of reversal	Series
2199·29	2199·29	8R	2199·3	3	(Spark)
2194·42	2194·46	6R	2194·5	3	(Spark)
2171·43	2171·24	2R	2171·2	3	(Spark)
	2151·31	5R	2151·3	4	——
	2148·64	5R	2148·6	3	$2p_2 - 3s$
	2121·15	2R	2121·2	4	$X_2 - 6d_2$
	2113·85	4R	2113·9	?	$X_3 - 4d_3$
	2100·84	4R	2100·9	?	$2p_1 - 4d_3$
	2096·30	4R	2096·3	?	$X_2 - 6s$
	2094·25	3R	2094·3	?	$2p_1 - 4d_2$
	2091·61	2R	2091·6	?	——
	2080·57	3R	2080·6	?	$X_2 - 7d_3$
	2072·92	4R	2072·9	?	$2p_3 - 3s$
	2068·55	4R	2068·6	?	$2p_1 - 4d_1$
	2064·01	3R	....		
	2058·24	3R	....		
	2053·47	3R	....		

Explosion Spectrum of Tin.



1. Explosion in the air Pressure 76 cm. of Hg.
2. 〃 60 cm. 〃
3. 〃 50 cm. 〃
4. 〃 40 cm. 〃