# Deep Terms in the Spectra of Sc VIII and Sc IX

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Twenty-three lines in the scandium spectrum have been identified as radiations connecting higher terms with the ground states of Sc VIII and Sc IX.

IN a previous paper[1] it was reported that the spectrum of scandium had been photographed with a twenty-one foot grazing incidence vacuum spectrograph, and a classification was given for lines arising from transitions to the ground state of Sc V. On the same spectrograms lines are found which have been identified as due to radiations from Sc VIII and Sc IX.

The ground state configuration of Sc VIII (isoelectronic with Si I) is $3s^23p^2$, yielding $^3P$, $^1D$, and $^1S$ terms. Above this are the configurations $3s3p^3$, $3s^23p3d$, and $3s^23p4s$ in the order named, each giving rise to several odd singlet and triplet terms. The transitions $3s^23p^2\,^3P-3s3p^3\,^3S^0$, $3s^23p^2\,^3P-3s^23p3d\,^3P^0$, and $3s^23p^2\,^3P-3s^23p4s\,^3P^0$ have been identified. These data are shown in Table I.

TABLE I. *Scandium VIII.*

| CONFIGURATION | | $3s^23p^2\,^3P_0$ | $3s^23p^2\,^3P_1$ | $3s^23p^2\,^3P_2$ |
|---|---|---|---|---|
| | TERM VALUES | 0 | 2273 | 5509 |
| $3s3p^3\,^3S_1^0$ | 272,418 | $I=$ (5)<br>$\lambda=367.083$<br>$\nu=272,418$ | (15)<br>370.174<br>270,143 | (25)<br>374.658<br>266,910 |
| $3s^23p3d\,^3P_2^0$ | 319,570 | | (15)<br>315.163<br>317,296 | (20)<br>318.408<br>314,062 |
| $^3P_1^0$ | 322,541 | (20)<br>310.042<br>322,536 | (8)<br>312.239<br>320,268 | (12)<br>315.420<br>317,038 |
| $^3P_0^0$ | 323,674 | | (8)<br>311.138<br>321,401 | |
| $3s^23p4s\,^3P_0^0$ | 603,512 | | (4)<br>166.323<br>601,239 | |
| $^3P_1^0$ | 604,605 | (2)<br>165.396<br>604,610 | (3)<br>166.021<br>602,333 | (3)<br>166.920<br>599,089 |
| $^3P_2^0$ | 609,175 | | (2)<br>164.771<br>606,903 | (9)<br>165.655<br>603,664 |

In Sc IX, isoelectronic with Al I, the ground state configuration is $3s^23p$. Radiations involving transitions to the $^2P^0$ term of this configuration

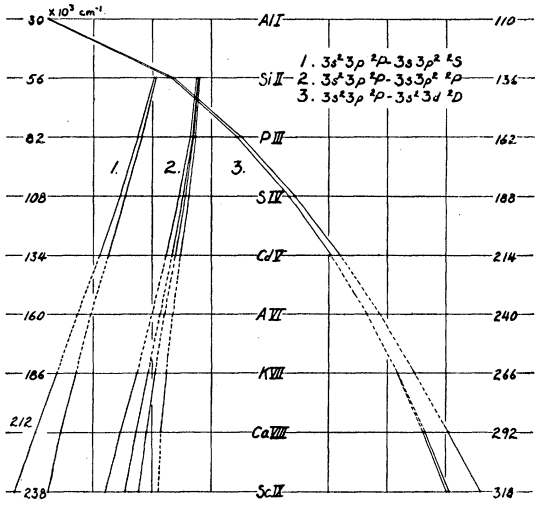


FIG. 1. Isoelectronic sequence Si I–Sc VIII.

TABLE II. *Scandium IX.*

| CONFIGURATION | | $3s^23p\,^2P_{1/2}^0$ | $3s^23p\,^2P_{3/2}^0$ |
|---|---|---|---|
| | TERM VALUES | 0 | 5758 |
| $3s^23d\,^2D_{3/2}$ | 313,858 | $I=$ (8)<br>$\lambda=318.615$<br>$\nu=313,858$ | (1)<br>324.570<br>308,100 |
| $^2D_{5/2}$ | 314,211 | | (12)<br>324.199<br>308,453 |
| $3s3p^2\,^2S_{1/2}$ | 240,363 | (2)<br>416.036<br>240,364 | (3)<br>426.250<br>234,604 |
| $3s3p^2\,^2P_{1/2}$ | 255,828 | (8)<br>390.888<br>255,828 | (4)<br>399.890<br>250,069 |
| $^2P_{3/2}$ | 259,146 | (385.883)<br>(259,146) | (12)<br>394.652<br>253,388 |

[1] Kruger and Phillips, Phys. Rev. **51**, 1087 (1937).

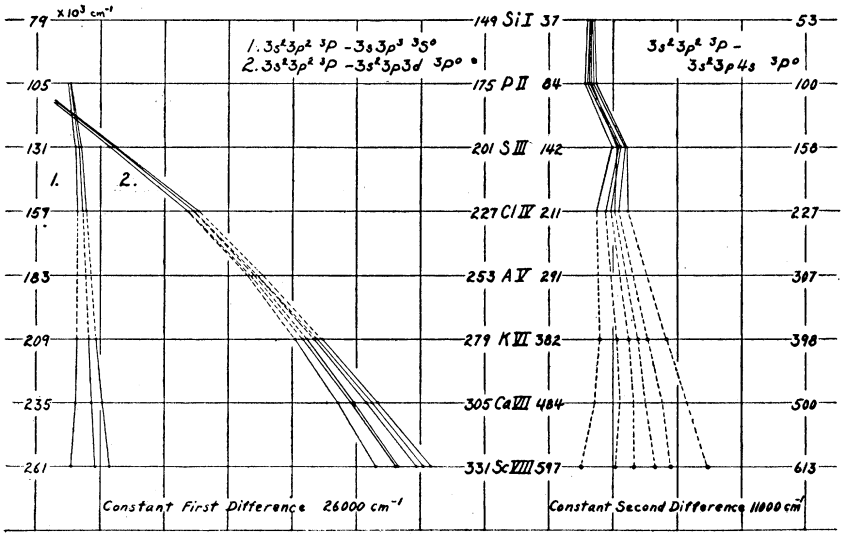


FIG. 2. Isoelectronic sequence Al I–Sc IX. Constant first difference 26,000 $cm^{-1}$.

from $3s3p^2\ ^2P, ^2S$ and from $3s^23d\ ^2D$ have been identified. These data are given in Table II. The transition $3s^23p\ ^2P_{1/2}{}^0 - 3s3p^2\ ^2P_{3/2}$ has not been observed, the predicted position 385.883A being too close to the second order position of the strong oxygen line 192.906A. Since the only satisfactory method so far found for the excitation of Sc spectra in the vacuum region involves the use of electrodes made of a mixture of scandium and boron oxides, observation of this line has been impossible.

Displaced frequency diagrams for the isoelectronic sequences Si I to Sc VIII and Al I to Sc IX are shown in Fig. 1 and Fig. 2, respectively. The only marked irregularity appears in the case of the $3s^23p^2\ ^3P - 3s^23p4s\ ^3P^0$ transitions in S III.

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# Interferometer Wave-Lengths in the Secondary Spectrum of Hydrogen

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Interferometer determinations of the wave-lengths of thirty-four lines in the spectrum of $H_2$ have been made, using an etalon crossed with a Littrow spectrograph. The average probable error of these measurements is 0.0003A.

## INTRODUCTION

THE complexity of the many-lined spectra of hydrogen and its isotopes, makes it important that some sort of tertiary standards be determined to facilitate the work in analysis of these spectra. Interferometer wave-lengths serve this purpose. No such wave-lengths of hydrogen have been published below λ4171.[1] The present paper deals with the region between λ3750 and λ4200.

## APPARATUS

With the exception of the discharge tube the apparatus used was the same as that described by one of the present writers in a previous paper.[2]

The quartz capillary of the discharge tube was 8 mm in diameter and 60 cm long. The front elec-

[1] Gale, Monk and Lee, Ap. J. **67**, 89 (1928).

[2] Kent and Lacount, Phys. Rev. **51**, 241 (1937).