As the frequency ν of the impinging quantum becomes very near to the characteristic absorption frequency $(E_k - E_i)/h$, the scattering (both of unmodified and modified frequency) becomes particularly intense, and in the Raman spectrum those transitions $i \longrightarrow s$ are particularly enhanced, for which the transition probability (ks) is high. So we might consider the observed frequencies, also, as differences between the frequency of the Hg line λ 1849 and the frequencies of the considered transitions. The values calculated in this way would differ only by 1.7 cm.$^{-1}$ from those given above, which falls within the limits of accuracy of the present measurements. In this way, we might account for the fact that only two lines of each band appear at such high pressure. The above-given classification of the observed lines holds both if we consider the phenomenon as a fluorescence or as a Raman effect.

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ON THE SPECTRA OF ZNII, CDII, INIII AND SNIV

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Abstract.—In the spectrum of ZnII six new combinations between known terms are located. In CdII the 7*S* term is found, and two intercombinations are recorded. In InIII one new multiplet, based on known term values, is given and possible values for the 6*F* terms obtained. In SnIV four multiplets are located all based upon previously known term values.

The spectra of ZnII and CdII were investigated by G. v. Salis[1] in 1925, who found a large number of terms based upon the normal configuration (d^{10} ZnIII, CdIII) and one anomalous doublet *D* term from (d^9s^2) of ZnII but only one of this pair of terms in CdII. At that time the Hund theory was not developed and the meaning of these anomalous terms was not known; nor had the Schumann region been accurately measured, so that the classification of Salis did not extend far beyond 2000 Å.

InIII and SnIV have been classified by Carroll,[2] Rao[3] and the writer[4] while Rao, Narayan and Rao[5] have recently summed up the known terms of each spectra and shown them to constitute a consistent scheme which may now be adopted with confidence.

This report deals with some further classifications in each of these spectra, arrived at largely by the use of term values already known, the multiplets lying generally in the very short wave-length region of the spectrum. The sources employed were in each case the vacuum spark between metallic electrodes. The newly-classified lines are given in tables I, II, IV and V; where in each case the observed and calculated values of the wave-length are given in I. A. (vac) below 2000 Å. The notation used is that of Russell and Saunders, now generally adopted except that the anomalous doublet D term referred to above is abbreviated to mD.

ZnII.—In table I are shown the new combinations in ZnII. One or two points only need comment. The line $4P_2 - 7S$ appears to be more intense than is to be expected for this higher S term combination and since $\Delta\nu$ is somewhat too large it may be that this line is blended with another, but this cannot be decided from the plates. The combination $4S - mD$ is a violation of the combination rules and the only reason for looking for such a combination here is that one of the corresponding lines, namely, $1S - {}^{x}D_3$ (Paschen's notation) was found by Paschen[6] in HgII. Strange to say, the above line is the one which violates both the l and j combination rules. It appears that in ZnII both of these lines are present, although there is still some doubt in regard to them since they are about 0.5 Å out of the expected position, while the $4P - 6S$ lines, which fall near the same part of the spectrum, are out only by 0.05 Å.

TABLE I

COMBINATIONS IN THE SPECTRUM OF ZNII

DESIGNATION	λ(CAL.)	(OBS.) λI. A. VAC.	I	γ	Δγ	TERM VALUES
mD_2—$4F$	1929.69	1929.89	1	51816	2718	mD_2 79449.96[1]
mD_3—$4F$	1833.48	1833.71	2	54534		mD_3 82169.02[1]
$4S$—mD_3	1594.36	1595.09	2	62692	2724	
$4S$—mD_2	1528.11	1528.67	1	65416		
mD_3—$5F$	1550.91	1550.76	1	64485		
$4P_2$—$6S$	1535.08	1535.11	3	65142	873	
$4P_1$—$6S$	1514.76	1514.81	1	66015		
$4P_2$—$7S$	1306.76	1306.70	3	76529	879	
$4P_1$—$7S$	1292.02	1291.86	1	77408		
$4S$—$5P_1$	986.53	986.54	1	101364	244	
$4S$—$5P_2$	984.15	984.17	1	101608		

[1] Term values by Salis.

CdII.—In table II three new combinations in the spectrum of CdII are given. The $7S$ term is new. It was not found by Salis, since the only combination ($6P - 7S$) which one might expect to find at that time falls in the infra red. Now, however, one may look for $5P - 7S$ in the Schumann region. The long sequence of effective quantum numbers for

S terms makes it possible to predict the term value of $7S$ to a few units of wave number. It is therefore easy to locate the pair of faint lines having $\Delta\gamma = 2483$. The stronger line should lie on the longer wave-length side as it is found to do. Fortunately there is no other pair of lines in the neighborhood which approximates to the requirements. The term value arrived at is $7S = 29084$ and fits nicely into the scheme of quantum numbers as shown in table III.

TABLE II

NEW TERMS AND COMBINATIONS IN THE SPECTRUM OF CdII

DESIGNATION	λ(CAL.)	(OBS.) λI. A. VAC.	I	γ	Δγ	TERM VALUE
$5P_2$—$7S$		1648.15	3	60674	2483	$7S$ 29084
$5P_1$—$7S$		1583.35	2	63157		
$5S$—$6P_1$	1055.84	1055.85	2	94710	672	
$5S$—$6P_2$	1048.40	1048.44	2	95382		
$5S$—mD_3	.....	.....	.	...		
$5S$—mD_2	1335.24	1335.14	1	74898		

TABLE III

EFFECTIVE QUANTUM NUMBERS AND DIFFERENCES FOR S TERMS OF CdII

TERMS	TERM VALUES	EFFECTIVE Q. NUMBERS	DIFFERENCES
$5S$	136376.59	1.794	
			0.073
$6S$	53386.37	2.867	
			0.018
$7S$	29084	3.885	
			0.008
$8S$	18335.49	4.893	
			0.004
$9S$	12624.31	5.897	
			0.002
$10S$	9223.21	6.899	
			0.001
$11S$	7033.80	7.900	
			0.001
$12S$	5540.60	8.901	

In regard to the $(d^9\ s^2)\,^2D$ terms of CdII it should be mentioned that McLennan, McLay and Crawford[8] have given a $^2D_3$ term based upon the line 4415.72(20)22640.0 which makes with the $^2D_2$ term of Salis $\Delta\gamma = 5635.1$. The term values thus arrived at are $D_2 = 61483.3$, $D_3 = 67118.1$. These terms should combine with the normal F terms and, by analogy with HgII, with the S terms. In table II are given the combination found between D_2 and $5S$. No combinations between these D terms and the normal F terms could be found except that $D_2 - 4F_3$ falls within two units of wave number of the line 2981.495 given by Eder and Valenta as a spark line and by Kayser and Runge[7] as an arc line.

InIII.—One new combination $5P - 6D$ has been found in InIII by means of known terms as shown in table IV. This, together with the fact that Rao Narayan and Rao[5] were able to predict and locate the $5D - 6P$ groups in the visible region near 6000 Å adds much to the confidence which one may now have in the term scheme of InIII. One other pair is given in table IV as $5D - 6F$, but this could not be checked by any further combinations and must therefore be considered merely as tentative. The system of term values is quoted here from the paper by the authors mentioned above as it is thought that the reference may not be generally available.

TABLE IV

COMBINATIONS IN THE SPECTRUM OF InIII

DESIGNATION	λ(CAL.)	(OBS.) λI. A. VAC.	I	γ	Δγ	TERM	VALUES	TERM	VALUES
$5P_2$—$6D_2$	917.40	917.30	0	109016		$5S$	226133	$5D_2$	97675
$5P_2$—$6D_3$	915.87	915.82	7	109192	176			$5D_3$	97385
$5P_1$—$6D_2$	882.25	882.21	4	113351	4335	$6S$	99255		
								$6D_2$	55602
$5D_3$—$6F$?		1752.38	1	57065		$7S$	56706	$6D_3$	55420
$5D_2$—$6F$?		1743.52	1	57355	290				
								$5F$	64154
						$5P_1$	168948		
						$5P_2$	164606	$6F$	40320?
						$6P_1$	81545	$5G$	39600
						$6P_2$	80208		

SnIV.—In table V four new combinations are given in the spectrum of SnIV. All of these were predicted by Rao, Narayan and Rao[5] except the first one. The fact that all of these lines appear without doubt in the expected positions within experimental error shows that the scheme now given for SnIV may be accepted with confidence. The term values are based upon an assumed value of $6G = 70400$, which must be very nearly correct. All the known terms are listed.

TABLE V

COMBINATIONS IN THE SPECTRUM OF SnIV

DESIGNATION	Δ(CAL.)	(OBS.) λI. A. VAC.	I	γ	Δγ	TERM	VALUES	TERM	VALUES
$4F$—$5G$	710.01	710.49	0	140748		$5S$	328671	$6D_2$	93885.4
								$6D_3$	93553.2
$5P_2$—$6D_2$	630.08	630.33	0	158647		$6S$	154540		
$5P_2$—$6D_3$	628.77	629.02	3	158977	330			$4F_3$	211243
$5P_1$—$6D_2$	605.23	605.51	3	165150	6503	$7S$	91063.1	$4F_4$	211231
$5P_2$—$7S$	619.07	619.34	3	161462		$5P_1$	259112	$5F_3$	115411.1
$5P_1$—$7S$	595.06	595.36	3	167965	6503	$5P_2$	252594	$5F_4$	115245.6
$5S$—$6P_1$	505.45	505.89	3	197671		$6P_1$	130826.2	$5G$	70400
$5S$—$6P_2$	499.94	500.36	3	199844	2173	$6P_2$	128648.8		
						$5D_2$	163374		
						$5D_3$	163267		

One matter in regard to the previous work of the author[4] on SnIV should be mentioned. Rao, Narayan and Rao have pointed out that the $5D - 5F$ multiplet which is inverted should probably have been classified as $4F - 5D$, thus giving this F term its origin in the ($5s$ $4f$) configuration instead of ($5s$ $5f$). This seems reasonable since it accounts for the inversion of the multiplet. It also clears up the matter in regard to the pair of lines at 1130 Å, which were classified by the writer as part of the spectrum of SnIV and also by Gibbs and White[9] as belonging to SnV. Rao, Narayan and Rao have shown also that the $5D - 5F$ multiplet should include the lines

$5D_3$–$5F_3$	....	......
$5D_3$–$5F_4$	2084.27 (8)	47,963.0
$5D_2$–$5F_3$	2081.25 (8)	48,021.1

The satellite was not found and does not appear on the author's plates. However, the two F terms so obtained, namely, $4F_{3,4}$ = 211243, 211231 and $5F_{3,4}$ = 115411, 115246, fit into a Rydberg sequence rather well, as these authors have pointed out. On the other hand, the corresponding $4F$ term could not be located definitely in InIII.

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POLARIZATION OF THE TUNGSTEN L RADIATIONS

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The state of polarization of characteristic x-radiations has within recent months been the subject of investigations by Bishop,[1] Haas,[2] Mark and Wolf,[3] Bearden,[4] and Wollan.[5] Haas examined the $K\alpha$ radiation of iron, Mark and Wolf the K lines of copper, while the others cited worked with the $K\alpha$ lines of molybdenum. With the exception of Bishop all of these experimenters have found the characteristic radiations to be, within the limits of their experimental errors, unpolarized. The present writers would add to these findings the results of a study of the L radiations of tungsten in which the states of polarization of the three lines $L\alpha_1$, $L\beta_1$, and $L\gamma_1$ were separately considered. The results are in accord with the consensus of the researches mentioned above, no polarization being found in the case of any line, though the method employed should have revealed any polarization as great as one per cent.