Letters to the Editor.

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Low Atomic Energy Levels for Elements of the Oxygen Group.

FROM spectral theory it is known that the lowest energy states for atoms of the oxygen group form a stable triad designated as $^3P_{012}$. Next higher to these is a metastable state $^1D_2$ and next to that again a metastable state $^1S_0$. For oxygen atoms the state $^3P_1$ expressed in frequency units is known to be 67 cm.$^{-1}$ higher than the state $^3P_2$ and the state $^3P_0$ 158 cm.$^{-1}$ higher than the state $^3P_1$. The states $^1D_2$ and $^1S_0$ have not hitherto been evaluated for oxygen atoms.

In the course of a recent investigation of the spectra of selenium and tellurium, we were able to identify all the energy levels $^3P_{012}$, $^1D_2$ and $^1S_0$ for the neutral atoms of both elements. The results are given in the following table:

	$^3P_2$	$^3P_1$	$^3P_0$	^3P mean	$^1D_2$ (suggested)	$^1S_0$ (suggested)
Oxygen	0	67	225	97	10587	28512
Energy differences				10490	17925	
					λ5577·341 A.	
	$^3P_2$	$^3P_1$	$^3P_0$	^3P mean	$^1D_2$ (suggested)	$^1S_0$ (suggested)
Sulphur	0	398	572	323	9523	25723
Energy differences				9200	16200	
					λ6300 A.	
	$^3P_2$	$^3P_1$	$^3P_0$	^3P mean	$^1D_2$	$^1S_0$
Selenium	0	1991	2535	1509	9576	23370
Energy differences				8067	13794	
					λ7247·5 A.	
	$^3P_2$	$^3P_0$	$^3P_1$	^3P mean	$^1D_2$	$^1S_0$
Tellurium	0	4707	4751	3153	10559	23199
Energy differences				7406	12640	
					λ7909·2 A.	

For tellurium it will be seen the terms $^3P_{012}$ are partially inverted, $^3P_1$ being higher than $^3P_0$. Mean values for the energy levels $^3P_{012}$ are 1509 cm.$^{-1}$ for selenium and 3153 cm.$^{-1}$ for tellurium. If we consider the ratio $(^1D_2 - {}^3P_{\text{mean}})/(^1S_0 - {}^1D_2)$ we obtain the value 0·585 in the case of selenium and 0·586 in the case of tellurium.

From observations made on the Zeeman effect with the oxygen green line λ5577·341 A. and described by Prof. McLennan in his Bakerian Lecture (NATURE, July 7, 1928, p. 38, and *Proc. Roy. Soc.*, No. A 785, vol. 120, p. 327), it became definitely known that the auroral green line λ5577 A. originates in electronic transitions between the metastable states $^1S_0$ and $^1D_2$ of oxygen atoms. It has a frequency, therefore, given by $\nu = {}^1S_0 - {}^1D_2$ which, expressed numerically in frequency units, is equal to 17924·7 cm.$^{-1}$. If we suppose that the ratio $(^1D_2 - {}^3P_{\text{mean}})/(^1S_0 - {}^1D_2) = 0{\cdot}585$ be applicable to the spectrum of oxygen as well as to the spectra of selenium and tellurium, we obtain 10490 cm.$^{-1}$ and 28415 cm.$^{-1}$ for the mean energy difference $^1D_2 - {}^3P_{012}$ and $^1S_0 - {}^3P_{012}$ for oxygen atoms. From this it follows that the radiation corresponding to the electronic transitions $^1D_2 - {}^3P_{012}$ in oxygen should have a mean wave-length of approximately λ9530 A. and that corresponding to the transitions $^1S_0 - {}^3P_{012}$ an approximate wave-length of λ3520 A. This means that we should expect to obtain in the spectrum of the polar aurora and in that of the light of the night sky a close triplet in the neighbourhood of λ9530 A. and a similar one in the neighbourhood of λ3520 A., the separations in both cases being 67 cm.$^{-1}$ and 158 cm.$^{-1}$. Up to the present such radiations have not been observed either in polar or non-polar auroral light or in the spectrum of atomic oxygen. They should, however, be carefully looked for and experiments in that direction are now being set in train by one of us.

From the numbers given in the table above it will be seen that the lines in the spectra of selenium and tellurium analogous to the auroral green line of oxygen have the wave-lengths λ7247·5 A. and λ7909·2 A. respectively. Moreover, by extrapolation from the numbers given in the table, one is led to the view that a line in the spectrum of sulphur analogous to the auroral green line of oxygen should have an approximate frequency of 16200 cm.$^{-1}$ and an approximate wave-length of λ6300 A.

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The Grant of Invalid Patents.

THE trend of the excellent leading article in NATURE of Nov. 9, on "The Grant of Invalid Patents", is to recommend that more power be entrusted to the Patent Office because of the great evil of expensive patent litigation, but in the course of the article two statements occur which I submit are misleading. The writer says (1) that opposition proceedings before the Comptroller are coming to be used as a cheap method of obtaining an official opinion of validity. Now I believe it to be beyond dispute that the Comptroller's decision has no importance whatever as a certificate of validity, and validity is not a question with which he is at all concerned at the hearing of the opposition proceedings. Definite grounds of opposition are laid down by sec. 11 of the Act, and with them he is alone occupied.

Prior publication and prior grant may be, and are commonly, an issue before him, but his decision on these points merely amounts to saying that he cannot find the applicant's invention expressly stated in other specified documents which are put before him, and his decision on the point has no weight whatever in a subsequent action in the High Court.

Secondly, the writer says that the *quale* of subject matter is already handled by the Patent Office. This is only true in the limiting sense that the Patent Office will not grant a patent for something which is *manifestly* not a manner of manufacture, for example, a system of indexing *or* a medical treatment, even though it was described as a "method of extracting lead from men". Yet with this limitation any experienced patent agent will say that it is nearly always possible to get an invention through the Patent Office.

Space does not permit me to enlarge generally on the other point of view, though on it there is much to be said. There is the danger of allowing Patent Office officials, excellent and efficient as they are, to decide academically and without proper evidence on what are after all practical questions—I say without proper evidence, for a full-dress trial at the Patent Office would, except for the comparatively small court charges, be as expensive as a trial in the High Court. Again, Patent Office 'mistakes' would be serious, for they would mean that improper grants were made, or that grants were improperly refused. So far as the lawyer is concerned, it might well happen that although the excessive cost of patent actions was reduced there would, nevertheless, be a very much greater number of small patent actions!