Letters to the Editor.

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Occurrence of the Aurora Line in the Spectrum of the Night Sky.

I HAVE pursued the line of work outlined in my letter to NATURE of March 31, 1921 (vol. 107, p. 137). The result has been to show that at Terling, Essex, the aurora line can be photographed on two nights out of three. Exposures were made on 150 nights, irrespective of weather.

The intensity on ordinary occasions appears to have little or no connection with magnetic disturbance or the distribution of spots on the sun. The most interesting point that has come out, however, is that the aurora line is much stronger at Terling than at Beaufront Castle, near Hexham, Northumberland. I have made exposures on twenty-six different single nights at the latter place, and have never found a trace of the aurora line on any of them, though the same instrument and the same kind of plates were used as at Terling.

Positive results at Terling were sandwiched in between the negative results at Beaufront; thus the latter cannot be attributed to seasonal variation.

Five nights' cumulative exposure have been tried on two occasions at Beaufront, and on each plate the aurora line was obtained.

I have been very much astonished at this diminished intensity of the aurora line as one goes north. The difference of latitude is about 3°. It would seem that the aurora line as photographed in the south of England will not fit into the scheme of distribution of the polar aurora. I hope to pursue this line of work to the north and to the south as opportunity may offer.

RAYLEIGH.

October 9.

Atomic Structure.

IN connection with the problem of the constitution of the atom discussed in my letter to NATURE of March 24 last (vol. 107, p. 104), I should like to add a few complementary remarks about the manner in which the orbits of the electrons in the atom are characterised.

According to this view of atomic constitution, the electrons in the atom are arranged in groups in such a way that the orbit of every electron within one and the same group is characterised by the same total number of quanta. Since, however, for orbits characterised by more than one quantum there exist several types of orbits possessing the same total number of quanta, the electrons within each group do not in general play equivalent parts, but are divided into a number of sub-groups corresponding to different types of possible orbits. Now it is a salient feature of this picture that the atom cannot be said to be composed of a number of well-defined spherical shells of electrons moving in sharply separated regions of the atom. In fact, although the electrons of a given group mainly move within one and the same shell-shaped region of the atom, the electrons, at any rate of certain sub-groups, will in their revolution penetrate into the region of the orbits of the electrons of inner groups. This gives rise to a coupling between the various groups, which is an essential feature of the interpretation of the stability of the atom. As a consequence of this, the orbit of an electron may be considered from different points of view, according as attention is mainly paid (1) to the larger part of the orbit which lies outside the region of inner groups, and which nearly coincides with an almost closed Keplerian ellipse, or (2) to the mechanical properties of the whole orbit, regarded as a type of central orbit composed of loops which only in their outer part possess an approximately Keplerian character.

Now in the classification described in my former letter the orbits were regarded from the first, and more superficial, point of view. The numbers of quanta characterising the orbits of the electrons in the different groups correspond to Keplerian ellipses, which coincide approximately with the outer parts of the orbits of the electrons in question. It has since been possible, by a detailed examination of the parts of the orbital loops situated within the region of inner groups, to classify the orbits from the second, and more fundamental, point of view, leading to a simple and unambiguous result. In fact, we are led to a classification in which, when we proceed outwards from the nucleus, the number of quanta characterising a certain group of orbits is always larger by one unit than that of the preceding group. For the groups in the inner region of the atom, where the attraction of the nucleus preponderates, this new rigorous classification coincides with the old one of my former letter. But it departs from the old for groups in which the orbits of the electrons mainly fall in the outer region of the atom, where the attraction of the nucleus is largely compensated for by the repulsion of the electrons in the inner groups. For these groups the quantum numbers of the orbits given in my former letter were equal to, or even smaller than, those of inner groups.

Notwithstanding the essential progress made by this modification in the classification of the orbits, the main features of this model of the atom remain the same. For instance, my former statements of the numbers of electrons in the various groups and sub-groups in the atom hold unaltered for all groups. In fact, in fixing these numbers by the correspondence principle we find them to depend on the harmony of the motion of the electrons within each single group. They depend, therefore, primarily on the relative dimensions of the approximately Keplerian loops, and only secondarily on the way in which these loops are joined together to form complete central orbits. Thus the previous model of the atoms of the inert gases holds unaltered also as regards the outer groups, provided that the numbers stated as defining the number of quanta of the orbits in the various groups are considered instead as defining the number of sub-groups within the corresponding groups. Moreover, the numbers in question offer an approximate estimate of the spatial extension of the regions of the orbits of the electrons in the different groups in the atom. For instance, the orbits in the outermost "shell" in the Niton atom must be characterised as six-quanta orbits instead of as two-quanta orbits; but the dimensions of the orbital loops will by no means be of the same order of magnitude as those of the orbit of an electron revolving in a Keplerian orbit characterised by six quanta in the region outside that of the orbits of the electrons in the five inner groups; they will rather be of the same order as those of a similar Keplerian orbit characterised by only two quanta.

From these remarks it will be seen that my former applications of the theory to the interpretation of the physical and chemical properties of the elements