THE CORPUSCULAR THEORY OF MATTER

BY

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CHAPTER VI.

THE ARRANGEMENT OF CORPUSCLES IN THE ATOM.

We have seen that corpuscles are always of the same kind whatever may be the nature of the substance from which they originate; this, in conjunction with the fact that their mass is much smaller than that of any known atom, suggests that they are a constituent of all atoms; that, in short, corpuscles are an essential part of the structure of the atoms of the different elements. This consideration makes it important to consider the ways in which groups of corpuscles can arrange themselves so as to be in equilibrium. Since the corpuscles are all negatively electrified, they repel each other, and thus, unless there is some force tending to hold them together, no group in which the distances between the corpuscles is finite can be in equilibrium. As the atoms of the elements in their normal states are electrically neutral, the negative electricity on the corpuscles they contain must be balanced by an equivalent amount of positive electricity; the atoms must, along with the corpuscles, contain positive electricity. The form in which this positive electricity occurs in the atom is at present a matter about which we have very little information. No positively electrified body has yet been found having a mass less than that of an atom of hydrogen. All the positively electrified systems in gases at low pressures seem to be atoms which, neutral in their normal state, have become positively charged by losing a corpuscle. In default of exact knowledge of the nature of the way in which positive electricity occurs in the atom, we shall consider a case in which the positive electricity is distributed in the way most amenable to mathematical calculation, *i.e.*, when it occurs as a sphere of uniform density, throughout which the corpuscles are distributed. The positive

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electricity attracts the corpuscles to the centre of the sphere, while their mutual repulsion drives them away from it; when in equilibrium they will be distributed in such a way that the attraction of the positive electrification is balanced by the repulsion of the other corpuscles.

Let us now consider the problem as to how $1 \ldots 2 \ldots 3 \ldots n$ corpuscles would arrange themselves if placed in a sphere filled with positive electricity of uniform density, the total negative charge on the corpuscles being equivalent to the positive charge in the sphere.

When there is only one corpuscle the solution is very simple: the corpuscle will evidently go to the centre of the sphere. The potential energy possessed by the different arrangements is a quantity of considerable importance in the theory of the subject. We shall call Q the amount of work required to remove each portion of electricity to an infinite distance from its nearest neighbour; thus in the case of the single corpuscle we should have to do work to drag the corpuscle out of the sphere and then carry it away to an infinite distance from it; when we have done this we should be left with the sphere of positive electricity, the various parts of which would repel each other; if we let these parts recede from each other until they were infinitely remote we should gain work. The difference between the work spent in removing the negative from the positive and that gained by allowing the positive to scatter is Q the amount of work required to separate completely the electrical charges. When there is only one corpuscle we can easily show that $Q = \frac{9}{10}\frac{e^2}{a}$, where e is the charge on a corpuscle measured in electrostatic units and a is the radius of the sphere.

When there are two corpuscles inside a sphere of positive electricity they will, when in equilibrium, be situated at two points A and B, in a straight line with O the centre of the sphere and such that $OA = OB = \frac{a}{2}$, where a is the radius of the sphere. We can easily show that in this position

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