LETTERS TO THE EDITOR.

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Röntgen Ray Theory.

THE most important question whether Röntgen rays are to be considered as falling into the domain of light, or whether they are something else, has occupied so many minds, that the literature on this subject has grown enormously; but is it settled yet whether they are transversal waves of very small wave-length, or longitudinal waves, or vortex motion of the ether, or longitudinal impulses, or due to electromagnetic dispersion, or radiant matter?

Having read so many theories, with so many supporters and opposers, one gets puzzled what to believe.

Not a small part of the confusion is caused by the number of contradictory experiments; and no wonder at this, the question being, in fact, of the utmost complication; that is to say, not only as to the nature of the rays themselves, but also the way in which to get them.

Being engaged in the study of silent electric discharges, it was rather in our line to consider the question of kathodic, as well as of our anodic, discharges. Thus we arrived at a conclusion about the nature of Röntgen rays, which explains a great deal, though we must confess that certain assumptions have to be made.

This is not an attempt to explain this most difficult problem, but to suggest an hypothesis that is most nearly in accordance with experiments, so far as they go.

We consider Röntgen rays to be nothing but discharged kathode rays, and will now test this hypothesis by seeing how it will explain some of the most striking experiments and facts.

As a matter of fact, kathode rays are deflected by a magnet; they obey the law of attraction of a current by a magnet; *i.e.* they behave as a current or stream of negatively charged particles.

These negative particles impinge upon the glass wall o. the tube, which, as is well known, possesses a strong positive (external) charge.

Is there anything strange in the idea that those particles may lose their charge when in contact with the positive charged wall, and proceed on their way as *discharged* particles?

These *discharged* particles cannot, and are not, attracted by a magnet; why should they be? Hence the essential difference between kathode and Röntgen rays is explained.

Röntgen rays would thus discharge a negatively or positively charged body, as a matter of course, since any electrified body, struck by neutral particles, always loses its charge.

Now let us consider some important details: in the first place, with regard to the focus tube. Some people do not accept the property of being reflected as possessed by the Röntgen rays. It seems to us that the experiments of Tesla with his T-tube, allowing him to take simultaneously a sciagraph from reflected and from rays that have passed through different plates of metal, are conclusive in this respect; but they prove that the total amount of reflexion varies not very much for the least and for the best reflectors; the maximum result obtained with zinc (platinum does not seem to have been tested) was only 3 per cent.

Probably platinum will give a higher percentage of reflected rays; but even then it does not sufficiently account for the large difference of efficiency of the ordinary and the focus tube.

According to our theory the real cause of the high efficiency of the focus tube lies in the fact that the kathode rays strike on an actual anode, instead of upon an anode by induction.

This, so far, is not new. To quote Lodge, in an article written some time ago: "Hence, undoubtedly the X-rays do not start from the kathode, or from anything attached to it, but do start from a surface upon which the kathode rays strike, whether it be an actual anode or only an anti-kathodic surface; best, however, if it be an actual anode."

Röntgen and Rowland had discovered the same thing. According to our theory, it is evident that the negatively charged particles can lose their charge sooner and more completely when they strike an actual anode, than when they strike an anode by induction (of greater surface, and thus of smaller density).

Everybody will agree with Prof. Peckham, where he says that the discharge-tube is a resonator for its coil, and when the coil and tube are properly attuned the maximum effect is obtained. We should say, when the discharging capacity of the surface struck by the kathode rays can keep time with the vibrations of the intermittent current or stream of charged particles, the most intense Röntgen rays will be obtained.

If discharging—or, better to say, neutralising—of the waves of negative particles from the kathode be not synchronous with their impinging upon the focus or wall, they cannot lose all their charge, and will proceed either as particles with a minute negative charge, or with a minute positive charge, or perhaps mixed with neutral parts.

The result will be feebler Röntgen rays, and, according to the preponderance of the one or the other particles, these rays will discharge an electrified body, and give it *charge* according to its own charge.

Borgmann found that a negatively charged plate, when exposed to Röntgen rays, lost its charge to become positively charged; when the plate was positively charged, it lost part of its charge.

Righi found just the contrary; a positively charged plate lost its charge to end with a negative charge.

Porter, and nearly all other experimenters, found in all cases a complete loss.

We could explain these differences by admitting that neither Borgmann nor Righi had pure Röntgen rays, but had them mixed with positive and negative rays respectively.

We consider Porter's X_1 X_2 X_3 rays, and Lenard's gamut of rays of more and less magnetic deflexibility, as Röntgen rays of less and more purity, *i.e.* neutrality.

The more perfectly the negative charge has been taken away by the anode—without, however, imparting a positive charge instead—the more intense the Röntgen rays will be, and the stronger penetrating power they will possess.

It is hardly necessary to say that it must be very difficult to obtain perfectly neutral rays; this end will obviously only be attained when the whole system of generating—current, frequency, self-induction, capacity, vacuum, size and form of tube, and all the rest—be in true harmony with one another; and to realise this, means no small thing to do in practice.

We do not venture to say that our theory explains everything, but we do think it explains much; we do not ignore the fact that it is difficult to understand how the Crookes' radiant matter could pass through the glass wall as discharged matter, but the theory of ether motion also presents difficulties. Experiments on the Lenard rays passing as charged particles through aluminium, are described in NATURE of May 27 (p. 93).

Why should the etheric disturbance in the air answer so closely to the vacuum in the tube? Why should the rays, if they be ether vibrations, which in any case must be of so short a wave-length that the well-known properties of light do not show, make any difference whether they are obliged to pass through one or the other metal or material? If the intermolecular space be of any influence to them, one should expect refraction in those materials that show greater resistance to the rays passing.

The strongest proof for our theory is Lafay's experiment, where he found that Röntgen rays, passed through a negatively charged leaf of silver, can again be deflected by a magnet, and in the same direction as the kathode rays in the tube; and when the leaf was positively charged, in the opposite direction.

That means that neutral, non-deflectible rays, after recharging, become again sensitive to the magnet; the deflection being absolutely in accordance with electromagnetic laws of attraction and repulsion.

Unfortunately this experiment, repeated by Lodge, has not been confirmed by him; but it is easy to understand that recharging, just like discharging, is no simple thing to accomplish.

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Some Further Experiments on the X-Rays.

MESSRS. A. VOSMAER AND F. L. ORTT, in a paper kindly sent to me by the editor of NATURE, have arrived at the conclusion that the X-rays are more or less perfectly discharged particles. Others—Sir W. Crookes, for example—have suggested the