

reach the earth. The existence of such pencils of rays was clearly presupposed to be necessary to the theory as already formulated by me in 1899; and this assumption is now said to be untenable.

From the results which are here produced, however, it will undoubtedly appear that there must be a flaw somewhere or other in the reasoning of the distinguished natural philosopher; for one is inclined to regard the descent of the above-mentioned pencils of rays to the earth as an experimental fact.

I have also endeavoured, in Chapter VI, directly to demonstrate the points in which Schuster's assumptions in no way admit of being applied to our case. I will here, moreover, with regard to the electrostatic repulsion between our helio-cathode rays, refer to formulæ by OLIVER HEAVISIDE. In his *Electrical Papers*, Vol. II, Part III, p. 495, mathematical investigations are to be found of electrically charged corpuscles in translatory motion, and from these it appears, on a discussion of the formulæ, that when the velocity of the corpuscles equals that of light, the electrostatic repulsion between the rays maintains the balance with the electro-dynamic attraction. And as regards our helio-cathode rays, their velocity, according to the theory, differs no more than a hundred metres from that of light.

We find, with regard to these rays that the acceleration with which an electron is repelled from the pencil of rays will not be what Schuster gives, but from the very first moment 3.3 million times less. Subsequently this acceleration decreases with very great rapidity, in so far as the longitudinal mass of the repulsed electron comes into play.

In a paper he has just published, HALE communicates some preliminary results on the general magnetism of the sun, at which he has arrived by the aid of instruments and experimental methods that are altogether admirable. He considers that the entire sun must be magnetic, with polarity like that of the earth, and with a vertical intensity at the poles of about 50 gaussess.

These results seem at first sight to be quite irreconcilable with those in this work. If the sun were perceptibly magnetic in the same manner as the earth, but with an intensity 70 times as great, it is perfectly certain that no helio-cathode ray of the kind in question could ever reach the earth.

Hale, however, is of opinion that the magnetism of the sun differs radically from that of the earth.

It seems to me that the phenomena observed by Hale might be explained as the effects produced by invisible spots, or by the pores, considered as electric vortices, notwithstanding all the reasons that Hale adduces against such an assumption.

In a note to the *Comptes Rendus de l'Académie des Sciences*, Paris, Aug. 25, 1913, I have given the reasons that favour my view.

The experimental investigations which at first were designed to procure analogies capable of explaining phenomena on the earth, such as aurora and magnetic disturbances, were subsequently extended, as was only natural, with the object of procuring information as to the conditions under which the emission of the assumed helio-cathode rays from the sun might be supposed to take place.

The magnetic globe was then made the cathode in the vacuum-box, and experiments were carried on under these conditions for many years.

It was in this way that there gradually appeared experimental analogies to various cosmic phenomena, such as zodiacal light, Saturn's rings, sun-spots and spiral nebulæ.