

were of the order of magnitude of the negative charges previously obtained.

Thus, at the same time as negative electricity is radiated from the kathode, positive electricity travels towards that kathode.

I endeavoured to determine whether this positive flux formed a second system of rays absolutely symmetrical to the first.

(4) For that purpose I constructed a tube (Fig. 2) similar to the preceding, except that between the Faraday's cylinder and the opening β was placed a metal diaphragm pierced with an opening β' , so that the positive electricity which entered by β could only affect the Faraday's cylinder if it also traversed the diaphragm β' . Then I repeated the preceding experiments.

When N was the kathode, the rays emitted from the kathode passed through the two openings β and β' without difficulty, and caused a strong divergence of the leaves of the electroscope. But when the protecting cylinder was the kathode, the positive flux, which, according to the preceding experiment, entered at β , did not succeed in separating the gold leaves except at very low pressures. When an electrometer was substituted for the electroscope, it was found that the action of the positive flux was real but very feeble, and increased as the pressure decreased. In a series of experiments at a pressure of 20 microns, it raised a capacity of 2000 C.G.S. units to 10

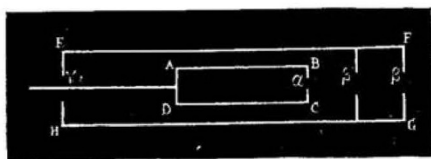


FIG. 2.

volts; and at a pressure of 3 microns, during the same time, it raised the potential to 60 volts.¹

By means of a magnet this action could be entirely suppressed.

(5) These results as a whole do not appear capable of being easily reconciled with the theory which regards the kathode rays as an ultra-violet light. On the other hand, they agree well with the theory which regards them as a material radiation, and which, as it appears to me, might be thus unenunciated.

In the neighbourhood of the kathode, the electric field is sufficiently intense to break into pieces (*into ions*) certain of the molecules of the residual gas. The negative ions move towards the region where the potential is increasing, acquire a considerable speed, and form the kathode rays; their electric charge, and consequently their mass (at the rate of one valence-gramme for 100,000 Coulombs) is easily measurable. The positive ions move in the opposite direction; they form a diffused brush, sensitive to the magnet, and not a radiation in the correct sense of the word.²

THE FRENCH MAGNETIC SURVEY OF THE WORLD.

IN Europe, as well as in the United States of America, the study of terrestrial magnetism has for some time played an important part.

M. le Commandant de Bernardières has written

¹ The breaking of the tube has temporarily prevented me from studying the phenomenon at lower pressures.
² This work has been carried out in the laboratory of the Normal School, and in that of M. Pellat at the Sorbonne.

a most interesting account of the construction of new magnetic maps of the globe, undertaken by the Bureau des Longitudes. The following are a few facts given by him, which show to what extent it is contemplated to carry out the work.

From the magnetic determinations already obtained, some maps have been made; observatories too, permanent and otherwise, have been built. But the work is not entirely satisfactory. The maps are chiefly the result of observations made by navigators, and are only of limited parts scattered over the face of the earth.

In order to have a *general* magnetic map, numerous observations would have to be made, distributed over all regions, taken as nearly as possible at the same time, and in the same way with similar instruments. To this end the Bureau des Longitudes have appealed to Vice-Admiral Besnard, Minister of Marine, who has promised help, and put at their disposal officers and sailors, and also a great number of instruments. The Colonial Minister has also shown interest in the matter, and promised his assistance in the colonies.

Seven sets of observers have been organised, consisting each of a lieutenant, ensign or hydrographer, and one assistant. These expeditions have been arranged as follows:—

Atlantic Ocean	{ West Coast of Africa, East Coast of America, Antilles, &c.	M. Schwérer, lieutenant of the ship.
Pacific Ocean	. West Coast of America	M. Blot, ensign of the ship.
Pacific Ocean	. Oceana	M. Monaque, ensign of the ship.
Indian Ocean	{ Red Sea, South Coast of Asia, Oriental Coasts of Africa, Madagascar, and other islands	M. Paqué, ensign of the ship.
Chinese and Japanese Seas	{ Coasts of Indo-China, of China and Japan	M. Terrier, ensign of the ship.
—	{ Madeira, Canary Islands, Azores, Cape Verd Islands, Senegambia	M. de Vanssay, hydrographic engineer.
Iceland	{ North Sea, Scandinavia, Denmark, Scotland	M. Houette, captain of the frigate, commanding the Iceland station; M. Morache, lieutenant of the ship.

With expeditions in these various parts of the earth, it will be possible to make observations almost simultaneously.

In order to determine the correct value of the magnetic elements, as well as to ascertain the exact variation of these elements, the missions have been supplied with the finest instruments, which have been adjusted at the observatories of Montsouris and Parc Saint-Maur; comparisons will also be made at every magnetic observatory at which they arrive during the expedition. Special instructions have been given with regard to calculations and method of observation, in order to insure a perfect comparison of results.

Six of these expeditions have started, and have communicated already the result of some of their first observations; the work, however, will have to be continued about two more years.

The ship *Manche*, which left France last spring, for Iceland, has returned with a great number of observations, obtained in Cherbourg, Scotland, the Shetland Isles, Iceland, Norway, and Denmark. In the observatory constructed by the *Manche* at Keykiawik, two complete observations of variations were obtained, having each a duration of eight days.

It will be very interesting to compare the results of the present day with those of the *Recherche*, obtained sixty years ago, and since then of several other expeditions. The successful return of the *Manche* certainly indicates that great things may be expected of the other expeditions, and makes it certain that a most important step has been taken by the French Government for the advancement of science.