of the apparatus. The first description of this new departure was given in the *Fortschritte auf dem Gebiete der Röntgenstrahlen* for June, 1913, and more recently a further account has appeared in a later issue (Band xviii., p. 256).[1]

Dr. Lilienfeld creates an electric field in the neighbourhood of the antikathode between an aluminium tube and a white-hot wire. The working potential difference is then applied to the main electrodes and a discharge immediately passes. Since the current taken by the tube depends upon the temperature of the so-called priming device, the operation is under control.

But Mr. Coolidge[2] has simplified this design still further by placing a small spiral of tungsten at the centre of the kathode; heating this by an independent current he obtains a supply of electrons which are repelled and driven against the target with such speed as to produce copious X-rays where they strike. Thus, given a powerful induction coil and noting that the bulb is so well exhausted that 100,000 volts at its electrodes produce no discharge, the spiral is heated and the current that then passes is simply a function of the temperature. Variation of the potential difference would mean an alteration of the speed at which the electrons are driven against the target. The *quality* of the X-rays produced can therefore be varied, irrespective of their quantity. This is not possible with any other type of X-ray tube. Its importance cannot be over-rated. It places in the hands of X-ray operators an instrument of precision. Many questions are still outstanding; it is not even claimed yet that this apparatus is beyond the experimental stage. Meanwhile, however, it may be of interest to point out that the Coolidge tube has already given some remarkable results. The most successful bulb so far made measured 18 cm. in diameter, and was blown from German glass; it carried a current of from 1·7 to 36 milliamperes with the spiral heated to a temperature varying between 2010° and 2240° absolute. It was run for fifty minutes continuously on one occasion with 25 milliamperes passing. There was, of course, great heat developed in the antikathode, but the regularity of the action seems to have been unaffected. No fluorescence appeared upon the glass of this bulb, and the starting and running voltages were identical. The tube is also its own "rectifier," and may be run off an alternating circuit without any additional device to suppress one phase.

The prospect of being able to speed up the electron so much that it may give rise to a radiation with a wave-length equal to, or even shorter than, that of the Gamma ray from radium, offers great therapeutic possibilities.

It remains so far to improve the means of supplying electricity to the tube that a steady potential difference may be maintained at its electrodes. Then, since reversal seems impossible with the Coolidge system, it should be feasible to produce pencils of approximately *homogeneous* X-rays in definitely measurable *quantity* and of a *quality* expressed in terms of the coefficient of absorption in some agreed substance.

An attempt to construct a tube upon the new principle is at present being made in the physics laboratory of the Cancer Hospital, and experiments will be taken in hand there as soon as possible to test the types of ray obtainable by this means. CHARLES E. S. PHILLIPS.

[1] A good summary is published in the *Archives of the Röntgen Ray*, for February, p. 340

[2] *Physical Review*, December, 1913.

THE SICILIAN EARTHQUAKE OF MAY 8.

THE earthquake which visited the south-east flank of Etna on May 8 is evidently one of the strongest of the local shocks which occur so frequently within the bounds of the volcano. Unlike the Messina earthquake of 1908, the shock was heralded by many slight tremors in the surrounding district, several having been felt every day since April 25. But for these warnings, the loss of life might have been far greater than it was, though more than 150 persons are reported to have been killed and about 500 injured. The villages of Linera, Passapomo, Pennisi, and Zerbati are completely ruined; Cosentini, S. Caterina, and S. Maria Vergina are half-destroyed; while about a dozen other villages from Zafferana and S. Venerina on the north to Trecastagni on the south are seriously damaged.

The epicentre of the earthquake is clearly at and near Linera. The details at present known are insufficient to determine the boundary of the meizoseismal area, but its greatest dimension can scarcely exceed two or three miles. For the same reason, nothing more is known as to the extent of the disturbed area beyond the fact that it was small considering the violence of the shock near the epicentre. Probably the disturbed area is far less than that of some of the weakest of British shocks. This alone proves how rapid was the decline in intensity from the central region. At Acireale, only four miles south of Linera, the damage to property was slight. At Catania, seventeen miles to the south, the shock was felt, and excited some alarm. These two facts—the great intensity near the epicentre and the rapid decline in strength outwards—show that the focus must have been quite close to the surface.

It is, however, in its relations with previous earthquakes in the same region and with the eruptions of the neighbouring volcano, that the interest of the earthquake chiefly lies. Two and a-half years before, on October 15, 1911, a similar, though less destructive, earthquake occurred in the immediate vicinity. The meizoseismal area in this case was a narrow band, four miles long and about a-third of a mile wide, extending from Fondo Macchia to Guardia, and passing about a mile and a-half to the north-east of Linera. On this occasion twelve persons were killed and forty-eight injured. On July 19, 1865, the same district was ruined by an earthquake, by which seventy-four persons were killed and fifty-six injured. Other shocks visited the same or neighbouring villages on July 11, 1805, and Janu-

ary 26, 1859; while, from 1893 to 1900, twenty-seven strong shocks were felt, six of them being of ruinous strength.

Many of these earthquakes were closely connected as regards time with Etnean eruptions. The earthquake of 1805 occurred after, and that of 1859 during, a period of activity. The earthquake of 1865 took place eighty-eight days after the conclusion of a violent eruption; and that of 1911 twenty-two days after the close of the last eruption, which began on September 10 of that year and lasted for twenty-three days. The recent shock occurred about two years and eight months after the end of the same eruption.

The same phenomena seem to characterise all the earthquakes of this district. The disturbed area is small, the intensity of the shock great in its central portion, and the isoseismal lines extremely elongated in form. In some cases the axes of the isoseismal lines are directed towards the central crater; in others (as in the earthquake of 1911) in a perpendicular direction. The small depths of the foci, their situation within the Etnean boundary, the direction of the meizoseismal bands, and the close connection of many of the earthquakes with eruptions of Etna—all these phenomena point clearly to the volcanic origin of the earthquakes, their immediate cause being probably local slips along radial and peripheral fissures.[1] C. DAVISON.

THE BACHELET LEVITATED RAILWAY.

THE daily Press, or rather a section of it, has been greatly excited during the past week by the exhibition of a model railway, the invention of M. Emile Bachelet, in which a metal carriage is levitated in the air above the rails in a model railway, and then flung forward with very great speed through a series of solenoids. The reporters for the daily Press have discovered new and tremendous possibilities in a scientific principle entirely new to them, but which has been perfectly well known to every electrician and physicist for the last twenty-five years.

The repulsion of a metal plate or ring by an electromagnet or coil carrying an alternating current was discovered independently by Dr. J. A. Fleming and by Prof. Elihu Thomson. In 1887 Dr. Fleming invented and described in the *Electrician* of March 25, 1887, an alternating current galvanometer, in which a copper disk suspended in the interior of a coil carrying an alternating current was repelled and deflected. On June 10, 1887, Prof. Elihu Thomson published in the *Electrician* a lecture on novel phenomena of alternating currents, in which he described the repulsion of copper disks and rings by an alternating electromagnet. Prof. Thomson's apparatus was exhibited at the Paris Exhibition in 1889, and the experiments shown by Prof. Fleming to the Royal Society of Arts in a lecture in May, 1890, and also at a Royal Society *soirée* in the same year, as well as at a Friday evening discourse at the Royal Institution in March, 1891.

Dr. Fleming expounded the whole matter with numerous striking illustrations. Heavy copper rings were made to float in the air, or were shot up into the air with great velocity. This repulsion is due to the repulsion between the currents in the magnet coil and the eddy curents set up by the alternating field in the plate or ring.

The principle was applied by Prof. Elihu Thomson in the invention of an alternating current electric motor, and it has been developed in the well-known compensated repulsion motor of Winter and Eichberg. It is also applied in several forms of rotating and recording electric meter. The phenomena known as "electromagnetic repulsion" are therefore perfectly familiar to electrical engineers, and except in the ingenious application to the support of a model railway carriage there is nothing new. Press reporters and others who have been astonished by the exhibition of this force are merely learning afresh facts which were publicly exhibited and described by Profs. Fleming and Elihu Thomson nearly a quarter of a century ago. Careful experiments and quantitative measurements will, however, be necessary before any valid opinion can be formed whether the principle admits of economical application in the propulsion of real railway trains. Nevertheless M. Bachelet deserves credit for his highly ingenious application of this well-known principle of electromagnetic repulsion.

NOTES.

LORD LAMINGTON, G.C.M.G., G.C.I.E., has consented to be president of the Research Defence Society, in succession to the late Sir David Gill, K.C.B., F.R.S.

ON the recommendation of the council and of the special committee on the Hayden award, the Academy of Natural Sciences of Philadelphia has this year conferred the memorial gold medal on Dr. Henry Fairfield Osborn, in recognition of his distinguished work in vertebrate palæontology.

AT the annual meeting of the Irish Forestry Society on April 23, it was stated by Prof. Campbell that the department hoped to secure 15,000 acres for State forestry in Ireland. A grant had been obtained from the Development Commissioners of 31,430*l.*, spread over fifty-two years, for a scheme of forestry in Cork, and the department is applying for a further grant of 45,000*l.* It is thus evident that State forestry in Ireland has broken ground in earnest, and this makes it all the more remarkable that State forestry in England and Scotland should still be waiting to start.

THE sixtieth general meeting of the Institution of Mining Engineers will be held in London, on Thursday, June 4, in the rooms of the Geological Society, under the presidency of Sir William E. Garforth. The following papers will be read, or taken as read:—Sinking and equipment of Blackhall Colliery for the Horden Collieries, Ltd., J. J. Prest

[1] M. Baratta, I terremoti d'Italia, 1901, pp. 829-33; A. Riccò, Boll. Soc. Sis. Ital., vol. xvi., 1912, pp. 9-38.