unusually numerous. During the first twelve hours about 114 shocks were felt, and during successive intervals of the same length the numbers were 88, 60, and 47. In the first three days more than 1700 shocks were recorded by seismographs in Tokyo. After the Mino-Owari earthquake of 1891 the number of after shocks recorded at Gifu during the first three days was 639, and nearly a month elapsed before the number rose to 1700.

THE PROBLEM OF LIGHT QUANTA.—In the February issue of the *Philosophical Magazine*, M. le Duc de Broglie puts forward a tentative theory of light quanta and shows how it furnishes an explanation of some of Bohr's results while at the same time it gives the diffraction and interference effects of the wave theory. According to the author, the light quantum has a mass of the order of 10^{-50} grams, a variable velocity nearly that of light and an internal symmetry corresponding to that of an electro-magnetic wave. These light quanta considered as a gas give the pressure of light on a surface exposed to them. If at any time the internal variations in the quantum are in phase with the oscillations in an Einstein energyless wave with which it for the instant coincides in space, they will remain in phase and therefore all quanta on the same wave will be in phase with the wave and with each other. It is this "coherence" amongst the quanta distributed over the same wave which allows the wave theory explanations of diffraction and interference to be retained in the new theory.

EMISSION OF α-PARTICLES BY RADIUM.—Messrs. H. Geiger and A. Werner describe in the *Zeitschrift für Physik*, February 8, 1924, an investigation made in the Physikalische Reichsanstalt to redetermine the number of α-particles emitted by radium. A special instrument was devised, in which the zinc sulphide screen was placed at an angle of 45° to the direction of the α-rays, so that it was possible for two observers to watch the front and back simultaneously, by means of separate microscopes. Special attention was given to the preparation of the screen, to ensure that the result should be influenced as little as possible by failures of the α-particles to produce scintillations. A small funnel, the opening of which was closed by a sheet of mica, was filled with radium emanation, and compared with a standard radium preparation by means of the γ-rays. The emanation, with its products of degeneration, was used to produce scintillation on the screen, and these were recorded independently by the two observers on a revolving drum. It was thus possible to determine which scintillations were missed by each observer, and thus eliminate the subjective, personal error. It was found in the preliminary experiments that the error due to inactive grains in the screen was only about 0·4 per cent. The effects of scattering of the rays and of statistical variations were considered, and the corrected value for the number of α-particles emitted by one gram of radium was found to be $3{\cdot}40 \times 10^{10}$. Rutherford and Geiger, in their first counts, when the standards were not fixed as at present, found $3{\cdot}57 \times 10^{10}$. Assuming the velocity of the α-particles of radium to be $1{\cdot}5 \times 10^{9}$ cm./sec., the heat emitted per gram of radium in equilibrium with emanation, radium A and radium C′ is 22·25 calories per hour. Hess found experimentally 25·2, and Rutherford 25·1 calories per hour per gram; so that it seems as though, besides the kinetic energy of the α-particle and the recoil atom, further energy is liberated on disintegration, in consequence of the rearrangement of the atomic nucleus of radium.

TITANIUM AND SILICON IN STEEL.—No. 241 of the Technologic Papers of the U.S. Bureau of Standards is by G. K. Burgess and G. W. Quick, the subject being "A comparison of the deoxidising effects of Titanium and Silicon on Rail Steel." The experiments cover a large number of tests of American rail steel, which is a high-carbon product containing 0·65 to 0·75 per cent. carbon. Ingots deoxidised by silicon and by titanium have been used in the manufacture of rails, which have then been compared by mechanical tests and by sulphur prints. The result of the investigation is to show that titanium has a greater effect than silicon in reducing segregation both of carbon and of sulphur, and that the resulting rails are more uniform in hardness. The results of tensile, impact, and endurance tests do not show so much improvement. A small quantity of titanium remains in the steel and is sometimes to be seen in the form of coloured inclusions. The amount of piping is greater in rails treated with titanium than in those which have been deoxidised by silicon. The amount of nitrogen in combination with iron and manganese is reduced by the addition of titanium, but when the proportion of added titanium is large, the nitrogen is probably held in combination with that element.

MAINTENANCE OF TELEPHONE SYSTEMS.—P. E. Erikson and R. A. Mack read an interesting paper on telephone maintenance to the Institution of Electrical Engineers on March 6. It is well known that owing to the development of faults on a telephone line its efficiency gradually falls off unless special precautions are taken to detect and remove them at the earliest opportunity. In recent years the construction of high tension power lines for supplying electrical energy to factories and railways has made necessary special precautions to safeguard the communication circuits against external disturbances. The various systems of transposing telephone wires have been developed not only to reduce this interference but also to prevent "cross-talk" between the individual circuits. The successful operation of a "phantom" circuit is only possible when a very accurate balance between the various circuits it utilises is maintained. Paper insulated telephone cables had been in use for years before the Pupin coil was invented. The introduction of this coil made the maintenance of an accurate balance a necessity. The thermionic valve repeater sometimes develops "echo" effects, especially when used with long loaded cables. With the new four-wire repeater the echo effects can be practically avoided, but at the ends of the circuit balancing is still necessary. As the outside line plant of a large telephone system represents the great bulk of the capital expenditure, every effort should be made to utilise it to the utmost of its capacity. The authors describe various types of apparatus developed by the Western Electric Co. of America by means of which the various losses in a telephone system can be accurately measured and in some cases the causes readily located. From the discussion which followed, it appears that the Post Office engineers in Great Britain have developed accurate methods of their own for testing insulation and for locating minute faults to a high degree of precision.

ERRATUM.—In the Research Item in NATURE of March 22, p. 441, referring to the crystal structure of hydrogen chloride, it should have been stated that the capillary tube on which the crystal deposit is formed is cooled by passing through it a current of hydrogen cooled in liquid air, or for the lowest temperatures a current of liquid oxygen; the hydrogen chloride is introduced into the vacuum through another tube.