carried on in them. The three buildings endowed and equipped by Sir William C. Macdonald for engineering, chemistry and mining, and physics, afford excellent facilities for study and research. There are special laboratories and workshops in which machinery of full size has been erected, so that all investigations can be carried on in all respects under working conditions.

THE tenth report of the Technical Instruction Committee of the County Borough of Plymouth has been received. The concluding words of the report show that the committee realises that fundamental principles rather than technical details should be the object of the work in such municipal science, art and technical schools as that at Plymouth. The committee remarks :—"It must not be assumed that the work of the schools is intended to embrace what are commonly called technical subjects only. Their object is to give such higher education and training, combined with manual and technical skill, as may enable their students to perform their work in life with greater intelligence, ability and success."

SINCE Prof. Perry brought forward the subject of "The Teaching of Mathematics" at the meeting of the British Association last September, several associations of teachers have discussed the reforms suggested or appointed committees to report upon the matter. A committee of the Assistant Masters' Association has had the subject under consideration, and a preliminary report has been drawn up, from which it appears that masters in secondary schools are in favour of most of the reforms advocated by speakers at the British Association meeting. The report is as follows :—I. *Arithmetic.* (1) The method of teaching in the early stages should be inductive and concrete. Actual measuring and weighing should be introduced as early as possible. (2) Decimals should be treated as an extension of the ordinary notation, their nature being illustrated by actual metric weights and measures. Multiplication and division of a decimal by a decimal would, we think, have to follow vulgar fractions. (3) The decimalisation of English money and English weights and measures should be practised frequently. (4) Approximate methods should be gradually introduced after the treatment of finite decimals. They should be taught with due regard to rigidity of proof. Appreciation of the degree of approximation should be continually insisted upon. (5) If "commercial arithmetic" is to be taught at all, the subject-matter should receive more adequate and correct treatment, and the examples should be drawn from transactions as they actually occur.—II. *Algebra.* (1) The foundation of algebra should be "literal arithmetic," *i.e.* algebra should at first be arithmetic generalised. (2) The minus sign should receive its extended meaning from copious illustrations ; and illustrations, not rigid proof, should also be resorted to for the purpose of the "rule of signs." (3) Algebra should often be applied to geometry. (4) Logarithms should form an important section of the subject. We believe that the graphic method could be very usefully employed in this connection. (5) We desire to deprecate the waste of time so commonly practised in mere manipulation of symbols.—III. *Geometry.* (1) We are strongly of opinion that the ordinary deductive geometry should be preceded and continually supplemented by concrete and inductive work. (2) Whilst "mensuration" might possibly be taught in connection with physics and arithmetic, we believe that the value of geometry would be enhanced by practical applications of the propositions as they occur. (3) We feel very strongly that Euclid's text is very unsuitable for teaching geometry. But we are impressed with the difficulty of abolishing its use in the face of external examinations. In the circumstances, we can only hope that examining bodies, even if they insist on Euclid's sequence, will allow greater latitude in methods of proof, and give greater prominence to easy "riders" and applications of geometry.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 12.—"The Dissipation of Energy by Electric Currents induced in an Iron Cylinder when rotated in a Magnetic Field." By Ernest Wilson, Professor of Electrical Engineering, King's College, London.

The effect which induced currents have upon the distribution of magnetism in an iron cylinder, when rotated about its longitudinal axis with uniform angular velocity in a magnetic field, has already formed the subject of a communication (Wilson, Roy. Soc. *Proc.*, vol. lxix. p. 435, also NATURE, vol. lxv. p. 502). The present paper deals with the energy dissipated by these electric currents, and a comparison is made between the results of experiment and theory. In connection with the theory of the subject a contribution by Mr. J. B. Dale is made use of. The cylinder experimented upon has diameter and length each 10 inches (25·4 cm.), and is rotated between the poles of a magnet weighing some tons. It is supplied with exploring coils, threaded through holes drilled in a plane containing its longitudinal axis, by the aid of which the electromotive forces due to rotation in a magnetic field have been observed. The results of experiment have been obtained graphically by a process of double integration. The distribution which has to be assumed in connection with the experiments is that the induced currents distribute themselves on the surfaces of cylinders similar to and concentric with the cylinder experimented upon. Two other distributions are also discussed, namely, the distribution assumed by Baily (*Phil. Trans.* Roy. Soc., A, vol. clxxxvii., 1896, pp. 715–746), that in any section the electric currents flow in rectangular paths similar to the boundary of the section, and the distribution in which the current density in any path is constant throughout the path.

Dealing with the distribution assumed in connection with the experiments, both graphical treatment and theory agree in giving the formula $3{\cdot}95B^2f^2l^2/10^{16}\rho$ for the watts dissipated per cubic centimetre, where B is the intensity of magnetic induction assumed constant, f is the frequency, l is the length of the cylinder assumed equal to its diameter, and ρ is its specific resistance. In the experiments the frequency was varied from 1/45 to 1/360, and for each the average intensity of induction was varied from 1000 to 20,000. In each case the watts per cubic centimetre are less than would be dictated by the above formula. The ratio of the results is 1·3 at frequency 1/360, and is substantially constant for all values of the induction density. At frequency 1/45 this ratio varies from 1·4 to 1·7 for high and low values of the induction density, but it is 3·1 for an intermediate value. A similar, though less marked, effect is observed at frequency 1/90. The explanation given is that with these intermediate forces at these frequencies very great crowding of the induction to the surface occurs ; and, moreover, since the wave-form of the electromotive force near the surface of the cylinder in all the experiments is more rectangular, the dissipation of energy per cubic centimetre is less than the formula above would give, since *there* the wave-form is assumed to be a sine-curve. On the assumption that the electromotive force at the surface is truly rectangular, the formula obtained by graphical treatment is $2{\cdot}08B^2f^2l^2/10^{16}\rho$.

Having reconciled the results of experiment with those of theory, the author compares the dissipation of energy in rotating and alternating magnetic fields. It is pointed out that in the case of circular plates in which the diameter is very great as compared with the thickness, and in which the lines of force are uniformly distributed in the plane of the plate, the rotating field would dissipate about 1·7 times as much energy as an alternating magnetic field in the same time. The results are, however, greatly influenced by variation in wave-form, and even when the lines of force are confined to the plane of the plate, a condition not always met with in practice, the rate of dissipation of energy for a given average induction density may be considerably reduced if the distribution of magnetic induction is such as to give a more rectangular wave-form to the induced electromotive force.

"Note on a Magnetic Detector of Electric Waves, which can be Employed as a Receiver for Space Telegraphy." By G. Marconi, M.I.E.E. Communicated by Dr. J. A. Fleming, F.R.S.

The detector is based, in the author's opinion, on the decrease of magnetic hysteresis which takes place in iron when, under certain conditions, it is exposed to the effects of Hertzian waves. On a core of thin iron wires is wound a coil consisting of one or two layers of insulated copper wire, and over this and separated from it by insulating material is wound a second longer coil. The ends of the inner coil are connected to earth and the aërial conductor, and the ends of the outer coil to a telephone. The iron core is magnetised by a permanent magnet at one end, which is rotated by clockwork so as to cause a continual slow change in the magnetisation. The magnetisation, however, lags behind the magnetic force owing to the hysteresis of the iron, but when a high-frequency current passes through the inner winding there is a decrease in the hysteresis, due

apparently to the iron molecules being momentarily released from constraint. A sudden variation in the magnetisation of the iron results, and this induces a current in the outer copper winding connected to the telephone. The author finds that the telephone reproduces very accurately the transmitted signals, and that the receiver is more sensitive than the coherer and more suitable for use with a syntonic system of wireless telegraphy. Experiments with the receiver have been carried out between St. Catherine's Point and North Haven, the distance between these points being 152 miles; the length of the electric waves used was 200 metres.

"A Note on the Effect of Daylight upon the Propagation of Electromagnetic Impulses over Long distances." By G. Marconi, M.I.E.E. Communicated by Dr. J. A. Fleming, F.R.S.

During the experiments carried on between Poldhu, Cornwall, and the U.S. s.s. *Philadelphia* it was observed that the signals transmitted at night had a greater carrying power than those transmitted by day. The transmitting conductor consisted of fifty bare copper wires suspended from a wire stretching between two poles 48 metres high. On board ship the receiving conductor was suspended from the mast and was composed of four wires the tops of which were 60 metres above the sea level. Signals were sent from Poldhu at stated intervals from 12 to 1 a.m., from 6 to 7 a.m., from 12 to 1 p.m. and from 6 to 7 p.m. Until the *Philadelphia* was 500 miles from Poldhu no differences were observed; at distances of more than 700 miles signals transmitted during the day failed entirely, whereas those sent at night remained quite strong up to 1551 miles and were decipherable up to 2099 miles. Daylight at Poldhu was rapidly increasing from 6 to 7 a.m., and it was observed that on the *Philadelphia* the signals which were quite clear at 6 a.m. had almost disappeared by 7 a.m. Confirmatory tests were carried out between Poldhu and North Haven, and it was found that receiving wires 12·1 metres high could be used at night, but that, other things being equal, the height had to be increased to 18·5 metres for the daylight signals to be equally clear. The author suggests that the effect may be due to the diselectrification of the transmitting elevated conductor by daylight, the electrical oscillations being thereby prevented from acquiring so great an amplitude as they attain during darkness. That the effect has not been previously noticed may be due to the extra high potential to which the aërial wires at Poldhu were charged for this long-distance work. This potential was sufficient to cause sparking between the tops of the wires and an earthed conductor 30 cm. distant.

EDINBURGH.

Royal Society, June 16.—The Hon. Lord M'Laren in the chair.—Prof. C. G. Knott read a paper on the change of resistance of nickel due to magnetisation at various temperatures. The apparatus used had been constructed twelve years ago in Japan, but other work had prevented anything like a thorough investigation being made with it. Two exactly equal pieces of nickel wire were coiled so as to form anchor-ring cores to magnetising coils of copper wire coiled round them. Round each nickel wire were coiled two distinct coils with exactly the same number of turns. Thus by joining up the coils in different ways the experimenter was able to subject the enclosed nickel to a strong magnetic field or to no field, without in any way altering the strength of current circulating in the coils. The nickel coils were balanced on a Wheatstone bridge. The magnetising current was passed round the pairs of coils on the nickel cores, so as to magnetise the one nickel but not the other. In this way the heating effect was practically the same in both coils and the change of resistance due to heating very nearly compensated. The coils were heated up to various temperatures in an air bath and the resistance change was measured by deflection after a balance was nearly adjusted. The galvanometer was gauged by means of the deflection produced when a definite change of resistance was made in one arm of the bridge. The first series of experiments indicated that there was a decrease in the proportional change at higher temperatures; but this showed that the total amount of change estimated in ohms for any given wire was very nearly the same at all temperatures between the limits of 10° and 170° C. The bearing of this result upon Prof. J. J. Thomson's theory of corpuscles was pointed out; but further results were held over for another communication.—Prof. Knott also gave an account of the last piece of quaternion work which Prof. Tait had jotted down on July 2, 1901, just two days before his death. The notes bore upon the properties of the linear vector function and were a following up of previous work published in the *Proceedings*.—Dr. Hugh Marshall described the results obtained by him in the first part of an investigation of the thallic sulphates and double sulphates. From these it would appear that it is largely a matter of solubility whether normal or basic salts are obtained, rather than a matter of sulphuric acid concentration. Thus, potassium thallic sulphate, $KTl(SO_4)_2,4H_2O$, when treated with dilute sulphuric acid gives a sparingly soluble basic salt, $K_2TlOH(SO_4)_2$; the latter dissolves easily in dilute nitric acid and this solution gives crystals of the first-mentioned normal salt. No thallic alums could be obtained.

July 7.—Sir William Turner in the chair.—An obituary notice of Lieut.-Colonel J. H. B. Hallen, C.I.E., F.R.C.S.E., was communicated by Principal W. Owen Williams.—Mr. J. G. Goodchild contributed a paper on Scottish mineralogy, based upon a study of the specimens under his charge in the Edinburgh Museum of Science and Art. It dealt chiefly with the developmental history of albite studied in relation to crystal genesis in general. The paper also dealt with the crystallography of Scottish cerussite, analcine, forsterite and some others. Drawings of a large number of crystals were exhibited.—Mr. James N. Miller demonstrated the mode of applying his mechanical trisector to the quinquesection of an angle. It was an ingenious extension of the properties of the trisector.—In a paper on experimental observations on leucolysis, by Drs. A. Goodal and E. Ewart, the following conclusions were arrived at:—(1) Necrobiotic changes occur in the circulatory leucocytes in health; (2) these changes are much more evident in conditions of impaired nutrition and toxæmia, notably in cancerous cachexia; (3) in toxic conditions usually associated with leucocytosis the extent of the necrobiotic changes in the white cells varies in inverse ratio to the number of leucocytes in the circulating blood; (4) these necrobiotic changes can be rapidly induced "in vitro" by the action of certain organisms or other products; (5) the rapidity and extent of the changes depend on the kind of organisms, the virulence of the culture and the number of organisms employed.—In a paper on cross-magnetisation in iron, Mr. James Russell described a large number of experiments showing how the induction, either longitudinal or circular, was affected by cross fields and how the effects of these cross fields were themselves reacted upon. As one among many results, consider the case of a steady longitudinal field with a cyclically changing circular field superposed. The induction due to the longitudinal field went through a corresponding cycle with its maximum points occurring at the instants of greatest change in the cyclic circular field. The cyclic change in the longitudinal field was very similar in form to the change accompanying twisting.—In a note on a suggested improved method of measuring deep-sea temperatures, Prof. Knott called attention to the unsatisfactory character of the methods at present in use, and advocated the use of the platinum thermometer, with which the temperature must be taken *in situ*. Various obvious difficulties in the way of applying the platinum thermometer to deep-sea work were considered, also the manner of measuring the depth at the instant of taking the reading. For experiments down to moderate depths there was no special difficulty in using these electric resistance thermometers, and by such rapidly acting apparatus important problems connected with the penetration of solar radiation through surface waters could be readily solved.

PARIS.

Academy of Sciences, July 24.—M. Bouquet de la Grye in the chair.—On electrolytic actions developed by batteries consisting of two liquids, one being an acid, the other an alkali, by M. Berthelot.—On the existence in the albumin of birds' eggs of a fibrogen substance capable of being transformed, *in vitro*, into pseudo-organised membranes, by M. Armand Gautier. Fresh white of egg, after filtration through paper, was diluted with water and treated with a current of an indifferent gas, such as nitrogen or carbon dioxide. A substance is precipitated in the form of white transparent membranes, possessing a rudimentary organisation, and approximating in composition to the fibrin of human blood and to myosin, but differing considerably from egg-albumin.—On the glycuronic acid in the blood of the dog, by MM. Lépine and Boulud.—Report on a memoir of M. Torres concerning a scheme for a steerable balloon presented to the Academy on May 26. The committee regards the work of M. Torres as constituting a very interesting contribution to the theory of steerable balloons, and considers it desirable that

experiments on the subject should be made.—The mission to Martinique; extract from a letter of M. Lacroix to M. Michel Lévy. A short account of the experiences of the exploring party. Stress is laid on the fact that no heavy masses appear to have fallen upon St. Pierre; the destruction must have therefore been due to the effects of masses of incandescent gases. The torrential rains have caused great ravages, and in some cases have changed the hydrography of the coast. Soundings show that the sea bottom near the coast line has not undergone any appreciable alteration.—On the generalisation of the analytical prolongation, by M. Émile Borel.—Observations on the preceding communication, by M. P. Painlevé.—Anomalies presented by the charge of isolated conductors on solid dielectrics. Particular magnetic phenomena proved in the neighbourhood of the nodes of electric oscillations, by M. V. Crémieu.—On the mechanical phenomena of the electric discharge, by M. Jules Semenov. It has been generally supposed that when a spark passes between two conductors material particles are torn off each pole and carried to the opposite pole. The author describes experiments which show that no particles are removed from the positive pole and that the material carried by the spark towards the negative pole arises exclusively from the gas or vapour in the immediate neighbourhood of the positive pole.—Photograph of a multiple lightning flash, by M. Piltschnikoff.—On magnetic double refraction, by M. Quirino Majorana. The study of magnetic double refraction in solutions of ferrous chloride and of dialysed ferric oxide has led to the deduction of the following laws: the double refraction is proportional to the thickness of the liquid normal to the lines of force, to the concentration of the liquid, to the square of the field strength and to the reciprocal of the square of the wavelength.—On the atomic weight of radium, by Mme. Curie. By concentrating by fractional crystallisation a large quantity of radiferous barium chloride, about 0·1 gram of radium chloride has been obtained, the atomic weight of which, on the assumption that radium is a divalent metal, is 225. According to its chemical properties radium belongs to the series of the alkaline earths. The anhydrous chloride is spontaneously luminous.—The action of hydrochloric acid upon the sulphates of aluminium, chromium and iron, by M. A. Recoura. By the action of hydrochloric acid upon chromium sulphate a chromium chlorosulphate is obtained, $CrSO_4Cl,6H_2O$, the chlorine of which is not precipitated from its aqueous solution by silver nitrate. Freezing-point determinations showed that this compound is not dissociated in aqueous solution.—On the mixtures formed by sulphur and phosphorus at temperatures below 100° C., by M. R. Boulouch. No definite chemical combination of sulphur and phosphorus appears to be formed below 100° C. A eutectic mixture which melts sharply at 9°·8 simulates a definite compound.—On the precipitation of copper bromide and chloride by sulphuric acid, by M. Georges Viard.—Study of cerium silicide, by M. Sterba. A well-defined crystallised silicide of cerium is obtained by heating together cerium oxide and silicon in the electric furnace. Its composition is $CeSi_2$, and it possesses great stability. Its properties are different from those of calcium silicide and approximate rather to those of the silicides of the heavy metals.—The action of alcohols upon the sodium derivatives of other alcohols, by M. Marcel Guerbet. A mixture of œnanthyl alcohol, ethyl alcohol and sodium heated in sealed tubes to 230° C. gives some normal nonyl alcohol. The method appears to be a general one for obtaining higher homologues of the higher alcohols.—Study of the simultaneous distillation of two non-miscible substances, by MM. Eug. Charabot and J. Rocherolles. The ratio between the weight of a substance not miscible with water and the weight of water which distils simultaneously varies in the direction approaching unity when the temperature increases short of the critical temperature of one of the liquids.—On a new di-iodophenol, by M. P. Brenans.—The action of nitrous acid in acid solution on the α-substituted β-ketonic esters; the synthesis of homologues of pyruvic acid, by MM. L. Bouveault and R. Locquin.—On a method permitting of the separation from complex animal or vegetable liquids of the greater part of the ternary substances and several of the bases which may accompany them, by M. S. Dombrowski.—The variations of the iodine in the blood, by MM. E. Gley and P. Bourcet.—The pharmacodynamic properties of some aromatic semicarbazides, by MM. Auguste Lumière, Louis Lumière and J. Chevrottier.—The experimental transmission to descendants of lesions developed in the ancestors, by MM. A. Charrin, A. Delamare and Moussu.—On the evolution of the cranial ring detached by trepanning and immediately transplanted, by MM. V. Cornil and Paul Coudray.—Mosquitoes and yellow fever in Havana, by M. André Poëy.—The elaboration of zymogen in the gastric glands of the snake Berus, by M. L. Launoy.—On artificial parthenogenesis, by M. C. Viguier.—The production of sleep and local and general anæsthesia by electric currents, by M. Stéphane Leduc. With electric currents the complete inhibition of the cerebral centres can be instantly obtained and without apparent pain, leaving intact the centres of respiration and circulation. A complete general anæsthesia can thus be obtained which is without any after action.—Spermatogenesis in *Cybister Roeselii*, by M. D. N. Voinov.—On the *rôle* of the spleen in the hæmatolytic function, by M. Louis Lapique.—On the presence of lecithin in plants, by MM. Schlagdenhauffen and Reeb.—On the conservation of the germinating power in seeds, by M. L. Maquenne.—On the specialisation of parasitism in *Erysiphe graminis*, by M. Ém. Marchal.—On the hydrography of Tidikelt in the Central Sahara, by M. G. B. M. Flamand.—On the constitution of the sea floor, by M. J. Thoulet.

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