with a metallic point connected to the ground or to the kathode. The rays then are attracted to a point on the tube exactly opposite to that touched by the conductor; the best position for the latter is at a distance from the kathode equal to its radius of curvature. Tubes could, of course, be constructed so that the focus of the kathode rays fell normally on the wall of the tube; it is found, however, that after some time the glass loses its fluorescent property, showing a dark spot at the incident point of the rays. The device with the metallic point enables the fluorescent spot to be changed from time to time.

The surgical aspects of photography with Röntgen rays are considered by Mr. Albert Carless in the March number of the *Practitioner*. The conclusion arrived at with reference to radiography is "that it can be of real value in a certain limited number of cases there can be no doubt, but unless very considerable improvements are made in the technique, it will be but little resorted to in practical work."

Prof. M. J. Pupin contributes to the March number of the *Engineering Magazine* (New York) an account of his experiments with Röntgen rays. He has obtained excellent results with a pear-shaped Crookes' tube, of five inches diameter, excited by a six-plate Holtz machine. He finds that a cylindrical vacuum tube without internal electrodes, but with external tinfoil coatings at the extremity of the tube, will do very well as a substitute for a Crookes' tube.

Our American correspondent writes, under date February 28: "The new art of 'radiography' is still prosecuted in America with unabated ardour. The most successful apparatus yet devised seems to be that of Prof. John S. McKay, of the Packer Institute, Brooklyn. It is a small tube five inches long, and an inch, or rather more, in diameter, which is known and sold by instrument-makers as a 'perfect vacuum' tube. This is attached directly to the terminals of the secondary coil. The copper electrodes are less than an eighth of an inch apart; but the vacuum is so perfect, that the spark will leap the whole length of the tube outside rather than cross this small interval inside. The tube produces very little light, and is sometimes, when in use, perfectly dark. This tube is light and convenient, and does not become hot like the Crookes' tube. After running it continuously for half an hour with a pressure of 200,000 volts, it is scarcely warm to the touch. But the special advantage is that the rays radiate in all directions from the centre, so that exposures may be made simultaneously within a radius of two feet from the centre of the tube. The best results were found at a distance of one foot, and with an exposure of five minutes. Experiments to determine the relative opacity of different substances show that the opacity to X-rays is generally in inverse proportion to the diathermancy of the substances tested. Thus rock-salt is most opaque: next comes alum, then glass, then quartz. Camphor gum, gum copal, and vulcanite are almost equally transparent; amber somewhat less so, and sealing-wax quite opaque. Iceland spar, mica, and selenite are quite transparent. Iceland spar seemed to give evidence of double refraction. Charcoal is quite transparent, more so than wood. Anthracite coal is somewhat opaque, but not so much as glass. Egg-shells, like bones, are opaque. Of liquids tested, mercury, sulphuric acid, glycerine, and kerosene were somewhat opaque, the opacity varying about as the density. Prof. McKay has also produced pictures on a sensitive gelatine film wrapped in paper with some metallic object upon it, and placed in the dielectric of an electric condenser, the terminals of which are connected with an induction coil or Holtz machine. After rapidly charging and discharging this condenser or Leyden jar for two or three minutes, a distinct image of the metallic body is found to be radiographed upon the sensitive film.

"A remarkable application of Prof. McKay's apparatus has been made by Edward P. Thompson, an electrician, who has devised a fluorescent screen on which shadows may be thrown showing the action of the bones in motion, as of the hand, and he hopes to show the motion of the bony skeleton of a bird in flight. It has been stated that the great drawback to aerial locomotion is our ignorance of the exact way in which a bird flies. Hence the inventor attaches much importance to his apparatus, which he calls the 'kinetoscotoscope.' It will show, among other things, the motion of the parts of a broken bone, indicating the locality and nature of the fracture, as the bones may be moved or bent back and forth before the screen, thus opening and closing the crack. The taking of pictures is not the design of this apparatus. The fluorescent screen is prepared by pulverising barium platino-cyanide to a fine powder, and pouring upon a draughtsman's tracing cloth a small quantity of varnish, or of a mixture of oil and turpentine, stirring the powder in with it, and drying."

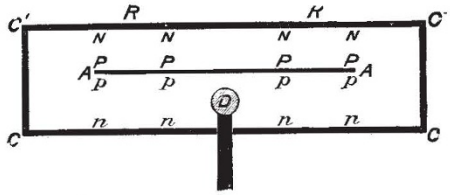
With regard to seeing Röntgen shadows by means of a fluorescent screen, Mr. Swinton informs us that he finds that instead of employing blotting-paper saturated with barium platino-cyanide, it is much better to make a hot emulsion of the barium platino-cyanide in gelatine and water, and apply this in a thick coat to a piece of glass On cooling, the barium platino-cyanide crystallises out, and the gelatine protects it from abrasion. A thick and uniform coating is what is wanted. The glass being rather opaque to the X-rays, but transparent to light, the plate should be obviously placed with the gelatine side next to the Crookes' tube, and the glass side next the eye.

ON THE GENERATION OF LONGITUDINAL WAVES IN ETHER.[1]

IN a short note published in NATURE of February 6, I suggested an arrangement of four insulated and electrified spherical conductors with their centres in one line, giving rise to ethereal waves in the surrounding atmosphere, of which the disturbance in the line of centres is essentially longitudinal. But at any finite distance from this line there must also be laminar or distortional waves of the kind expressed in Maxwell's equations. The object of my present communication is to show an arrangement by which a large space of air is traversed by pressural disturbance, or by waves essentially longitudinal, or by condensational-rarefactional vibrations; with but a very small proportion, practically evanescent, of laminar waves.

Let AA be a plane circular metal plate insulated within a metal case CCC'C', as indicated in the drawing. Let D be a discharger which can be pushed in so as to make contact with A.

Let A be charged to begin with, positively for instance as indicated by the letters PP*pp*; NN*nn* showing negative electricity



induced by it. Let now the discharger be pushed in till a spark passes. The result, as regards the space between AA and the roof RR over it, will be either an instantaneous transmission of commencement of diminution of electrostatic force, or a set of electric waves of almost purely longitudinal displacement, according as ether is incompressible or compressible.

Hence, if the theory of longitudinal waves, suggested by Röntgen as the explanation of his discovery (for the consideration of which he has given strong reasons), be true, it would seem probable that a sensitive photographic plate in the space between AA and RR should be acted on, as sensitive plates are, by Röntgen rays. Either a Wimshurst electrical machine or an induction-coil, adapted to keep incessantly charging AA with great rapidity so as to cause an exceedingly rapid succession of sparks between D and A, might give a practical result. In trying for it, the light of the sparks at D must be carefully screened to prevent general illumination of the interior of the case and ordinary photographic action on the sensitive plate.

The arrangement may be varied by making the roof of sheet aluminium, perhaps about a millimetre thick, and placing the sensitive photographic plate, or phosphorescent substance, on the outside of this roof, or in any convenient position above it. When a photographic plate is used there must, of course, be an outer cover of metal or of wood, to shut out all ordinary light from above. This arrangement will allow the spark gap at D to be made wider and wider, until in preference the sparks pass between AA and the aluminium roof above it. The transparency of the aluminium for Röntgen light will allow the photographic plate to be marked, if enough of this kind of light is produced in the space between the roof and AA, whether with or without sparks.

[1] A paper by Lord Kelvin, read before the Royal Society on February 13

The new photography has hitherto, so far as generally known, been performed only by light obtained from electric action in vacuum; but that vacuum is not essential for the generation of the Röntgen light might seem to be demonstrated by an experiment by Lord Blythswood, which he described at a meeting of the Glasgow Philosophical Society on Wednesday, February 5. As a result he exhibited a glass photographic dry plate with splendidly clear marking which had been produced on it when placed inside its dark slide, wrapped round many times in black velvet cloth, and held in front of the space between the main electrodes of his powerful Wimshurst electrical machine, but not in the direct line of the discharge. He also exhibited photographic results obtained from the same arrangement with only the difference that the dark slide, wrapped in black velvet, was held in the direct line of the discharge. In this case the photographic result was due, perhaps wholly, and certainly in part, to electric sparks or brushes inside the enclosing box, which was, as usual, made of mahogany with metal hinges and interior metal mountings. It is not improbable that the results of the first experiment described by Lord Blythswood may also be wholly due to sparking within the wooden case. I have suggested to him to repeat his experiments with a thoroughly well closed aluminium box, instead of the ordinary photographic dark slide which he used, and without any black cloth wrapped round outside. The complete metallic enclosure will be a perfect guarantee against any sparks or brushes inside.

If the arrangement which I now suggest, with no sparks or brushes between AA and the roof, gives a satisfactory photographic result, or if it shows a visible glow on phosphorescent material placed anywhere in the space between AA and the roof above it, or above the aluminium roof, it would prove the truth of Röntgen's hypothesis. But failure to obtain any such results would not disprove this hypothesis. The electric action, even with the place of the spark so close to the field of the action sought for as it is at D, in the suggested arrangement, may not be sudden enough or violent enough to produce enough of longitudinal waves, or of condensational-rarefactional vibrations, to act sensibly on a photographic plate, or to produce a physical glow on a phosphorescent substance.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—At a Congregation held on Tuesday, the series of resolutions relating to the claims of women, the consideration of which was adjourned last week after the rejection of the proposal for admitting women to the B.A. degree, were discussed and rejected.

CAMBRIDGE.—Mr. Charles Davison, well-known for his researches on earthquakes and and other seismic phenomena, has been approved by the General Board of Studies for the degree of Doctor of Science.

The Isaac Newton Studentship in Astronomy and Physical Optics has been conferred on Mr. John Gaston Leathem, Scholar of St. John's College.

Dr. Joseph Griffiths has been appointed an additional Examiner in Surgery.

The Panjab University has, like the University of Calcutta and Allahabad, become affiliated to the University of Cambridge. Graduates in Arts of the Panjab are thereby exempted from the previous examinations, and may proceed to their degree by means of a Tripos Examination after two years' residence in Cambridge.

The Syndicate for the consideration of the question of degrees for women has been nominated, and consists of the Vice-Chancellor, Dr. Butler, Master of Trinity, Dr. Peile, Master of Christ's, Mr. Austen Leigh, Provost of King's, Prof. E. C Clark, Prof. Clifford Allbutt, F.R.S., Prof. Sidgwick, Dr. Jackson, Prof. Forsyth, F.R.S., Dr. Keynes, Prof. Armitage Robinson, Prof. Foster, F.R.S., Mr. R. T. Wright, Mr. W. L. Mollison, and Mr. R. A. Neil. Its appointment will be opposed on the ground that an excessive proportion of its members have already committed themselves to definite views on the questions at issue, and that only two members of less than twenty years' standing are included.

The Examination in Sanitary Science for the diploma in Public Health will begin on April 7, and will extend over ten days.

A conversazione will be held to-night in the Cavendish Laboratory, in commemoration of the opening of the new buildings. The President of the Cambridge Philosophical Society (Prof. J. J. Thomson) and Mrs. Thomson are the hosts.

THE hall which Mr. M'Ewan has added to the Edinburgh University buildings, at a cost of between £60,000 and £70,000, will be opened early in the ensuing summer.

THE University of Indianapolis has just been organised by representatives of Butler College, the Medical College of Indiana, the Indiana Dental College, and the Indiana Law School.

PRESIDENT JOHN M. COULTER, of Lake Forest University, has resigned in order to accept the head Professorship of Botany in the University of Chicago, which has been endowed with 1,000,000 dollars in its Botanical Department.

THE following are among recent appointments:—Dr. Christopher Childs to be Assistant in the Hygienic Department at University College, London, under the direction of Prof. Corfield; Dr. Allan MacFadyen to act as hon. secretary of the British Institute of Preventive Medicine; M. Salih Zéky to be Director of the Observatoire Impérial Météorologique et Séismique at Constantinople, in succession to the late M. A. Coumbary; Dr. W. Kurchinski, of Kieff, to be appointed Extraordinary Professor of Physiology at Turieff (Dorpat).

THE Executive Committee of the City and Guilds of London Institute have awarded the second Salters' Company's Research Fellowship, for the encouragement of higher research in chemistry in its relation to manufactures, to Dr. Sidney Williamson, who was for two years a student at the City and Guilds Technical College, Finsbury, and subsequently for three years at the City and Guilds Central Technical College. The Fellowship is tenable at the latter, and Dr. Williamson proposes to work on some questions bearing on food-stuffs generally, more particularly the examination of some definite albumenoids, with the ultimate object of ascertaining the influence of various manures on the growth of crops in so far as *quality* of produce is concerned.

THE Middlesex County Council have voted the sum of £10,785 for the purpose of technical education classes in the county during the current year. This is a slight increase on the amount appropriated during 1895, but since the available amount exceeds twenty-two thousand pounds, there still remains a large surplus which ought to be devoted to its proper purpose. The explanation of the unwillingness of the Council to benefit education in their midst to the fullest possible extent may be found, perhaps, in the falling off in the number of candidates for county scholarships. This diminution is most marked. For the fifteen scholarships of £20 each for three years for boys, there were 100 candidates fewer than in 1893, in which year the scholarships were first offered. The decrease in the number of competitors has been gradual. In 1894 the number was 220, in 1895 it had fallen to 184, and it is less again this year. As there are at least 80,000 children in elementary schools in Middlesex, the number of candidates ought certainly to be much larger.

The Report of the Director of Technical Instruction to the County Council for the County Palatine of Lancaster for the year ending August 31, 1895, which was presented to the Council at a meeting held on the 6th ultimo, contains many interesting statistics of the work which is being accomplished in Lancashire. The work in many departments is pre-eminently satisfactory. We are glad to notice that the Committee have made a grant of £250 to each of the University Colleges of Liverpool and Manchester, for we believe that one of the surest ways of improving the education of any county is to strengthen the centres of higher instruction within its borders. It is certainly one of the weaknesses of the Lancashire scheme for technical education that they give no assistance to secondary schools in their county. The middle classes are as much in need of all kinds of education as any section of the community, and though in Lancashire the following annual grants can be afforded—viz. horology, £500; plumbing and sanitary science, £750; horticulture and bee-keeping, £500; practical agriculture (including veterinary science, poultry-keeping, and allied subjects), £1000; as well as grants to encourage the study of music, yet for the development of the modern side of their secondary schools nothing is allowed. It is interesting to compare the decision of the Lancashire Committee with the recommendation of the recent Commission, "that this grant . . . ought to be all of it paid in future to the local authorities for secondary education . . . not merely to technical education,