vacuum tube. The query at once arises, if glass is permeable to these particles in virtue of their relatively great velocity, why is it not permeable (in lesser degree) to the same particles moving with smaller velocities? That it is not, is evident from the fact that vacuum tubes retain their high degree of exhaustion unimpaired for years.

In view of these difficulties, I would propose a third theory, which may be called the "ether-vortex" theory.

Let it be supposed that the X-rays are vortices of an intermolecular medium (provisionally, the ether[1]). These vortices are produced at the surface of the kathode, by the negative charge, which forces them out from among the molecules of the kathode.

Let us now apply the tests above mentioned.

According to this theory, an oscillatory discharge, while it may be just as effective as a series of separate impulses, is not essential to the formation of the vortices. The vortices being forced outwards from the surface of the kathode by the negative charge, the effect of the positive charge at the anode would be to drive them in. Hence their appearance at the kathode alone.

One of the greatest puzzles connected with the behaviour of the X-rays is the fact that while they can pass almost unimpeded through air at atmospheric pressure (let alone water, glass, wood, flesh, bone, and metals) *when once outside the enclosure in which they are produced*, they cannot even reach the walls of the enclosure, except there be a very high vacuum within. This problem receives a very natural solution if it be considered that, in order that ether-vortices may result from the electrical impulse, this impulse must be communicated to them; and must not be dissipated in the interchange of molecular charges which accompanies, or rather produces, the discharge at moderate or high pressures.

As exhaustion proceeds there are fewer molecules present to effect this discharge with sufficient rapidity, and as this limit is approached there will be a division of the energy of the electric impulse between the electrified molecules and the ether-vortices, and in the end all the energy of the discharge will be confined to the latter.

The reason for the non-appearance of the rays under ordinary conditions is not that the rays cannot reach the walls of the enclosure or pass through them, but that they cannot form at all. The propagation of vortices in straight lines, the absence of interference phenomena, of reflection, refraction and polarisation, follow from the properties of vortices, and from the absence of anything corresponding to a wave-front. The passage of an ether-vortex through a mass of matter may be compared with a passage of a smoke-ring through a wire gauze screen or a series of such; and as the motion of the rings is more impeded the greater the diameter and the number of wires per unit volume, so, the greater the number and the size of the molecules—that is, the greater the density—the more effective will the medium be in dissipating the energy of the ether-vortices.

The production of fluorescence, actinic effects, and the dissipation of electric charges by light (which is an ether motion) would make it at least probable that similar (though perhaps not identical) effects would be produced by the motions of ether vortices.

Prof. J. J. Thomson has measured the velocity of kathode rays and obtained a result so very far less than the velocity of light as to preclude entirely the idea of there being any connection between the two. If these results can be made to apply to the X-rays, the analogy with the properties of smoke-rings would lead us to expect such a result. The kathode rays have been shown by Lenard to have a considerable range in their properties, depending on the mode of their origin.[2] It seems likely that their velocities are to a considerable extent dependent on the potential and the suddenness of the electrical impulse; and if this were shown to be true of the X-rays, it would be to that extent a confirmation of the theory.

[1] A possible objection occurs to the formation of ether-vortices in a medium which is usually considered free from viscosity; but the fact that vibrating molecules can and do communicate their motions to the surrounding ether shows that the communication of vortex motion may also be possible.

Though not a necessary part of the theory, it may be considered that the expulsion of the ether-vortices is due to an accumulation of ether in the kathode, and this would lend support to the theory that this accumulation is not merely a result of the negative charge, but that this excess of ether is what constitutes the negative charge.

[2] The distinction between the X-rays and the kathode rays appears to be somewhat artificial, and it seems probable that the X-rays are only kathode rays sifted by the various media they have traversed.

The foregoing evidence may be considered scarcely sufficient to entitle the proposition here advocated to the dignity of a theory, but it may at least merit consideration as a working hypothesis which may serve as a guide in future experiment.

ALBERT A. MICHELSON.

## *UNIVERSITY AND EDUCATIONAL INTELLIGENCE.*

OXFORD.—The Oxford University Junior Scientific Club will hold a conversazione on Tuesday evening, May 26. The rooms and laboratories of the University Museum, Oxford, will be thrown open by permission of the delegates and professors, and apparatus and experiments illustrating recent progress in the various branches of natural science will be exhibited. During the evening Prof. Silvanus P. Thomson will give a lecture on "Luminescence," with demonstrations.

On Tuesday, June 2, before the above Club, Prof. W. Ramsay, F.R.S., will deliver the fifth annual Robert Boyle Lecture, on "Argon and Helium, the two recently discovered gases." The "Robert Boyle Lecture" was instituted in 1892, and the lecturers hitherto have been Sir Henry Acland (1892), Lord Kelvin (1893), Prof. A. Macalister (1894), Prof. A. Crum Brown (1895).

The vacancies in the Public Examinerships in the Honour School of Natural Science have been recently filled up as follows:—In Animal Morphology, Prof. E. Ray Lankester and Mr. Adam Sedgwick; in Botany, Prof. D. H. Scott and Mr. R. W. Phillips; in Geology, Prof. A. H. Green and Mr. J. E. Marr; in Physics, Mr. R. E. Baynes; in Chemistry, Prof. W. Ramsay; and in Animal Physiology, Prof. C. S. Sherrington.

The Scholarships and Exhibitions advertised for proficiency in Natural Science are not numerous this year. Merton and New College offer each one, the examination to be held conjointly by the two colleges at the end of June. Magdalen offers one or more Demyships in Natural Science for competition in October, and the Delegacy of Non-Collegiate Students offers a scholarship for Chemistry. There seems to be a tendency at the present time to curtail the number of scholarships in Natural Science.

The Hope Professor of Zoology is giving a course of public lectures at the Museum, on the Hope Collections. The second lecture of the series will be given on Wednesday, May 27, at 2.30 p.m.

Prof. H. A. Miers, F.R.S., Waynflete Professor of Mineralogy, gave his inaugural lecture at the University Museum on Wednesday last.

A Decree will be proposed on the 26th inst. providing for the enlargement and alteration of certain rooms in the University Museum, in order that they may be adapted to the purposes of the Professor of Mineralogy.

Mr. G. F. Scott Elliot gave a lecture to the Ashmolean Society last Monday, on the race elements of South Africa.

CAMBRIDGE.—The dates of the examinations for entrance scholarships and exhibitions in Natural Science at the several colleges during the next academical year, have been announced as follows:—St. John's and Trinity, November 3, 1896; Pembroke, Caius, King's, Jesus, Christ's, and Emmanuel, November 17, 1896; Peterhouse and Sidney, Clare and Trinity Hall, December 8, 1896; Downing, April 20, 1897. The subjects are in General Chemistry, Physics, Zoology, Botany, Geology, and Physiology, two or more sciences being required. Application for particulars should be made to the respective tutors some weeks before the date of the examination. The yearly value of the scholarships varies from £80 to £40.

Vacancies for students of Biology at the University tables in the Zoological Stations of Naples and Plymouth are announced. Applications to occupy these are to be sent to Prof. Newton by May 27.

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THE University of Utrecht will celebrate the 260th anniversary of its foundation on June 22 and five following days.

MR. JOHN H. ROCKEFELLER has given to Vassar College (women's) 100,000 dols. for a new building, to be either dormitory or recitation hall.

MR. ANDREW CARNEGIE has given to the city of Duquesne, Iowa, a library, gymnasium, and public bath. The buildings are to cost 150,000 dols.

THE following are among recent appointments:—Dr. Otto Fischer to be Extraordinary Professor of Physiological Physics at Leipzig; Dr. Albert P. Brubaker to be Assistant Professor of Hygiene in Jefferson College, Philadelphia; Dr. E. B. Sangree to be Professor of Pathology and Bacteriology in the Vanderbilt University, Nashville, Tenn.

THE new buildings at Owen's School for boys, Islington, which were recently opened by the Master of the Brewers' Company, include some new class-rooms for the teaching of practical science. There is a good science lecture-room, as well as physical and chemical laboratories, both well arranged and equipped. A new art room has also been added. The Brewers' Company have provided the funds for building, and the London Technical Education Board those for furnishing.

THE will of Mr. H. W. Massey, of Toronto, contains numerous bequests to charities and educational institutions. Among the latter are 50,000 dols. to the American University at Washington, for a building to bear his name; 10,000 dols. to the Alma Ladies' School at St. Thomas; 100,000 dols. to the University of Mount Allison at Sackville, N.B.; 50,000 dols. to the Wesleyan Theological College at Montreal; 200,000 dols. to the University of Victoria, Toronto; 100,000 dols. to the Wesleyan College of Winnipeg, Manitoba.

WE learn from the *Lancet* that Glasgow University is to receive under the will of the late Dr. John Grieve the sum of £8000, which is to be applied at the discretion of the court to the foundation of a lectureship, fellowship, or scholarship. The present demand for teaching in the subject of public health is very inadequately met by the existing laboratory arrangements, and the University Court has decided to equip a temporary laboratory until more satisfactory permanent dispositions are possible. Some recent communications with possible benefactors of the University render it probable that a lectureship in geology will shortly be instituted.

AS we reported in our issue of February 20 of this year, it was decided by the County Council of Hampshire that the Finance and Technical Education Committees should meet together and report to the next meeting of the Council their opinion upon the manner in which the balance remaining after the annual expenditure on technical education had been defrayed, should be dealt with. At the meeting of the Council held on Monday, the 11th inst., the joint Committees reported that as an Education Bill had been introduced into Parliament dealing with the Local Taxation (Customs and Excise) Duties, they were of opinion that it would be undesirable to proceed with their deliberations. The report of the Technical Education Committee showed that good work had been done in the county during the past session.

ON Saturday, May 2, the new grounds of Columbia University were dedicated, and the corner-stones of Physics Hall and Schermerhorn Hall were laid. A large and distinguished company gathered to honour the events, among whom were the Governor of the State and the Mayor of the City of New York. Congratulations were sent by the President of the United States. The new grounds comprise about seventeen acres, commanding a fine view of the Hudson, and very near to and in sight of the tomb of General Grant. The site is that of the Battle of Harlem, fought September 16, 1776. On this site a group of buildings are now rising, which will provide admirably for the University, giving it facilities unrivalled by any other in America. Its endowment also places it in the front rank. The University has productive property in New York City valued at twelve million dollars, besides large endowments of personal property. Several of the new buildings are gifts—the library from the President of the University, Seth Low, Schermerhorn Hall from William C. Schermerhorn, and the Havemeyer building from the Havemeyer family. University Hall is to be built by gifts from alumni of the University.

THE Johns Hopkins University is only twenty years old, yet as regards excellence of work it ranks high among the leading universities in the world. A little brochure containing an account of the constitution and growth of the University has been published in commemoration of the recent twentieth anniversary. The fact that contributions amounting to more than a million of dollars have been received, is an indication that the foundation is firmly established in the confidence of the public. Nearly three thousand students have been instructed; three hundred of the graduates have been teachers in universities, colleges, and high schools, and altogether eight hundred persons who have been pupils of the University have been engaged in teaching; in fact, nearly every university and college in America numbers among its faculty a student of Johns Hopkins University. Since its opening, the University has encouraged the publication of the results of advanced scientific research. Several journals have been regularly maintained, and support has been given to many separate works. Among the most important serial publications are the *American Journal of Mathematics*, *American Chemical Journal*, *American Journal of Philology*, *Studies from the Biological Laboratory*, *Memoirs from the Biological Laboratory*, *Journal of Experimental Medicine*, and the *Johns Hopkins University Circulars*. Many separate publications have also been issued under the auspices, or with the aid, of the University, among the most noteworthy of these being Prof. Rowland's "Photographs of the Normal Solar Spectrum," "The Oyster in Maryland" (a publication in popular form of Prof. Brooks' investigation of the oyster and its relation to interests of Maryland), "Embryology of Insects and Arachnids," by Adam T. Bruce, "Geology and Physical Features of Maryland," by G. H. Williams and W. B Clark, Bulletins and Reports of various departments of the Johns Hopkins Hospital, and a number of topographical and geological maps. For the study of the marine fauna of the Chesapeake region, including the oyster, the Chesapeake Zoological Laboratory, or Marine Station, was instituted in 1878, and a considerable sum of money annually appropriated for its maintenance. Further, the University annually nominates a scholar to occupy a table at Wood's Holl Biological Laboratory, for the prosecution of biological investigation. Thus in a variety of ways the University has fostered original research and sound instruction, and has therefore contributed to the welfare of Baltimore and the advancement of science.

## SCIENTIFIC SERIALS.

*American Meteorological Journal*, April 1896.—A speculation in topographical climatology, by Prof. W. M. Davis. The author refers to certain relations between existing topographic features and climatic conditions, the study of which enable us to infer the vanished climates of the past by means of their still-preserved topographic products. He discusses at some length the records of arid and humid climates, the consequences of various glacial theories, &c., and suggests an exploration of the most critical regions by well-trained topographical climatologists, with the points at issue clearly in mind.—The new meteorological observatory on the Brocken, by A. L. Rotch. This observatory has an elevation of 3750 feet above the sea and is the highest mountain in Northern Germany. Observations, with some interruptions, were made between 1836 and 1869, and have now been resumed under the superintendence of the Prussian Meteorological Institute. The greatest difficulty in securing continuous observations is the frost, owing to which an anemometer cannot be kept in action, and much trouble is experienced with thermometers and rain-gauges; nevertheless, in addition to automatic records, direct observations are made thrice daily, from which important contributions will be added to our knowledge of the upper air. Further particulars of the work at this station will be found in *Die Natur* of the 26th ult. by Herr Koch, the Superintendent.

*Bollettino della Società Sismologica Italiana*, vol. i., 1896, No. 10 and 11.—Summary of the principal eruption phenomena in Sicily and the adjacent islands during the four months September to December, 1895, by S. Arcidiacono. For the whole year (1895) the following summary is given. Etna was covered by clouds on forty-six days; of the remainder, it was in a state of "emanation" on 172 days, and in a "strombolian" condition on 147 days. In Vulcano, Stromboli, and Salsi di Paternò, no change has occurred except that, on March 29, Stromboli passed from the normal to the explosive phase, at the same time a sensible earthquake was felt at several places in Calabria.—On a new type of seismometrograph, by G. Agamennone. The instrument consists of a pendulum of mass 200 kg. and length 16 metres, whose movements are magnified by the light horizontal lines at right angles to one another. When the first tremor occurs, the velocity of the strip of paper is increased from about 30 cm. per hour to about 5 mm. per second. The instrument is installed in the Central Meteorological and Geodynamical Office at Rome.—Notices of Italian earthquakes (August–October 1895), the most important being the Adriatic earthquake of August 9.