have been made by M. H. Becquerel in the direction of polarisation; but I have already kept you too long. He had more particularly studied a very remarkable phenomenon, viz. that certain phosphorescent bodies—such as sulphide of calcium, for instance, and salts of uranium—on exposure to ordinary sunlight give out rays of some kind which pass through bodies opaque to light, and are able to affect a photographic plate beneath them. So far these agree in their properties with the X rays which are obtained from a Crookes tube, which they far more closely resemble than they do rays of ordinary light; but the rays thus obtained were found by Becquerel to admit of polarisation by means of tourmalines in a manner altogether unmistakable. I think, therefore, that we may take it as established that the Röntgen rays are due to some kind of transversal disturbance propagated in the ether.

The non-exhibition of the ordinary phenomena of diffraction and interference is explicable on the supposition that the vibrations in the X rays are of an excessively high order of frequency. I am not sure that a different sort of explanation might not, perhaps, be possible which I have in my mind, though I have not matured it; but, save the possibility of that, one is led to regard them as consisting of transverse vibrations of excessively high frequency. This opens out some points of considerable interest in the theory of light; but I am afraid it would keep you too long if I were to attempt to go further into this matter. I will merely remark that, taking the way in which these rays are most commonly produced, viz. as coming from a point where the kathodic discharge in the Crookes tube falls on the opposite wall, we may understand how it is that vibrations of excessively unusual frequency may be produced. These highly charged molecules, charged with electricity, coming suddenly against the wall, may produce vibrations of a degree of frequency which we are not at all prepared for; but I see by the clock that I must not detain you any longer on speculations.

Postscript.—This "different sort of explanation" is one between which and the supposition of periodic vibrations of excessively high frequency my mind has for a long time oscillated. In the above lecture I gave the preference to the latter; but subsequent reflection leads me strongly to incline to the former. I hope before long to develop fully these views elsewhere; meanwhile, suffice it to say that I am disposed to regard the disturbance as non-periodic, though having certain features in common with a periodic disturbance of excessively high frequency.

THE ICE VOYAGE OF THE "FRAM."

DR. NANSEN has communicated to the *Daily Chronicle*, by telegraph from Tromsö, some interesting details given by Captain Sverdrup, with reference to his voyage in the *Fram*. The marvellous way in which the *Fram* withstood the ice-pressure, and the methods employed to free the ship from the ice, is an object-lesson for future Arctic explorers. The telegram is abridged below.

On March 14, 1895, Nansen and Johansen left us. During the first month after their departure, the ice was very quiet and the drift inconsiderable. Towards the end of April the drift, however, improved, and we were carried westwards. On July 26 the *Fram* was in 84° 50′ N., and 73° E. long. There was during this time much ice-pressure, but it never reached the ship. Then we had winds from south-west and west, which during the summer drifted the *Fram* backwards towards the east and north-east. It was not before October that the favourable drift recommenced, and during the autumn and winter, and especially during January and the first part of February 1896, our drift was better than ever.

On October 16, 1895, the *Fram* had reached the highest latitude observed, viz. 85° 57′ N., and 66° E. long. In the middle of February we were on 84° 20′ N., and 23° E., but here the drift closed until May, when we were again carried southwards. On July 19 we had reached 83° 14′ N., and 14° E. long.

There we got the *Fram* out of the grasp of the ice by blasting with gun-cotton and powder, and began to force our way southwards. During the whole drift in the ice the *Fram* was exposed to constant and violent pressures. None of these were, however, so dangerous as that which we had at New Year before Nansen left us. Immediately after his departure we were occupied in removing the huge mass of ice which on that occasion was pressed against the *Fram's* sides. At the end of March, just as the last portion of this ice was being removed, the ice suddenly cracked in all directions round the ship, and a broad water-lane was formed, which came within a few feet of the *Fram's* stern. Strong pressure very soon began along this crack, and the ice was so much broken up that the *Fram* at the end of July lay close to open water. A single mine was sufficient to free the ship from the ice.

As this mine was exploded, the *Fram* glided from the ice into the water like a ship being launched from her ways, but with a noise like thunder, the crew cheering loudly as she struck the water. Having been brought into a safe harbour by warping and sawing the ice, she was again, in August, frozen in. The ice-pressures were, during this year, of no great importance in comparison with the pressures this last summer.

During one week in June this summer (1896), at the height of the spring tides, the *Fram* was regularly exposed to violent pressures caused by the changing tide-currents. She was then once or twice a day lifted 6 to 9 feet, and her bottom could be seen resting on the ice. On all these occasions the *Fram* proved to be the very ship for ice. She was quietly lifted, and not a noise or a crack was heard from her timbers. The men on board were not disturbed in their slumber, even when the pressure was at its highest, and we awoke in the morning in ignorance of what had happened during the night. It was not before we came on deck that we observed how high we were lifted above the ice.

The temperature of the air was pretty even during our whole voyage, and did not fall lower than during the first winter. The depth of the sea was during our drift about the same as we had found before Nansen's departure, viz. 1800 to 1900 fathoms. In the temperature of the sea there was also little change, but the warm layer of Gulf Stream water under the cold surface-water increased a little in body as we came westwards. Depôts of provisions, boats, kayaks, and all necessary equipment were during our whole drift kept in readiness on the ice in the neighbourhood of the *Fram*, in case of fire or other accidents.

The time passed comfortably and peacefully, much in the same way as during the first winters. An easier expedition can hardly be imagined. Our principal work was to take the regular observations, sleep, eat, and drink. Our health was perfect the whole time, and we had no sign of scurvy. When the ice began to slack a little this summer, we worked hard to loosen the *Fram* from the ice—a difficult task, owing to the huge ice, piled up by pressures, in which our ship was frozen. We succeeded, after some days' hard work, by blasting, using mines of up to 100 lb. of powder. Guncotton proved the best.

From July 19 to August 13 we forced our way southwards through 150 miles of close ice. The ice was, as a rule, very high, and the floes were so extensive that we could not see all of them, even with telescopes. It often seemed to be hopeless, and if the *Fram* had not been such a superior ship for ice-navigation it would have been quite useless to try to force our way through ice-masses of such a description. It was by steam and warping that we broke our way through foot by foot, and where the ice was too bad for this it was forced by blasting.

We came out of the ice on August 13—the same day on which Nansen and Johansen arrived at Vardö in Norway.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Lords of the Committee of Council on Education have appointed Mr. A. J. R. Trendell, C.M.G., to be Assistant-Secretary of the Department of Science and Art, in succession to Mr. G. F. Duncombe, retired. Mr. Edward Belshaw succeeds Mr. Trendell as the Chief Clerk.

THE retirement of Prof. Erismann from the chair of Hygiene in the University of Moscow, is announced.

COLONEL PENNYCUICK, late R.E., has been appointed President of the Engineering College, Cooper's Hill, in the place of General Sir Alexander Taylor, retired.

THE following announcements have been recently made:—Dr. Burney Yeo, to be Professor of Medicine, and Dr. Curnow, to be Professor of Clinical Medicine at King's College, London.

A SCHEME for a Central Technical College in Liverpool, for which the plans have already been accepted, now awaits the

sanction of the City Council. The estimated cost, apart from the final equipment, amounts to £80,000.

THE syllabus of lectures at the British Institute of Preventive Medicine, for the Session 1896-97, has just been issued, and contains particulars as to the work in the following departments:—Bacteriology: (1) Bacteriology in relation to Medicine and Pathology; (2) Bacteriology in relation to Hygiene; (3) Biological Chemistry; (4) Original Research Work: Hygiene, Clinical Investigation, Bacteriology of Fermentation, Water Laboratory, and Photomicrography.

THE following appointments have recently been made at the Swansea Technical School:—Lecturer in Metallurgy, Allan Gibb, Honours Associate in Metallurgy of the Royal College of Science. Lecturer in Physics, W. Williams, B.Sc. (London), Senior Demonstrator, Physical Department, Royal College of Science. Lecturer in Engineering, T. Gilbert Jones, B.Sc. (Vict.), Wh.Sc., &c., Lecturer in Applied Mechanics and Steam, Huddersfield Technical School.

AMONG recent appointments abroad we notice the following:—Prof. Thomas A. Williams, of South Dakota, to be Assistant in the Division of Agrostology of the Department of Agriculture; Mr. F. S. Earle, to be Professor of Biology at the Alabama Polytechnic Institute; Dr. Karl Rümker, to be full Professor of Agriculture in the University of Breslau; Dr. F. W. Küster, to be Professor of Physical Chemistry in the University of Göttingen; Dr. Wm. Sandmeyer, to be Professor of Physiology in the University of Marburg; Dr. Max Fischer, to be Professor at the Agricultural Institute at Leipzig; Dr. Richard Lorenz, to be Professor of Electro-chemistry at the Polytechnic Institute at Zürich; Herr Troske, to be Professor of Engineering at the Technical High School, Hanover; Dr. J. Biehringer, to be Docent in General and Technical Chemistry at the Technical High School, Braunschweig; Dr. Benecke, to be Docent in Botany in the University of Strasburg.

THE *Calendar* of the People's Palace, East London, Technical College for the Session 1896-7, contains information concerning all the classes which are to be held next winter, and their name seems to be legion. Not only can the student of pure science receive instruction in any branch from thoroughly competent teachers, but also the person desirous of help in learning how to make artificial flowers for bonnets, or how to cut out a coat. We fancy it would be difficult to name a subject which does not come within the syllabus of this technical school. We refer the students of East London to the *Calendar* itself for information concerning scholarships, exhibitions, fees, &c.

THE City of London College, Moorfields, has issued its list of classes to be held during the forthcoming session, and a very full syllabus of lectures proposed to be given in the Engineering Laboratory of the same establishment has reached us.

PARTICULARS of the technical instruction lectures and classes organised by the British Horological Institute, Northampton Square, London, E.C., have been published for the session, which commences on September 8. They include drawing and theory classes held at the Institute on Tuesday and Thursday evenings, or instruction in theory by correspondence. Ordinary and honours theory examinations, held at the end of April in each year, are opened to all engaged in the horological trades. Certificates are issued to watch and clock repairers who satisfy the examiners of their proficiency. The certificates will be of two classes, both for watches and clocks: an ordinary and an honours certificate. Practical examinations in new work will be held annually in April, and the silver medal of the Institute will be awarded to recipients of the honours theory certificate and the practical certificate for new work, who obtain the largest aggregate number of marks in both examinations.

THE Aberdeen County Council, says *Education*, is making careful inquiry at various fishing centres as to the extent to which the County Councils in England have provided technical instruction for fishermen. The Cornwall County Council spends between £500 and £600 per annum on this branch of their work, and they have appointed a lecturer to give instruction on the curing of herring and pilchards; the natural history of crabs and lobsters, mackerel, oysters, and salmon; the making of crab-pots, splicing and net repairing, and so on; and to supervise demonstrations on oyster and lobster culture at Falmouth. Instruction is also provided in the subject of navigation, with a view to the examinations of the Board of Trade. The Essex County Council have started a marine biological station at Brightlingsea, to give practical instruction in the natural history of food fishes and other creatures. Experiments are also conducted in oyster culture, and lectures and demonstrations are given at the station. In Lancashire and Northumberland instruction has been given on the natural history of fish and navigation. At the conference, which was held last December, the proposal was put forward that a few practical fishermen should be selected from different centres in Aberdeenshire, and enabled to visit the more important fishing centres with a view to acquiring, and afterwards extending, a knowledge of the different methods of fishing, the treatment of fish after capture, preservation, and so on.

THE Department of Science and Art has issued the following lists of Scholarships and Exhibitions just awarded:—Whitworth Scholarships (tenable for three years), £125 a year each: Frederick C. Lea (24), engineer; William A. Taylor (23), engineer; Henry T. Davidge (24), engineer; John W. Hinchley (25), student (formerly engineer). Whitworth Exhibitions (tenable for one year), £50 each: William Du Bois Duddell (23), engineering student; John A. Sloan (23), engineer; Alfred J. White (20), engine-fitter apprentice; Hugh Wallace (21), engineering student; Edward A. Gere (22), student; Frank W. Arnold (23), engineering teacher; Hugh B. Phillimore (22), electrical engineer; Hanson Topham (19), mechanic; Harry E. Wimperis (19), engineer; Charles E. Handy (19), engine-fitter apprentice; Bertram J. Rouse (22), engine fitter; Frank H. Corson (19), fitter apprentice; Thomas G. Procter (20), engineering student; Harry Geldart (21), mechanic; Hector H. Garratt (20), engineer apprentice; George Wall (22), engineering student; George W. Howe (20), electrical engineer apprentice; William W. Firth (21), engineering student; Harry Grute (22), fitter; Hugh J. Williams (23), turner; Frank Mould (24), engine fitter; Frank H. Jeffree (22), engineer; Denys Walton (19), engineer apprentice; Allan J. Grant (20), engineer; William G. Hibbins (24), engineer; Joseph P. Ward (21), engineer; George L. Overton (21), student; Asa Binns (22), fitter; Albert Pidgen (23), fitter; William P. Ferguson (21), fitter.

THE list of successful candidates for Royal Exhibitions, National Scholarships, and Free Studentships (Science) is as follows:—National Scholarships for Mechanics: Ernest Larmuth (17), student; Raymond B. Smith (17), engineering student; John B. Shaw (22), engineer; Frederick J. Tyler (22), engineer apprentice. National Scholarships for Chemistry and Physics: Henry L. Heathcote (19), student; James M. McEwen (17), solicitor's clerk; Arthur Hopwood (21), hatter; Percy Hughes (18), laboratory assistant; Sydney W. Smith (18), student. National Scholarships for Biological Subjects: Herbert Wright (21), weaver; Wilfred Thomas (20), laboratory assistant. National Scholarships: Alfred J. White (20), engine-fitter apprentice; James Walker (23), engineer; John Cresswell (19), student; Ernest W. J. Edwards (17), assistant demonstrator of physics; Archie McDougall (17), laboratory assistant; Frank E. Smith (19), laboratory assistant; George J. Fenwick (17), scholar; Hugh McDougall (19), laboratory assistant; Frank W. Arnold (23), engineering science teacher; Hanson Topham (19), mechanic; Harry E. Wimperis (19), engineer. Royal Exhibitions: William Alexander (20), engineer apprentice; William Scholes (16), student; Thomas G. Madgwick (18), engineering student; William Robertson (19), laboratory assistant; Charles E. Handy (19), engine-fitter apprentice; William Pickering (22), stonemason; George A. Robertson (22), engineering student. Free Studentships: Frank Jowett (18), student; Percy Kenyon (17), student; George W. Howe (20), electrical engineer apprentice; Frank Mould (24), engine-fitter; Philip G. Gundry (18), student; Allan Macdiarmid (22), student.

SCIENTIFIC SERIAL.

American Journal of Mathematics, vol. xviii. No. 3. (Baltimore, July.)—On the multiplication and involution of semi-convergent series, by Prof. Cajori. In vol. xv. Prof. Cajori has generalised Voss's results (*Math. Ann.*, vol. xxiv. p. 42), and some further contributions of his to this difficult subject are given in the *Bulletin* of the Am. Math. Soc. (vol. i. pp. 180-183). The search, he