—chiefly carbon monoxide and nitric oxide, with small proportions of hydrocyanic acid. Mixed with air in suitable quantity, the evolved fumes are highly explosive; but the Committee found no evidence to confirm the opinion that celluloid itself is liable to spontaneous ignition at ordinary temperatures or is explosive in ordinary circumstances.

A number of experiments were carried out at the Government laboratory for the information of the Committee. It was found that the "fuming-off" test devised by Prof. Will was the simplest and one of the most trustworthy methods for ascertaining the relative stability of various kinds of celluloid towards heat. No definite relation between chemical composition and stability to heat could be detected, though a small proportion of mineral matter appears to have a distinct stabilising effect. Celluloid contains sufficient oxygen to support its own combustion, and once ignited will continue to burn in the absence of air; chemical fire extinguishers using carbonic acid gas are, therefore, of little use, and water alone is the best means of extinguishing the substance when burning. The Committee makes a number of recommendations as to the storage and working of celluloid, with the view of lessening the danger from fire; for these the report itself should be consulted.

WIRELESS TELEGRAPHY.[1]

WHEN Mr. Marconi first came over to England in 1896, Mr. Swinton was the means by which he was introduced to Sir William Preece, and the latter, having just then come to the conclusion that his methods of inductive and conductive telegraphy—with which he had been attempting to effect communication with lightships—were unworkable, set the Post Office to work with Mr. Marconi, Sir John Gavey having charge of the experiments. It might seem strange, as Prof. S. P. Thompson had pointed out in NATURE, that Sir William Preece missed the possibilities of Sir Oliver Lodge's Hertzian-wave experiments, but took up Mr. Marconi with practically the same system. But Sir William Preece had always been particularly sympathetic to the young, and Sir Oliver Lodge had not approached him directly.

Next, quoting from an article which Sir William Crookes contributed to *The Fortnightly Review* in 1892, Mr. Swinton showed that Sir William Crookes had in those days fully realised the possibility of telegraphy by means of Hertzian waves. He clearly described how messages might be sent in Morse alphabet by means of apparatus tuned to special wavelengths and receivable only by apparatus similarly tuned. Mr. Crookes also referred to experiments made by Prof. Hughes in 1879, where wireless signals were transmitted over several hundred yards, at which experiments he had assisted. There seems to be no doubt that Hughes discovered Hertzian waves and noted their effects some years before Hertz rediscovered them, but, unfortunately, Sir George Stokes told Hughes, apparently quite erroneously, that the results could be explained by known induction effects, and Hughes was so much discouraged that he never published anything on the matter.

Then, with reference to Sir Oliver Lodge, Mr. Swinton said that he would always regard him as the original inventor of wireless telegraphy, because Sir Oliver Lodge in his Royal Institution lecture in 1894, and later at the Oxford meeting of the British Association in the same year, had first publicly sent signals, rung bells, and deflected galvanometers over a distance by means of Hertzian waves. It had been said that Sir Oliver Lodge did not make clear the telegraphic application of his experiments, but Mr. Swinton was present at Lodge's Royal Institution lecture, and was so much impressed with the telegraphic capabilities it suggested, that he had next morning discussed with his then assistant, Mr. J. C. M. Stanton, the possibility of setting up communication between his residence in Jermyn Street and his office in Victoria Street by Lodge's method. This experiment was never tried, as they had thought that too many large buildings intervened, but preliminary experiments were made in Mr. Swinton's office, and signals on a bell were successfully transmitted and received through several walls with a large Tesla high-frequency coil used as transmitter, and as receiver a coherer consisting of a heap of tintacks. This was two years before Mr. Marconi arrived in this country, but in making these statements Mr. Swinton did not wish in any way to belittle the great work that Mr. Marconi undoubtedly accomplished in making wireless a practical and commercial success by long-continued and arduous labours.

Passing to his experiments, Mr. Swinton stated that finding a difficulty in reading wireless messages by ear, he had devoted attention to automatic recording apparatus. A simple arrangement that he had devised was to employ a sensitive or manometric flame, such as can be made exceedingly sensitive to minute sounds, the flame greatly shortening and roaring the moment the smallest sound reaches it.

Different descriptions of these flames respond more readily to sounds of different pitches, and they also can be tuned to some extent, so that different flames would discriminate between signals of different acoustical pitch even of the same electrical periodicity. All that was necessary was to place the receiving telephone in proximity to the sensitive portion of the apparatus producing the flame, and if a screen were placed in front of the latter hiding the flame when it was shortened, photographic records of Morse signals were easily obtained by throwing by means of a lens a small image of the flame when visible upon a moving strip of photographic paper. Another method of recording the signals employed by the lecturer was to arrange a quick-period mirror galvanometer with the movable portion oscillating between adjustable stops, the oscillations being recorded on a strip of moving photographic paper by projecting on the latter the reflection in the oscillating mirror of a bright point of light proceeding from a pinhole in an opaque box, containing an electric lamp.

Operating, as he did, at his own house, with a very small aërial, Mr. Swinton, in order to magnify the signals, made use of several relays of the types invented by Mr. S. G. Brown. He showed three of these relays connected in series, actuated by signals received on a temporary aërial that Messrs. Gamage had kindly erected on the roof of the Institution of Electrical Engineers. The relays operated a Kelvin siphon-recorder, as well as a loud-speaking telephone, which could be heard by everyone present. At a quarter to nine o'clock a special congratulatory message was received. This was sent by Commandant Ferrié, a vice-president of the society, from the Eiffel Tower. Not only could every signal be clearly heard throughout the Lecture Hall, but it was also received on the siphon-recorder. Further, the motions of the siphon were made visible to the audience, being optically projected on a screen with the aid of an Epidiascope, kindly lent by Messrs. Leitz and Co. The dots and dashes were easily read, both audibly and visibly, though the Admiralty in London was accidentally during part of the time sending radio-telegraphic signals, which were likewise made audible by means of the loud-speaking telephone. The message from

[1] Abstract of the presidential address delivered to the Wireless Society of London on January 21 by Mr. A. A. Campbell Swinton.

the Eiffel Tower consisted of thirty-four words, and occupied about seven minutes. A congratulatory message was also received and rendered audible to the audience from the London Telegraph Training College at Earl's Court.

Mr. Swinton also showed the working of an ordinary Morse inker by means of wireless signals from a distance. For this he employed the three Brown relays with a Siemen's Post Office relay in addition. The inker was modified by turning the magnets upside-down, so that when energised they pulled the inking wheel away from the paper tape, and the signals were recorded when the magnets let go of the armature instead of when they attracted it, as is the usual arrangement. Mr. Swinton had devised this method to get over the difficulty of the extra current, due to the relay breaking the magnet circuit, sending a wireless signal back to the whole apparatus. With the modified arrangement this extra signal took place while the main signal was being received, so it could only accentuate the latter and do no harm, whereas before the modification was effected, when once started, the Morse inker went on working by itself like an electric bell.

Next the lecturer showed how it was possible to receive wireless signals on a phonograph. In the ordinary way, records made by this method were not loud enough to be heard by an audience, but a small microphone had been mounted on the repeating diaphragm, and connected to a loud-speaking telephone, and by this means signals from the Eiffel Tower and from the Admiralty, which had been recorded on the phonograph, were made audible throughout the hall.

Once an arrangement of relays that would work a Morse inker was provided it became possible to operate almost any kind of apparatus, and wireless signals sent by the British School of Telegraphy at Clapham were made, by means of the relays and an electromagnet, to work an air-valve in connection with a source of air pressure and an organ pipe, which latter gave forth in long and short blasts the signals of the message. Mr. Swinton said that the same apparatus worked a motor-horn very effectively, but the horn could not be used indoors, as its noise upset the relays.

Next it was explained how a Poulsen telegraphone could be used as a recorder; and that on the Poulsen-Pedersen system an Einhoven "string" galvanometer was employed for this purpose. With this instrument a signal containing energy to the extent of only one billionth of a watt could be registered, which is about the same sensibility as what is obtainable with a Bell telephone receiver. On the assumption that a 12 candle-power light, radiating one watt in the form of visible electromagnetic waves, was visible at a distance of five miles, and that the aperture of the eye was one-fifth of a square inch, then the amount of power reaching the eye would be about one-sixth of one billionth of a watt, so that natural detectors like the eye, and artificial detectors, such as the Einhoven galvanometer, had about the same order of sensitiveness, and were much more sensitive than any photograph process for instantaneous effects, although photography had the advantage that cumulative effects could be obtained by long exposures. Some years ago Lord Rayleigh found that the human eye and ear were of the same order of sensitiveness.

Another matter mentioned by the lecturer was that the Eiffel Tower aërial, as also those at Poldhu and at other large stations, gave out loud sounds when messages were being transmitted, this being probably due to the air particles being electrified and repelled, as in a Brush discharge.

In his concluding remarks, Mr. Swinton speculated on the future of wireless. The chief difficulty at present with regard to wireless telephony is to get a microphone that would carry sufficient current without burning up, while there is also the necessity for switching over, when changing from receiving to transmitting, which renders conversation troublesome. These are, however, difficulties that should be got over, and it was probable that in the not far distant future, we should have statesmen wirelessly addressing numerous audiences simultaneously, while wireless receiving stations would be set up in connection with halls where people would be able to go and hear *viva voce* all the prominent speakers of the day. Further, wirelessly operated column printing telegraphs would tell the latest news to all the nation, as also to any newspapers which continued to survive this much more rapid method of disseminating intelligence. Again, if we are ever to have Transatlantic telephony, it would probably be wireless, with which the difficulties due to the capacity and self-induction of the cables are avoided.

Mr. Tesla and Prof. Pedersen even believe in the possibility of wireless transmission of power, and in this connection it must be remembered that practically all the power on our planet comes from the sun in the form of electromagnetic waves, and amounts, on a clear day, to no fewer than 4,500,000 horse-power per square mile of the earth's surface. This is, at any rate, good evidence that enormous amounts of power can be transmitted over prodigious distances by means of electromagnetic waves, but it is difficult to imagine how efficiency could be obtained.

Finally, Mr. Swinton appealed to the romance attendant on the spectacle of great liners hurrying across the ocean to the assistance of a ship from whom they had just heard in wireless whispers the S.O.S. signal of distress.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The General Board of Studies will shortly proceed to appoint a University lecturer in mathematics and a Cayley lecturer in mathematics in succession to Dr. Baker, the new Lowndean professor, who held both of these posts.

Mr. A. H. Cooke, of King's College, and Mr. H. H. Thomas, of Sidney Sussex College, have been approved by the General Board of Studies for the degree of Doctor of Science.

The council of the Senate have issued an important report on the admission to University lectures and laboratories of men who are not members of the University. The success of the diplomas in agriculture and in tropical medicine and in other subjects, has led to a considerable increase in the number of students, not members of the University, who are using the University laboratories and lecture-rooms. It is proposed in future to keep a register of such students and to charge each of them a small fee.

MR. L. G. SUTTON has given a donation of 1000*l.* to the fund which is being raised to provide adequate buildings and laboratories for the agricultural and other departments of University College, Reading.

THE sixteenth annual dinner of the City and Guilds College Old Students' Association will be held at the Trocadero Restaurant, Piccadilly Circus, W., at 7.30 p.m., Saturday, February 21. Dr. G. T. Moody, president of the association, will occupy the chair. Tickets may be obtained by any old student of the college from Mr. G. W. Tripp, 4 Fairfield Road, Charlton, Kent.

THE legacies of the late Lord Strathcona include the following to educational institutions:—St. John's Col-