

The reading of the minutes of the previous meeting was dispensed with.

The names of Mr. Bacon, E. R. Keller and G. C. Common having been proposed for membership, they were duly referred to the Committee on Admissions.

The Chair announced that a series of lectures, to alternate with the business meetings of the Section, had been arranged for, and that Dr. Henry Morton, Mr. J. J. Carty, Prof. Elihu Thompson and one or two others had expressed their willingness to address the Section.

Mr. Carl Hering read a most interesting collection of notes on "Recent Progress in Electricity Abroad," taken mostly from European journals.

Some interesting discussion was elicited upon many of the points touched upon in Mr. Hering's paper.

Mr. L. F. Rondinella exhibited a collection of lantern slides of subjects from the Columbian Exposition, and gave a short talk descriptive of the views.

On motion, adjourned.

D. ANSON PARTRIDGE, *Secretary pro tem.*

NOTES ON RECENT DEVELOPMENTS IN ELECTRICITY ABROAD.—PART I.

BY CARL HERING.

[*A paper read at the stated meeting of the Electrical Section of the Franklin Institute, October 24, 1893.*]

Busy men, as most conscientious electricians are, generally have little time to study the vast amount of periodical literature published weekly, even if the journals were all accessible to them, and if the foreign languages in some of them were no hindrance. For the benefit of such busy men the following notes were compiled from articles in the principal foreign electrical journals for the present year; as they are all taken from periodicals, they necessarily contain nothing which has not already been published, and they are therefore intended to form a mere *résumé* or index to call attention to what has been done, leaving those who are interested in any of the subjects to look up further details for themselves.*

Electro-physics.—Taking up first the subject of electro-

* More complete abstracts of all the articles referred to will be found in the "Digest" of the *Electrical World*, from February 4, 1893, to date.

physics, I will limit myself to only a few of the more interesting papers, as most of that which has been published in this branch belongs to the subject of physics rather than to electrical engineering.

Mr. Arno has shown that a rotating electric field, quite similar to the well-known rotating magnetic field, can be produced, and that this can be applied to the construction of an electrostatic rotary field motor; it is only of theoretical interest, as the power developed is necessarily exceedingly small. There has been some discussion as to whether there is such a thing as electrostatic hysteresis, on which this phenomenon is supposed to be based, but authorities still differ.

Prof. Elihu Thomson states that he has succeeded in making a transformer in which a continuous current is made to give alternating currents of any desired frequency, and which contains no moving parts. Several other writers have shown how the frequency of an alternating current may be tripled and doubled quite readily in an alternator without increasing the speed. Dr. Sahulka has shown that a condenser may act as a transformer of current into phase, so to speak, that is, that a condenser in parallel converts a weak current of small phase difference into a strong current of large phase difference, and *vice versa*.

Several instruments have been described by means of which the curve of an alternating current can be resolved into its component sine curves.

Dr. Heydweiller has made a long series of tests with striking distances, giving quite a complete table of the results, which might be used to advantage in place of the very old table of De La Rive, which has been the standard of reference for so many years. The much-vexed question of the sparking distances has also been discussed by Mr. Peace, in a Royal Society paper, in which he gives what constitutes, probably, one of the most complete and reliable tests made for certain ranges. Mr. Precht has shown that lightning-rod points begin to discharge only when the potential has reached as high as 15,000 volts, and even extremely fine points can be charged to 2,500 volts before they will

discharge continuously; also that a bunch of points must be charged to a higher potential than a single point in order to discharge; he believes that in many cases the points of lightning rods are inactive. The difference of potential of the air at the top and at the bottom of the Eiffel Tower was found to vary from 3,000 to 7,000 volts, increasing sometimes to 10,000.

Mr. Arons described an arc lamp in which the arc is produced in vacuum between electrodes of mercury, showing some interesting results; the voltage and the current are quite low, but unfortunately the amount of light generated is not given.

In an interesting experiment made by Dr. Gore, he has shown that mechanical pressure may be converted into an electric current; the pressure is applied to an electrolyte, which then generates a current at the expense of nothing but the pressure.

A number of improvements have been described by Wimshurst and others in so-called electrostatic machines.

Numerous experiments have been described with stretched wires through which a current is passed; under certain conditions the wire will vibrate, some parts becoming luminous, while others remain cold; in another case the wire itself became deformed as if it had been placed between two files.

A number of articles have been published on the electrical transmission of sight, but although interesting, they appear to contain nothing new or of any great importance, and the matter may still be considered as an unsolved problem.

Much has been done in the line of the researches started by Hertz, but this is beyond the province of the present paper.

Professor Dewar has made some very interesting experiments with liquid oxygen, which he now makes in large quantities. Liquid oxygen is magnetic, and he has shown that in liquefied air the magnet will not suck out the oxygen, even though the nitrogen is not magnetic. But the most interesting parts of his researches, for electricians, are those which show that the resistance of all pure metals is probably zero

at the absolute zero of temperature; or, in other words, at that temperature electricity will pass through pure metals without any C²R loss; alloys, however, do not follow this rule. Professor Dewar has also succeeded in converting air into a solid. It has been stated that the magnetic moment of oxygen is about one-thousandth that of iron, and that liquid oxygen is an excellent insulator.

Much has been written on the electro-magnetic theory of light, but it is beyond the province of this *résumé*. An English scientist stated that electro-magnetic waves are strictly similar in their nature to light waves, differing only in the wave length. The light waves are about one-fifty-thousandth of an inch long, while the electro-magnetic waves that have been investigated are from a few inches to many yards in length.

Messrs. Lagrange and Hoho gave what appears to be the first published description of the phenomenon, now so well known, of heating a metal by its contact resistance with water. The heat produced is exceedingly intense, and is generated very rapidly—two qualities which may make the process one of considerable commercial value.

It is claimed by Mr. Sanford that Ohm's law should be qualified, as he believes that he has found that the nature of the medium surrounding a wire has an appreciable effect on the resistance of the wire; his conclusions, however, do not appear to be generally accepted, and it will be fortunate if it turns out that he is not correct.

Mr. Packey claims to have found by photography that there is what he calls an electrical spectrum different from the remaining part of the spectrum, and that it contained only the "electric rays" of the spectrum.

Several papers have been written, showing how the amount of light can be measured by absolute instead of comparative methods, but none of these appear to have as yet been put into the form of a practical photometer.

A number of interesting phenomena have been described with high tension and high frequency currents, which, however, time does not admit of mentioning here. Much has been written lately endeavoring to explain the phenomenon

that an incandescent lamp may be brought to great brilliancy by high tension, high frequency currents of exceedingly small ampèreage; most of the writers claim that it is due to skin-deep conduction, but this has been seriously questioned by several equally high authorities, and it can therefore still be considered as a phenomenon which cannot be explained. Dr. Leduc has shown that high tension alternating currents produced by electrostatic machines have properties which are analogous, but not identical with, those which Tesla uses. Mr. Rimington has shown that many of the phenomena with vacuum tubes can also be produced with such tubes when they contain no electrodes, and when they are placed in electrostatic fields. Lord Armstrong showed an interesting experiment, in which a cotton thread was carried bodily from one glass of water into another by a current from an influence machine.

A new and important re-determination of the mechanical equivalent of heat has been made by Messrs. Griffiths and Clark; they found it to be 778.99 foot-pounds.

Among the interesting articles of a speculative nature is one in which a French writer endeavors to show that the absolute temperature has the same dimensions as electrical potential.

Magnetism.—Mr. Meylan has shown that the great care taken by some makers to have perfect joints in dynamos is not justifiable, as the additional excitation required to overcome the effects of joints in a magnetic circuit is only about one to two per cent.; in transformers, however, the question is quite different, for if joints could be avoided, there would be a gain of ten to fifteen per cent. in the magnetizing current; he believes furthermore that the pre-determination of the characteristics of transformers having a closed magnetic circuit is very uncertain, and probably of little practical value.

Mr. Abdank Abakanowicz has described an interesting arrangement by means of which the effects of hysteresis may be compensated in measuring instruments by the simple addition of a second electro-magnet, properly designed and proportioned.

In Russia, a local north pole of the earth's magnetism has recently been found, thus showing that there are at least two north poles of the earth.

Units, Measurements and Instruments.—Many new instruments and new methods for making various measurements were described, but they are too numerous to mention here. Those interested in the measurement of self-induction will find several articles on the subject in recent numbers of *La Lumière Électrique*. Professor Fleming, in his recent Cantor lectures, has given a very good summary of the subject of the practical measurement of alternating currents.

The very extended researches which have recently been made with the Clark standard cell seem to show that it may now be considered as a very reliable and accurate standard, provided it is properly made. On the other hand, it appears that the Daniell standard has been abandoned, at least when accuracy and reliability are of great importance. It appears that the Clark cell may now be relied upon within one part in 10,000; that is, within one-hundredth of one per cent.

A number of tests have been made of the Elihu Thomson wattmeter, all of those published giving very favorable results; this, coming from abroad, is significant. Professor Fleming has called attention to the fact that meters placed in cellars are often subjected to great changes of temperature, producing an error of from ten to fifteen per cent. in the readings, a subject which he thinks ought to be considered more than it is in designing meters. Several forms of ohmmeters have been described, chiefly for use in measuring high resistance and insulation. The literature on the copper voltameter has received an important addition by the paper of Dr. Ottel; he shows, among other things, that the addition of alcohol makes the actual deposit more nearly equal to that required by theory; also, that an acid solution is better than a neutral one.

Much has been written about locating faults in underground mains, but most of the methods are either impracticable or rather cumbersome, requiring the patience of a German to apply them. Apparently successful high resistances have been made, consisting of rods of a mixture of

plumbago and clay. An interesting and simple method for measuring the magnetic qualities of iron was described by Dr. Behn-Eschenburg, in which the underlying principle is that the magnetic circuit is suddenly broken, which enables both the permeability and the residual magnetism to be readily determined with very simple apparatus.

Much has been written, especially by the French and Germans, regarding the behavior and the calculation of condensers for commercial use in alternating current circuits; although interesting, the results will be of little use until condensers become cheap enough to be used in practice. A feature of interest, if true, for all condensers, was reported in an English paper; it was shown that a condenser which was excellent at normal temperatures, possessed very bad insulation when the temperature approached the freezing point of water.

Recent experiments with the arc have apparently shown that its temperature is constant, being about $3,500^{\circ}$ C., and that the amount of light emitted per unit area of crater surface is also constant, for which reason some have urged its adoption as the unit of light; the amount of light given off per square millimetre of crater surface is given as about seventy candles. A French scientist suggests a photometric standard made of phosphorescent zinc sulphide, which, in common language, might be called luminous paint. If exposed to the light it will afterward emit light, the intensity of which seems to be independent of the original source of illumination, of its duration, and of the thickness of the layer. Among the different forms of photometers the Lummer-Brodhun type seems to be meeting with increasing favor. Several curious forms of photometers have been described, in one of which light is absorbed and measured by a semi-translucent screen of increasing thickness, and, in another, letters printed on successive sheets, each one with a darker background than the preceding, are used, but both are, of course, only very crude instruments.

For measuring extremely high temperatures, as in furnaces, and also for extremely low temperatures approaching the absolute zero, physicists seem to have found electrical

methods the most reliable. For high temperature thermometers, Dr. Barus concludes from a long series of experiments that a couple made of platinum with an alloy of platinum and iridium or rhodium gives the best results.

Mr. Lagarde has made a re-determination of the specific resistance of pure copper, and finds it to be 19.58 ohms, presumably legal ohms, at 0° C. for a wire 1,000 metres long and one millimetre in diameter. He also found that the temperature coefficient .00445 is fairly constant between 0° and 40° C., and that it is directly proportional to the conductivity of the copper.

A writer in a German paper calls attention to the fact that the shape of the waves of an alternating current will have quite a perceptible effect in the reading of a voltmeter and in the working of an alternate current arc light, and he concludes therefrom that both should be adjusted with currents from the same generator with which they are to be used.

A French writer has devised an analytical method for determining the shape of the curves of alternating currents, consisting of an experimental determination of the successive terms in the Fourier series, from which the curve can then be deduced. The measurements are made with auxiliary apparatus used in connection with the alternator.

There was much discussion in foreign journals regarding the work to be done by the Chicago Congress, but as all this was entirely ignored by the delegates to that Congress it may be passed over here. Although it has been of little use, it was none the less interesting and instructive.