stations, both north and south of the line, the difference, if any, is but small. It would appear, however, that both at Batavia and Port Blair, and also at Bombay (judging from the curves given by Mr. Chambers in his communication previously referred to), that the oscillation when the sun is in southern declination is slightly greater than that pertaining to the summer of the northern hemisphere. At the Russian stations, however, the oscillation of the opposite type is entirely restricted to the winter months, and is therefore far more pronounced in the winter curves in Fig. 2 than in the mean annual curves in Fig. 1. Hence it follows that the direct action of the sun on the tropical region is to produce an oscillation such that the pressure is lowest when the sun is most spotted, and it is as a compensation to this action that in the winter season an oscillation of the opposite character is set up on the plains of European and Asiatic Russia; possibly also in the Arctic regions, but this requires verification. Analogy would lead us to anticipate the existence of a similar oscillation in Antarctic latitudes when the sun is in northern declination, but perhaps less concentrated geographically owing to the absence of any dry continental land surface, corresponding to the Siberian and Russian plains. This point must remain for future inquiry.

While on the whole the Russian curves exhibit the oscillation so distinctly and strongly as to leave no room for doubt as to its reality, they show, nevertheless, that it is liable to great disturbances, which at times are so powerful as entirely to neutralise the effect. This will be very apparent if curves be drawn with the original values in the first three columns of the table above given for the winter months; but the most remarkable instance is that afforded by the winter of the year 1877 (at least of the first two months, for I have not yet received the volume of the Russian *Annales* for 1878). The mean pressure of December, 1877, at stations in Western Siberia, exceeded any on record during the whole period of thirty-one years comprehended in the registers before me; and it is not a little remarkable that in the previous July (the mid-winter of the southern hemisphere) an equally excessive, and (in the eight years for which I have registers) unprecedented pressure characterised South-eastern Australia. These accumulations of pressure were, doubtless, intimately connected with the similar phenomenon which characterised the intervening Indo-Malayan region in 1876–78, but the attendant circumstances are as yet by no means fully worked out.

With respect to the nature of the physical causes which produce that alternating oscillation of pressure between the Indo-Malayan region and the Russian plains, which conforms to the sun-spot cycle, our knowledge is still far too imperfect to allow of my attempting any exhaustive analysis. It may, however, be not wholly uninstructive to recapitulate some of the results of recent inquiry which bear upon this point, even admitting, as we must do, that in certain respects they require further verification. Such as they are, they indicate a possible explanation, which I will set forth as briefly as possible.

Among the best established variations in terrestrial meteorology which conform to the sun-spot cycle, are those of tropical cyclones and the general rainfall of the globe, both of which imply a corresponding variation in evaporation and the condensation of vapour. Now the variation of pressure with which we have to deal evidently has its seat in the higher (probably the cloud-forming) strata of the atmosphere. This is not only illustrated in the present instance by the observed relative excess of pressure at the hill stations as compared with the plains, but also follows as a general law from the fact established by Gautier and Köppen, viz., that the temperature of the lowest stratum varies in a manner antagonistic to the observed variation of pressure. It is then a reasonable inference that the principal agency in producing the observed reduction of pressure at the epoch of sun-spot maximum is the more copious production and ascent of vapour, which may operate in three different ways. First, by displacing air the density of which is $\frac{3}{8}$ths greater; second, by evolving latent heat in its condensation; and thirdly, by causing ascending currents, and thus reducing dynamically the pressure of the atmosphere as a whole. The first and second of these processes do not indeed directly reduce the pressure, but only the density of the air stratum, while they increase its volume. In order, therefore, that the observed effect may follow, a portion of the higher atmosphere must be removed, and this will necessarily flow away to regions where the production of vapour is at a minimum, viz., the polar and cooler portion of the temperate zones, and more especially those where a cold dry land surface radiates rapidly under a winter sky. Such an expanse is the great northern plain of European Russia and Western Siberia north of the Altai.

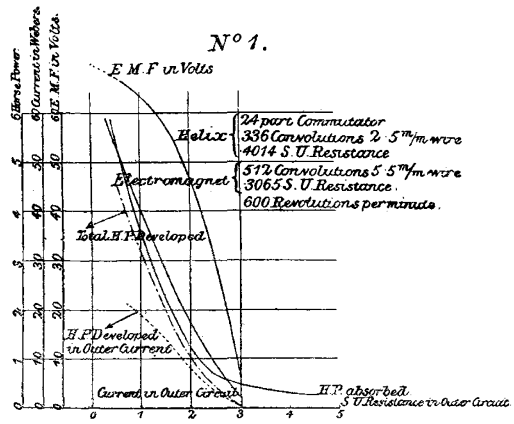
H. F. BLANFORD

SOCIETIES AND ACADEMIES

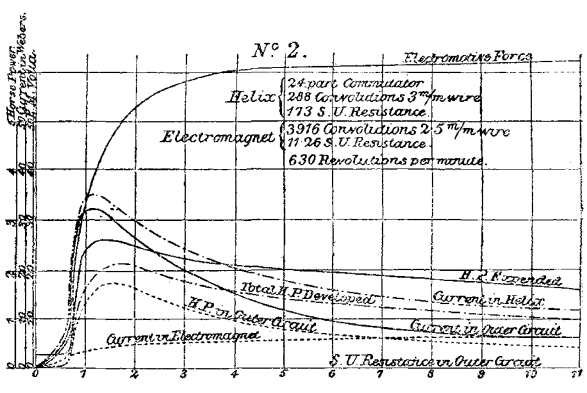
LONDON

Royal Society, March 4.—"On the Dynamo-Electric Current and on certain Means to improve its Steadiness." By C. William Siemens, D.C.L., F.R.S.

The author, after alluding to the early conception by Dr. Werner Siemens, of the dynamo-electric or accumulative principle of generating currents, makes reference to the two papers on the subject presented, the one by Sir Charles Wheatstone and the other by himself, to the Royal Society in February, 1867. The machine then designed by him, and shown in operation on that occasion, is again brought forward with a view of indicating the



progress that has since taken place in the construction of dynamo-electrical machines, particularly those by Gramme and Siemens von Alteneck. The paper next points out certain drawbacks to the use of these machines, both of them being subject to the disadvantage that an increase of external resistance causes a falling off of the current; and that, on the other hand, the short circuiting of the outer resistance, through contact between the carbon electrodes of an electric lamp, very much increases the electric excitement of the machine, and the power necessary to maintain its motion, giving rise to rapid heating and destructive sparks in the machine itself.



An observation in Sir Charles Wheatstone's paper is referred to, pointing to the fact that a powerful current is set up in the shunt circuit of a dynamo-electric machine, which circumstance has since been taken advantage of to some extent by Mr. Ladd and Mr. Brush, in constructing current generators.

The principal object of the paper is to establish the conditions under which dynamo-electric machines worked on the shunt principle can be made to give maximum results. A series of tables and diagrams are given, the results of experiments conducted by Mr. Lauckert, electrician, employed at the author's

works, which lead up to the conclusion that, in constructing such machines on the shunt principle, the resistance on the rotating helix has to be considerably reduced by increasing the thickness of the wire employed, and that on the magnets has to be increased more than tenfold, not by the employment of thin wire, but by augmenting the length and weight of coil wire employed. We reproduce two of these diagrams, No. 1 referring to the old form of winding and No. 2 to the new.

The results of this mode of distributing the resistances is summarised as follows:—

1. That the electromotive force, instead of diminishing with increased resistance, increases at first rapidly, and then more slowly towards an asymptote.

2. That the current in the outer circuit is actually greater for a unit and a half resistance than for one unit.

3. With an external resistance of one unit, which is about equivalent to an electric arc, when thirty or forty webers are passing through it, 2·44 horse-power is expended, of which 1·29 horse-power is usefully employed, proving an efficiency of 53 per cent., as compared with 45 per cent. in the case of the ordinary dynamo machine.

4. That the maximum energy which can be demanded from the engine is 2·6 horse-power, so that but a small margin of power is needed to suffice for the greatest possible requirement.

5. That the maximum energy which can be injuriously transferred into heat in the machine itself is 1·3 horse-power, so that there is no fear here of destroying the insulation of the helix by excessive heating.

6. That the maximum current is approximately that which would be habitually used, and which the commutator and collecting brushes are quite capable of transmitting.

Hence the author concludes that the new machine will give a steadier light than the old one with greater average economy of power, that it will be less liable to derangement, and may be driven without variation of speed by a smaller engine; also that the new machine is free from all objection when used for the purpose of electro-deposition.

This construction of machine enables the author to effect an important simplification of the regulator to work electric lamps, enabling him to dispense with all wheel and clockwork in the arrangement. The two carbons being pushed onward by gravity or spring power, are checked laterally by a pointed metallic abutment situated at such a distance from the arc itself, that the heat is only just sufficient to cause the gradual wasting away of the carbon in contact with atmospheric air. The carbon holders are connected to the iron core of a solenoid coil, of a resistance equal to about fifty times that of the arc, the ends of which coil are connected to the two electrodes respectively. The weight of the core (which may be varied), determines the force of current that has to pass through the regulating coil in order to keep the weight in suspension, and this in its turn is dependent upon the resistance of the arc. The result is that the length of the arc is regulated automatically, so as to maintain a uniform resistance signifying a uniform development of light.

Linnean Society, March 4.—Prof. Allman, F.R.S., president, in the chair.—Mr. Middleton exhibited two skulls of *Babirussa alfurus*, Less., from Borneo, which though quite adult, were both distinguished by unusual smallness of their tusks.—Dr. A. Günther brought forward two deep-sea fishes obtained during the *Challenger* expedition (*Echiodon* and *Scopelus*) to illustrate two kinds of metameric organs, first described by Dr. Ussow, which he described and designated as the *lenticular* and *glandular* kinds. Whilst admitting the great morphological resemblance of the former to an eye, he (Dr. Günther) gave reasons which induce him to dissent from the view that they are organs of vision. He showed that their structure is not opposed to the view that they, like the glandular kind, are producers of light, and that probably this production of light or luminosity is subject to the will of the fish.—Mr. J. Jenner Weir, on behalf of Mr. Edw. A. Nevill, showed the stuffed head of a Prongbuck (*Antilocapra americana*), shot by the latter in the Rocky Mountains, August, 1876. On the median nasal region of this specimen, what appeared to be a short unbranched third horn was developed. On discussion of the abnormality, it was suggested it might rather be an elongated warty growth than a true horn, after the type of the rear ones. A further careful examination into its structural conditions was recommended.—Mr. E. Morell Holmes read a paper on *Codiolum gregarium*, A. Braun, a new British alga discovered at Teignmouth by the Rev. R. Cresswell. The author considers that the hypnospores described by Braun do not belong to *Codiolum*, but to another alga, usually found growing with it. The growth of the plant and its fructification, contrary to Braun's supposition, last through the winter and spring. Mr. Holmes also exhibited specimens of the fructification of *Chætopteris plumosa* found in Britain for the first time by G. W. Traill, of Edinburgh. The unilocular sporangia in this instance were in a more advanced stage than those figured by Areschoug, and the multilocular sporangia differed in character from the illustration given by the last-mentioned Swedish naturalist.—Dr. Francis Day briefly recounted the peculiarities and descanted on the geographical distribution of a specimen of the Hebridal Argentine caught near the island of Skye, October, 1879. This fish has very rarely hitherto been got in the British waters. It is more often met with on the Norway coast, but its range extends southwards as far as the Mediterranean. It is supposed to frequent great depths and not to enter fresh water. A fish has been obtained in New Zealand, *Argentina decagon*, which seemingly quite corresponds with the foregoing, and it will be interesting hereafter, on further examination, to ascertain if they really are identical.—The following gentlemen were elected Fellows of the Society:—Messrs. S. M. Bairstow, J. T. Carrington, R. M. Middleton, S. O. Ridley, T. Charters-White, and Prof. P. Martin Duncan.

Mathematical Society, March 11.—C. W. Merrifield, F.R.S., president, in the chair.—Mr. W. J. Curran Sharp was admitted into the Society, and the following gentlemen elected Members:—Mr. C. S. Peirce, Johns Hopkins University, Baltimore, Mr. Emory McClintock, Milwaukie, Illinois, Prof. Seitz, Kirksville, Missouri, and Mr. E. Temperley, M.A.—The following communications were made to the Society:—Notes on a general method of solving partial differential equations of the first order with several dependent variables, by Mr. Tanner.—Note on the integral solution of $x^2 - 2Py^2 = -z^2$ or $\pm 2z^2$ in certain cases, by Mr. S. Roberts, F.R.S.—Notes (1) on a geometrical form of Landen's theorem with regard to a hyperbolic arc; (2) on a class of closed ovals whose arcs possess the same property as two Fagnanian arcs of an ellipse, by Mr. J. Griffiths.

Anthropological Institute, March 9.—Francis Galton, F.R.S., vice-president, in the chair.—The election of Mr. George Morrison as a new member was announced.—Mr. Francis Galton described the curious psychological fact of Visualised Numerals, on which he wrote a preliminary memoir in NATURE, vol. xxi. p. 252. This paper we hope to publish in our next number.

DUBLIN

Royal Dublin Society, January 19.—Physical and Experimental Science Section.—Howard Grubb, M.E., in the chair.—Note on the conductivity of tourmaline, by G. F. Fitzgerald, F.T.C.D. The author pointed out that though tourmaline did not possess unilateral conductivity for currents of uniform intensity, it might for currents of variable intensity, and that the latter was the true analogue of its unilateral heat conductivity.—Note on the construction of guard-ring electrometers, by G. F. Fitzgerald, F.T.C.D. In this paper the author shows the importance of having both the trap-door and guard-ring constructed of the same metal in order to insure a uniform distribution of electricity.—On the theory of the loud-speaking telephone, by Prof. W. F. Barrett. The author expressed his doubts as to the accuracy of the received theory which attributes the diminution of friction that occurs on the passage of a current to electrolytic action, a film of gas being thereby produced, and hence a reduction of the normal "stiction" between the chalk cylinder and the platinum faced arm which vibrates the diaphragm. One objection to this theory is the enormous rapidity of the changes that must occur and the difficulty of conceiving how the film of gas is to be got rid of, even if produced in an infinitesimal portion of time. Moreover, the author showed that even when the chalk was dry, in the ordinary acceptation of the word, the action still took place, excellent speaking being obtained from a cylinder that had been exposed for a month to a highly heated room and not once touched with water since it had been in the author's possession; doubtless if the chalk were strongly heated, its insulation would be too great and the current would not pass. The tendency of a closed electric current is to enlarge itself, and it might be to this cause the phenomenon was due. But the electrodynamic action of the current should occur equally well between a metal cylinder bearing on the metal arm; the author had therefore replaced the chalk cylinder by a polished brass cylinder, and employing a microphone transmitter at the other end of the line, the ticking of a watch was perfectly well heard as soon as the brass cylinder

was rotated. Whistling, too, was imperfectly heard, but not conversation. Here no electrolytic action could occur, and, therefore, the self-repulsion of a current on itself or other electro-dynamic action was shown to be a *vera causa*. The repulsive action of a current in passing from one conductor to another, described by Gore, and usually attributed to the production of heat and local expansion at the points of contact was another possible cause. But the author questioned the ordinary explanation of Gore's experiment, and conceived it probable that both it and the variations of friction in the Edison telephone receiver might be due to a common cause in both the currents passed from a bad conductor to a good one, and it was the opinion of the late Principal Forbes, formed after much research and careful inquiry, that a peculiar repulsive force was called into play when both electricity and heat were transmitted from a bad conductor to a good one. From any point of view the subject was one worthy of further investigation, which the author hoped to give to it. In conclusion, the author described an arrangement whereby he had adapted the magneto-telephone to the revolving cylinder in the Edison receiver, so that instead of having to do the entire work of vibrating the diaphragm, as in the Bell receiver, the magnetic action of the current simply varied the friction on the cylinder, and so varied the nature of the oscillations of the diaphragm, which were set up by mechanical means. But as much success was not obtained as was anticipated, nor did the combination in one instrument of the chalk cylinder and the magnetic action give good results, the variations in friction being probably not synchronous, from the direction of impulse not being always in the same way.—Natural Science Section.—G. Johnstone Stoney, F.R.S., in the chair. —On an application of Prof. Rossetti's newly discovered law of cooling to the question of radiation of heat from the earth, and to problems of geological climate and time, by Rev. Dr. Haughton, F.R.S.—Dr. Frazer exhibited a specimen of *Bopyrus squillarum*, parasitic on *Palæmon serratus*, from the west coast of Ireland, also an antler of red deer obtained from the Dodder bar in the River Liffey.

PARIS

Academy of Sciences, March 8.—M. Wurtz in the chair.—The mayor of Chatillon-sur-Long (Loiret), the birthplace of A. C. Becquerel, announced the opening of a public subscription for erection of a statue to Becquerel there, and the Academy willingly entered into co-operation.—On some applications of elliptic functions, by M. Hermite.—On the compensation of temperatures in chronometers, by M. Phillips. This relates chiefly to the perturbation known as the secondary error of compensation.—Chemical stability of matter in sonorous vibration, by M. Berthelot. He operated in two ways—(1) Placing substances in a vessel (of 250 cc. capacity) attached to one branch of a large horizontal tuning-fork vibrated electrically (about 100 simple vibrations per second), the other branch having an equivalent weight; (2) inclosing them in a large horizontal sealed tube, which was longitudinally vibrated by means of friction of a horizontal wheel with moistened felt, and gave 7,200 vibrations per second. The substances tried were ozone, arsenetted hydrogen, sulphuric acid in presence of ethylene, oxygenated water, and persulphuric acid. There was no decomposition, apparently, in any case.—New remarks on the heat of formation of gaseous hydrate of chloral, by M. Berthelot. He points out what he thinks the causes of M. Wurtz's non-success.—On the meeting of the two advance galleries of the great St. Gothard tunnel, by M. Colladon. This gives various interesting details. *Inter alia*, the volume of infiltrations in the south gallery attained 230 litres per second. M. Colladon's compressors at the two ends of the tunnel, sufficed throughout for ventilation, and the costly aspirating vessels required by M. Helwagg were not used. The difference of level at meeting was not over 0·10 m.; the lateral deviation less than 0·20 m. The total length measured in the tunnel was nearly 8 m. less than that calculated geometrically.—On the project of the inter-oceanic maritime canal; letter from M. de Lesseps. He gives a directive memorandum addressed to the members of the Technical Commission (which has been organised in eight brigades, each having its special work). The health of the party is reported excellent. —The President announced with regret the death of M. Zinin, at St. Petersburg, Correspondent in Chemistry.—Investigation of the coefficient of regularity of motion in transmissions by cables, by M. Leauté.—Function of velocities; extension of the theorems of Lagrange to the case of an imperfect fluid, by M. Bresse.—Syrphi and Entomophthoreæ, by M. Giard.—Memoir on the means applicable to destruction of phylloxera, by Dr. Hamm. He advises applying, about the roots, sulphide of carbon with infusorial earth or Peru guano as an absorbent; more of the sulphide can be thus applied without injuring the roots, and the evaporation is very slight. He also points out a line of experimental inquiry to find a pathogenic champignon which would be fatal to phylloxera.—On the toxical influence of the mycelium of vine-roots on phylloxera, by M. Rommier. Where a mycelium with long white filaments was developed on phylloxerised roots kept in a vessel at 15° to 20° temperature, the phylloxera disappeared, whereas it multiplied in the contrary case.—M. Pasteur spoke in favour of seeking a parasite wherewith to destroy phylloxera—as it would have been easy to destroy the silkworm race by means of the corpuscular parasite of pebrine. M. Blanchard, however, dissented; remarking on the limited extent of parasite-ravages on a given species in nature; also on the domesticity of the silkworm as contrasted with the wild independence of phylloxera. M. Pasteur replied, showing the possibilities of experimental multiplication of parasites.—Ephemerides of planet (103) Héra for the opposition of 1880, by M. Callandreau.—Laws concerning the distribution of stars of the solar system, by M. Gaussin. The distances of the planets from the sun and those of the satellites from their planet are in geometrical progression $a = a k^n$.—On the formulæ of quadrature with equal coefficients, by M. Radau.—On systems formed of linear equations with a single independent variable, by M. Darboux.—Demonstration of a theorem of Prof. Sylvester on the divisors of a cyclotomic function, by M. Pepin.—Comparison between curves of tensions of saturated vapours, by M. de Mondesir. The method described furnishes an instrument of singular power for control of the results of experiments.—Action of electrolysis on turpentine, by M. Renard. Among other results the product monohydrate of turpentine is regarded as a pseudo-alcohol, $C_{10}H_{16}H(OH)$.—On the synthesis of aromatic aldehydes; essence of cumin, by M. Etard.—On lesions of the kidney in slow poisoning by cantharidine, by M. Cornil.—On apparent death resulting from asphyxia, by M. Fort. Artificial respiration should be perseveringly practised for a number of hours (not yet determined) after apparent death.—On modifications produced in the system by albuminoid substances injected into the vessels (third series: insoluble ferments), by MM. Béchamp and Baltus. Pancreatine works grave disorder, and causes death where the proportion of it injected reaches about 0·15 gr. per kilogramme of the animal's weight. The substance is only partly eliminated by the urine, and then appears with all its characters.—On two new silicates of alumina and of lithia, by M. Hautefeuille.—On the phosphates and borophosphates of magnesia and lime from the guano deposit of Méjillones (lat. 23° to 24° S.), by M. Domeyko.—On the composition of the waters of Cransac (Aveyron), by M. Willm.—On the pliocene delta of the Rhone at Saint-Gilles (Gard), by M. Collot.

CONTENTS