Bouty and Foussereau failed altogether to obtain consistent results, these may be secured by using certain precautions, such as placing the induction coil at a sufficient distance (1 m. at least) from the bridge, directing its axis perpendicular to that of the rheostat, and placing the telephone perpendicular to the lines of force of the induction coil. In the case of water and very dilute solutions the electrostatic capacity of the containing cell is a source of disturbance, which may, however, be obliterated by introducing a small condenser of adjustable capacity.—The temperature coefficient of the dielectric constant of pure water, by F. Heerwagen. This was investigated with a kind of differential electrometer, in which two needles were suspended by one wire in two electrometers arranged vertically one above the other. The needles, the vessel, and one pair each of the quadrants were joined to one point in a constant voltaic circuit, and the other pairs to two other points. The lower electrometer was alternately empty and filled with pure water. Under these circumstances the ratio of the sensibilities was inversely as the ratio of the squares of the differences of potential. The value obtained for K was 80·878 - 0·362 (t - 17), where t is the temperature of the water in degrees centigrade.—Polarising effects of the refraction of light, by K. Exner. Glass gratings, necessary in order to obtain a sufficiently large angle of diffraction, have the disadvantage of producing polarisation effects due to change of medium in addition to those due to diffraction. This difficulty was overcome by attaching the cut surface to a semi-cylindrical lens by a drop of oil of the same refractive index. The polarisation effects show a fair agreement with Stokes's cosine law.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 8.—"The Process of Secretion in the Skin of the Common Eel," by E. Waymouth Reid, Professor of Physiology in University College, Dundee.

By special attention to the condition of the fish at the time of fixation of their skins for histological investigation, the author has succeeded in obtaining pictures of the various phases of secretory action. The *lowest* phase of activity was obtained by rendering hybernating fish suddenly motionless by a successful transfixion of the medulla, and then removing skin before recovery from "shock" admitted of reflex secretion. The *highest* phase of secretory action was produced by artificial stimulation of the intact animal by the vapour of chloroform, by faradisation, or by simply allowing a pithed summer eel to "slime" after recovery from the primary "shock." The following are the main conclusions:—

(1) The secreting elements of the epidermis of the common eel consist of goblet cells and club cells, both direct descendants of the cells of the palisade layer. The former supply a mucin, the latter threads and a material appearing as fine granules in the slime.

(2) The goblet cells contain mucin granules, and, after reaching the surface and discharging their load, are capable of undergoing regeneration by growth of the protoplasmic foot and re-formation of mucin.

(3) The threads of the slime resemble those of *Myxine glutinosa*, but are usually of finer texture. As in *Myxine*, they are developed from the club cells, but there are no special glandular involutions of the epidermis. The club cells of *Petromyzon fluviatilis* also supply slime threads.

(4) The granular material of the slime is the contents of vesicular spaces developed in the club cells in the immediate neighbourhood of their nuclei, and is set free enclosed in a lattice work developed by vacuolation of the surrounding material, and finally extruded, carrying with it the original nucleus of the club cell.

(5) The remainder of the club cell, after extrusion of its vesicle and nucleus, becomes a spirally coiled fibre, which finally breaks up into the fine fibrils of the slime.

(6) Severe stimulation, especially by the vapour of chloroform applied to the intact animal, causes so sudden a development of the coiled fibres from the club cells that the surface of the epidermis is thrown off and the secretory products set free *en masse*. This process is of reflex nature, for similar excitation applied to excised skin is without effect.

(7) A system of connective tissue cells, distinct from chromatophores, exists in the epidermis developed from cells which are direct descendants of leucocytes, and which can be traced from the blood vessels of the corium through the basement membrane into the epidermis. The number of these wandering cells in the epidermis is greatly increased by stimulation, probably with a view to providing subsequent support to the secretory elements during regeneration.

The paper was illustrated by photo-micrographic lantern slides.

June 15.—"On the Ratio of the Specific Heats of the Paraffins and their Monohalogen Derivatives." By J. W. Capstick, D.Sc. (Vict.), B.A. (Camb.), Scholar and Coutts-Trotter Student of Trinity College, Cambridge. Communicated by Prof. J. J. Thomson, F.R.S.

The object of the experiments was to throw light on an obscure point in the kinetic theory of gases, viz. the distribution of energy in the molecule.

From the ratio of the specific heats we can calculate the relative rates of increase of the internal energy and the energy of translation of the molecules per degree rise of temperature, by the well-known formula, $\beta + 1 = \frac{2}{3(\gamma - 1)}$, where γ is the ratio of the specific heats and β the ratio of the rate of increase of the internal to that of the translational energy.

In order to make the results comparable it was decided to keep the translational energy constant by working at a constant temperature—the temperature of the room.

The ratio of the specific heats was calculated from the velocity of sound in the gases. This was determined by Kundt's method, a double-ended form of apparatus similar to that described in *Pogg. Ann.* vol. cxxxv. being used.

The calculation requires the density of the gas to be known, a circumstance which makes the method very sensitive to small amounts of impurity. Regnault's value of the density was used for methane and the theoretical value for ethane, an analysis of the gas being made after each experiment to determine the correction for the air that was unavoidably present. All the other gases were freed from air by liquefaction immediately before being admitted into the apparatus, and the vapour density of the material in the state in which it was used was determined by a modified form of Hofmann's apparatus, which gave results concordant to one part in a thousand.

The formula used in calculating the ratio of the specific heats was

$$\gamma = 1{\cdot}408 \times \rho \times \left(\frac{l}{l'}\right)^2\left(1 + \frac{1}{p}\frac{d}{dv}(pv)\right),$$

the last factor being added to the ordinary formula to correct for the divergence of the gas from Boyle's Law.

The correction is obtained at once by putting in the equation $u^2 = -\gamma v^2\left(\frac{dp}{dv}\right)_t$ the value of $\left(\frac{dp}{dv}\right)_t$ given by the equation

$$\left(\frac{dpv}{dv}\right)_t = p + v\left(\frac{dp}{dv}\right)_t.$$

From the vapour density determinations a curve is constructed giving pv in terms of v, and the slope of this curve at any point gives the value of $\frac{d}{dv}(pv)$ in arbitrary units. Dividing by the corresponding value of p in the same units, we obtain the amount of the correction.

The correction increases the ratio of the specific heats by from 1 to 2 per cent. in most cases.

Observations varying in number from three to nine were made on each gas, the extreme range of the values being 2 per cent. for marsh gas, 1½ per cent. for methyl iodide, and 1 per cent., or less, for the rest.

The mean values of the ratio of the specific heats are shown in the following table:—

Methane	CH_4	1·313
Methyl chloride	CH_3Cl	1·279
Methyl bromide	CH_3Br	1·274
Methyl iodide	CH_3I	1·286
Ethane	C_2H_6	1·182
Ethyl chloride	C_2H_5Cl	1·187
Ethyl bromide	C_2H_5Br	1·188
Propane	C_3H_8	1·130
Normal propyl chloride	nC_3H_7Cl	1·126
Isopropyl chloride	iC_3H_7Cl	1·127
Isopropyl bromide	iC_3H_7Br	1·131

From this table we have the result that the gases fall into four groups, the members of any one group having within the limits of experimental error the same ratio of the specific heats.

These groups are—

I. Methane.
II. The three methyl compounds.
III. Ethane and its derivatives.
IV. Propane and its derivatives.

If the members of a group have the same ratio of the specific heats, we know that the ratio of the internal energy absorbed by the molecule to the total energy absorbed, per degree rise of temperature, is the same for all. Hence we have the result that, with the single exception of marsh gas, the compounds with similar formulæ have the same energy-absorbing power, a result which supplies a link of a kind much needed to connect the graphic formula of a gas with the dynamical properties of its molecules.

From the conclusion we have reached, it follows with a high degree of probability that the atoms which can be interchanged without effect on the ratio of the specific heats have themselves the same energy-absorbing power, their mass and other special peculiarities being of no consequence. Further, the anomalous behaviour of methane confirms what was clear from previous determinations, namely, that the number of atoms in the molecule is not in itself sufficient to fix the distribution of energy, and suggests that perhaps the configuration is the sole determining cause.

If this is so, it follows that ethane and propane have the same configuration as their monohalogen derivatives, but that methane differs from the methyl compounds, a conclusion that in no way conflicts with the symmetry of the graphic formulæ of methane and its derivatives, for this is a symmetry of reactions, not of form.

"On Interference Phenomena in Electric Waves passing through different Thicknesses of Electrolyte." By G. Udny Yule. Communicated by Prof. G. Carey Foster, F.R.S.

In the spring of 1889 Prof. J. J. Thomson published [1] a description of some experiments made by him for comparing the resistances of electrolytes to the passage of very rapidly alternating currents, the method consisting in comparing the thicknesses of layers of different electrolytes which were equally opaque to Hertzian radiation. During last winter I made trial of an arrangement identical in principle but more completely analogous to Hughes' induction balance. The method seemed, however, to offer several difficulties and disadvantages, and finally I adopted another, also, one may say, analogous to Prof. Thomson's, inasmuch as it measures transparencies, but in outward appearance completely different from his.

The wires B, F, D, about 1 mm. diameter, were spanned 6 cm. apart. If these wires be made too short, a wave-train emitted from B, B′ may reach the electrolyte x_1, or the bridge D, be reflected, and return to B before the primary has practically done oscillating. If this occur, the state of the secondary may affect the primary as in an alternate current transformer. If, however, Bx_1 be made longer than half the effective length of the wave-train, the reflected waves will not reach B until the primary oscillations have practically come to rest, and under these circumstances the latter will know nothing about any alternations in the secondary at or beyond x_1. This reaction of the secondary on the primary had been first noticed, and to a serious extent, by Herr J. Ritter von Geitler [1] with an exciter of the type used by Blondlot.[2]

In the actual apparatus the wires were at F_1 run out through a window in a loop of about 50 m. circumference round the laboratory garden. They re-entered the room at F_2 and were then run vertically through the vessel for containing the electrolyte. The circuit was completed by another loop, F_3F_4, 50 m. long, round the garden, re-entering the room at F_4, connecting to the electrometer at E, and bridged at D, 2·25 m. = $\frac{1}{4}\lambda$ from the electrometer. According to the researches of Bjerknes (*loc. cit.*) these dimensions should be sufficient, with the present apparatus, to prevent any sensible reaction.

The electrometer was the same one as that used by Bjerknes in his researches in the same laboratory. It is a simple quadrant electrometer with only one pair of quadrants and an uncharged aluminium needle of the usual shape suspended by a quartz fibre. One quadrant is connected to each wire. The needle taking no account of sign, elongations are simply proportional to the time integral of the energy: first throws, not steady deflections, are read.

Various glass jars were used for holding the electrolyte. The wires were run vertically through holes drilled in the bottom of the jar, into which they were cemented.

Several trials were made of this apparatus with dilute solutions of copper sulphate. Readings were taken in pairs alternately, with no solution in the jar and with some given thickness; usually about ten readings at each point. The ratio of the transmitted intensities so obtained was determined for several points and plotted as a curve. Some 5 or 6 cm. of electrolyte was the maximum thickness that could be used in these first experiments. The curves so obtained for these badly-conducting solutions always differed sensibly from the log-arithmic, and the more so the more the solution was diluted. If the mean log. dec. over the whole thickness was taken, the corresponding value of the specific conductivity appeared extremely high.

It appeared likely that these irregularities might be due to interference effects analogous to Newton's rings (by transmission), or the phenomena of "thin plates," particularly in view of the

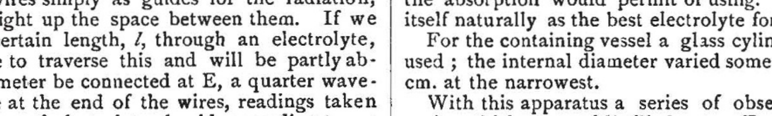


FIG. 1.

Let ASA′ be a Hertz exciter, and B, B′ secondary conductors similar to the primary from which a pair of long wires, stretched parallel to each other, are led off to a considerable distance. One may regard the wires simply as guides for the radiation, which then travels straight up the space between them. If we run these wires for a certain length, *l*, through an electrolyte, the radiation will have to traverse this and will be partly absorbed. If an electrometer be connected at E, a quarter wavelength from the bridge at the end of the wires, readings taken with various thicknesses of electrolyte should, according to my expectations, give a logarithmic curve, from which the specific resistance would be at once calculable.

The actual dimensions of the exciter, &c., erected were the same as those use by Bjerknes.[2]

A, A′, B, B′ circular zinc plates, diameter	40 cm.
Distance from A to B	30 ,,
Length of wire ASA (2 mm. diameter)	200 ,,
Wave length, λ	900 ,,

[1] "Roy. Soc. Proc.," vol. xlv. p. 269, 1889.
[2] *Wiedemann's Annalen*, vol. xliv. p. 513, 1891.

results obtained just previously by Mr. E. H. Barton in the same laboratory. I consequently desired to investigate for such interference phenomena over as great a thickness of electrolyte as the absorption would permit of using. Distilled water offered itself naturally as the best electrolyte for this purpose.

For the containing vessel a glass cylinder 114 cm. high was used; the internal diameter varied somewhat, but was about 12 cm. at the narrowest.

With this apparatus a series of observations were made for various thicknesses of distilled water. To cover, as far as possible, irregularities in sparking, readings were now taken in pairs alternately at the point to be determined and some other point taken for the time as the standard; it would have caused too great delay, and consequent irregularity in the effectiveness of the sparks, were all the water to be siphoned out between each pair of readings. As before, ten or twelve readings were usually taken at each point. The throw obtained with no liquid was also always taken as unity.

As a specimen of the usual spark variations, the following

[1] Doctor-Dissertation, Bonn, Jan. 1893, p. 22.
[2] *Compt. Rend.*, vol. cxiv., p. 283, Feb. 1892.

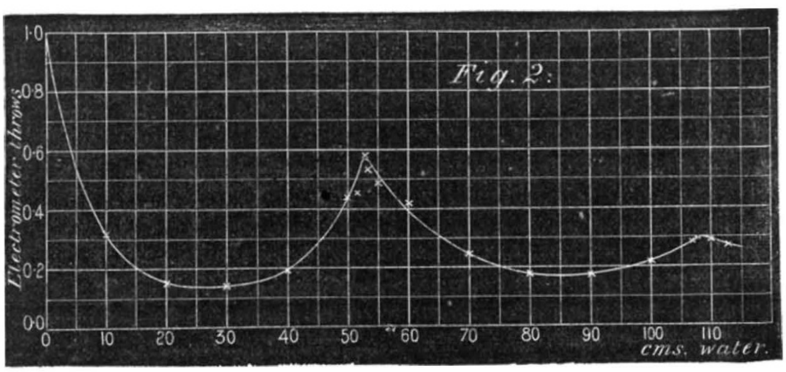
series of readings for the determination of the throw with 55 cm. water with reference to 40 cm. will serve. The series is taken quite at random from the others.

40 cm.	55 cm.
4·6	11·4
4·9	11·4
5·0	11·0
4·2	11·9
4·3	11·5
3·9	11·2
4·0	11·6
4·3	11·4
4·6	10·4
4·4	11·2
4·5	10·4
4·6	10·0

The readings are grouped separately, but it will be understood that they were taken in pairs alternately.

The complete results are given in the curve (Fig. 2). It is seen that for such a poor conductor as distilled water the interference completely masks the absorption effects. The intensity of the transmitted ray does *not* steadliy decrease; on the contrary, far more may be transmitted through a thick than through a thin layer of the absorbent medium. The transmission follows the same general law as for light with a thin plate; we are, in fact, dealing with a "thin" plate—a plate whose thickness is comparable with the wave-length. The intensity of the transmitted ray is a minimum for a plate $\frac{1}{4}\lambda$ thick, a maximum for $\frac{1}{2}\lambda$ thick, a minimum again for $\frac{3}{4}\lambda$, and so on.

The points on the curve round the maximum at $\frac{1}{2}\lambda$ are somewhat irregular, and the two maxima do not absolutely agree.



Taking the mean, we may say the wave-lengths in air and water are respectively:—

$$\lambda_a = 900. \qquad \lambda_\omega = 108 \text{ cm.}$$

This gives us for the coefficient of refraction and the dielectric constant—

$$n = 8{\cdot}33. \qquad \kappa = 69{\cdot}5.$$

The following are the values of K found by previous investigators, all that are known to me:—

Method used.	Authority.	κ
Alternated currents	Heerwagen [1]	79·56
	Rosa [2]	75·70
	Rosa [3]	70·00
Ruhmkorff coil	Cohn and Arons [4]	76·00
	Tereschin [5]	83·80
Hertz oscillations	Cohn [6]	73·50
	Ellinger [7]	81·00
	Itschegtiaeff [8]	1·75

[1] *Wied. Ann.*, vol. xlviii. p. 35, 1893.
[2] *Phil. Mag.*, vol. xxxi. p. 200, 1891.
[3] *Ibid.*, vol. xxxiv. p. 344. 1892.
[4] *Wied. Ann.*, vol. xxxiii. p. 13, 1888.
[5] *Ibid.*, vol. xxxvi. p. 792, 1889.
[6] *Ibid.*, vol. xlv. p. p. 370, 1892.
[7] *Ibid.*, vol. xlvi. p. 513, 1892.
[8] *Phil. Mag.*, vol. xxxiv. p. 388, 1892.

Excluding the Russian physicist as a negligible majority, it will be seen that my value of κ is somewhat low. The cause may lie in the fact that not the whole of the field surrounding the wires lies in the water.

The uncertainty due to this stray field might be easily avoided in one way, namely, by making one wire into a tube surrounding the other, and using this tube also as the jar for the electrolyte. This was, in fact, the arrangement originally intended to be adopted. Several disadvantages attended it, however, and led to its final rejection in favour of the simple wires and glass jar. First, such a condenser reflects under all circumstances a considerable portion of the incident energy.[1] Secondly, the variation of the position of the top surface of the electrolyte relatively to the top of the jar would introduce fresh interference phenomena. This appeared directly from the work of Mr. Barton to which I have already had occasion to refer. Lastly, the large surface of metal in contact with the liquid would render distilled water rapidly impure.

This investigation was carried out in the Physical Institute of the University of Bonn. I desire particularly to express my thanks to Prof. Hertz for his most useful advice and suggestions.

Chemical Society, June 1.—Dr. Armstrong, President, in the chair. The following papers were read:—On azo-compounds of the ortho-series, by R. Meldola, E. M. Hawkins, and F. B. Burls. The constitution of the orthazo-compounds is still unsolved owing to the contradictory results obtained by different investigators using different methods. The azo-β-naphthols have been represented by the formulæ X . NH . N : $C_{10}H_6$: O and X . N_2 . $C_{10}H_6$. OH. The principal evidence in favour of the former hydrazone formula was furnished by Goldschmidt and Brubacher; it is, however, rendered invalid by the authors' experiments. On reducing an acetyl derivative of the form X . N_2 . $C_{10}H_6$. OC_2H_3O or X . $N(C_2H_3O)$. N : $C_{10}H_6$: O with zinc dust and acetic acid, four products result, viz.:—X . NH . C_2H_3O, $C_{10}H_6(NH . C_2H_3O)$. OHβ, X . NH_2 and $C_{10}H_6$. NH_2 . OHβ.—The production of a fluorescein from camphoric anhydride, by J. N. Collie. On heating camphoric anhydride with resorcinol and a small quantity of zinc chloride at 180°, a fluorescein is obtained having the composition $C_{22}H_{22}O_5$; it is a reddish powder with a greenish lustre and shows a beautiful green fluorescence in dilute aqueous solutions.—Researches on the terpenes, III. The action of phosphorous pentachloride on camphene, by J. E. Marsh and J. A. Gardner. Camphene and phosphorus pentachloride interact at ordinary temperatures, yielding a compound of the composition $C_{10}H_{15}PCl_4$; on treatment with water a product is obtained from which two crystalline isomeric camphenephosphonic acids, $C_{10}H_{15}PO_3H_2$, have been isolated. On heating camphene with phosphorus pentachloride, a crystalline substance, $C_{10}H_{14}PCl_3$ is obtained; on treating this with sodium carbonate, a salt of the composition $C_{10}H_{14}ClPO_2NaH$ results, whilst on oxidation it yields chlorocamphenephosphonic acid, $C_{10}H_{14}ClPO_3H_2$.—The composition of a specimen of jute fibre produced in England, by A. Pears, junr.—Note on the combination of dry gases, by W. Ramsay. In connection with the results recently obtained by Baker, the author states that in 1886 he recorded the fact that dry hydrogen chloride does not combine with dry ammonia, even in presence of solid ammonium chloride.—Ortho-, para-, and peri-disulphonic derivatives of naphthalene, by H. E. Arm-

[1] J. Ritter von Geitler, Doctor-Dissertation, Bonn, Jan., 1893.

strong and W. P. Wynne. By displacing the amido-group in a naphthylamine derivative by SH and oxidising the resulting thioderivative, a sulphonic group enters the position previously occupied by the amidogen. By means of this reaction the authors have prepared and characterised the 1 : 1′, 1 : 2 and 1 : 4 naphthalenedisulphonic acids; nine out of the theoretically possible ten of these isomerides are hence now known. The 2 : 2′ : 3′ naphthalenetrisulphonic acid has been prepared by a similar method. The corresponding sulphonic chlorides and other derivatives of the above acids are also described.—Supplementary notes on madder colouring matters, by E. Schunck and L. Marchlewski. In 1853 Schunck obtained from madder a yellow colouring matter which he termed rubiadin; it is now shown that madder contains a glucoside of rubiadin, having the composition $C_{21}H_{20}O_9$. It yields a pentacetyl derivative, and on hydrolysis, is converted into rubiadin and dextrose. $C_{21}H_{20}O_9 + H_2O = C_{15}H_{10}O_4 + C_6H_{12}O_6$.—The constitution of rubiadin glucoside and of rubiadin, by L. Marchlewski. The author proposes a formula for rubiadin glucoside, and notes that on heating a mixture of symmetrical metadihydroxybenzoic acid, paramethylbenzoic acid, and sulphuric acid, he has obtained a substance isomeric with and closely resembling rubiadin, but melting at a lower temperature.

Physical Society, June 23.—Prof. A. W. Rücker, F.R.S., President, in the chair.—Mr. F. H. Nalder exhibited a bridge and commutator for comparing resistances by Prof. Carey Foster's method, the chief features of which are simplicity, compactness, long range, and great accuracy. The commutation of the coils to be compared is effected by mercury cups, the eight holes necessary for this purpose being arranged in a circle. An ebonite disc carrying the four connectors is mounted on a spindle in the middle of the circle, and the positions of the coils are interchanged by rotating the disc through 180°. A large range is secured by providing a number of interchangeable bridge wires, and a fine adjustment for the galvanometer key enables great accuracy to be attained.—Mr. W. R. Pidgeon and Mr. J. Wimshurst each read a paper on an influence machine, and exhibited their machines in action. In designing his machine, Mr. Pidgeon has endeavoured—first, to make the capacity of each sector large when being charged, and small when being discharged; second, to prevent leakage from sector to sector as they enter or leave the different fields of induction; and third, to increase the capacity of the machine by making the sectors large and numerous. The first object is attained by arranging fixed inductors of opposite sign to the sectors near the charging points, and of the same sign near the places of discharge. Objects 2 and 3 are secured by embedding the sectors in wax, run in channels in the ebonite discs which form the plates of the machine, and carrying wires from each sector through the ebonite, each wire terminating in a knob. In this way the sectors can be placed much nearer together than otherwise without sparking back. By setting the sectors skew with the radius they are caused to enter the electric fields more gradually, consequently the potential difference between adjacent sectors is kept comparatively small. Experiment showed that the use of the stationary inductors at the charging points increased the output threefold, and as compared with an ordinary Wimshurst, the output for a given area of plate passing the conductors was as 5·6 : 1. The recovery of the machine after a spark had occurred was particularly rapid. Mr. Wimshurst's new machine consists of two glass discs 3 feet 5 inches diameter, mounted about $\frac{3}{4}''$ apart on the same spindle. Both plates turn in the same direction. Between the discs are fixed four vertical glass slips over 4 feet long, two on each side, and each covering about $\frac{1}{8}$th of a disc. Each slip carries a tinfoil inductor, which has a brush touching lightly on the inside of the adjacent disc on its leading edge. Collecting and neutralising brushes touch the outsides of the discs, and the few metallic sectors attached thereto. An account of some experiments made to determine the efficiency of the machine was given. The author also showed that when all the circuits of the machine were broken, it still continued to excite itself freely, and sparked from the discs to the hands when brought near. In a written communication, Prof. O. Lodge said his assistant, Mr. E. E. Robinson, constructed a machine on lines similar to Mr. Pidgeon's a few months ago, and had now a large one nearly completed. Mr. Robinson's fixed inductors are carried on a third plate fixed between the two movable ones. The sectors are quite small, and neither they nor the inductors are embedded. On close circuit the machine gives a large current ($\frac{1}{10000}$ ampère), and on open circuit exceedingly high potentials. In Dr. Lodge's opinion, Mr. Pidgeon attaches too much importance to his sectors and their shape. Mr. J. Gray wrote to say that stationary inductors enclosed in insulating material would probably give trouble at high voltages, because of the surface of the insulator becoming charged with electricity of opposite sign to that on the inductor. He suggested that this might explain why Mr. Pidgeon could not obtain very long sparks. Prof. C. V. Boys inquired as to how far the wax made insulating union with the ebonite, for if good, glass might possibly be used instead of ebonite. He greatly appreciated the design of Mr. Pidgeon's machine. After some remarks by the president on the great advances which had been made, Mr. Pidgeon replied, and Mr. Wimshurst tried some further experiments with a small experimental machine.—A paper on a new volumemometer, by Mr. J. E. Myers, describing the developed form of Prof. Stroud's instrument, was, in the absence of the author, taken as read.—Mr. R. W. Paul exhibited a compact form of sulphuric acid voltameter of small resistance. The voltameter is a modification of a pattern designed at the Central Institution, in which the rate of decomposition is determined from the time required to fill a bulb made in the stem of a thistle funnel. He also showed a handy form of Daniell cell devised by Prof. Barrett. When not in use, the porous pot containing the zinc is removed from the copper sulphate solution and placed in a vessel containing zinc sulphate or sulphuric acid. A paper on long-distance telephony, by Prof. J. Perry, F.R.S., assisted by H. A. Beeston, was read by Prof. Perry. The case of a line of infinite length, having resistance capacity, self-induction, and leakage, is taken up, and the state of a signal as it gets further and further away from the origin is considered. Taking the shrillest and gravest notes of the human voice to have frequencies of about 950 and 95 respectively, the distance from the origin at which the ratio of the amplitudes of these high and low frequency currents is lessened by $1/m$th of itself, has been determined when $m = 4$ for different values of leakage and self-induction; and under similar conditions the distances at which the relative phase of the two currents become altered by $1/n$th of the periodic time of the most rapid one, have been worked out for $n = 6$. The results are given in the form of tables, from which it appears that if there was no self-induction, increasing the leakage increases the distance to which we can telephone, whilst if there was no leakage increasing the self-induction increases the distance. When self-induction and leakage are not too great, increasing either increases the distance, and for particular values the distances become very large. At the end of the paper tables of general application are given, from which the limiting distances for any line can be readily found by multiplying the numbers by simple functions of the constants of the line. Mr. Blakesley said that some ten years ago he discussed the subject, when capacity and resistance were alone considered, and now pointed out that when self-induction and leakage were introduced the equations were still of the same form. He also suggested how terminal conditions on lines of finite length might be easily taken into consideration. Prof. Perry, in reply, said the introduction of self-induction and leakage rendered the calculations very laborious, and that the terminal conditions were much more complicated than Mr. Blakesley supposed.

Zoological Society, June 20.—Sir William H. Flower, K.C.B., F.R.S., President, in the Chair.—The Secretary exhibited and made remarks on two eggs of the Cape Coly (*Colius capensis*) laid in the Society's Gardens.—A head of a rhinoceros from Northern Somali-land was shown by Mr. Walter Rothschild; also a Caspian seal, believed to be the only specimen of this seal in England; and a series of skins of parrots of the genus *Cyanorhamphus* from New Zealand and other islands of the South Pacific. Mr. Rothschild proposed to refer the specimens of this group from the Auckland Islands to a new species to be called *C. forbesi*.—Other objects exhibited and remarked upon were a specimen of the foot of a calf, in which there were three toes springing from a single cannon-bone, by Mr. W. Bateson, some teeth of a ray (*Myliobatis*) from the Lower Tertiaries of Egypt, remarkable for their enormous size, by Mr. A. Smith-Woodward, and a fragmentary skull of a lemuroid mammal from south-east Madagascar with very remarkable characters, by Dr. Forsyth-Major.—A communication was read from Messrs. Hamilton H. Druce and G. T. Bethune-Baker, containing a monograph of the butterflies of the genus *Thysonotis*. This included a revision of the synonomy of the species, descriptions of several new species and varieties, a complete table showing the distribution of the genus, and descriptions of the genitalia.—Among other communications was one from the Rev. H. S. Gorham; containing a list of the Coleoptera of the family *Cleridæ* collected by Mr. Doherty in Burmah and Northern India, with descriptions of new species; and an account of some species of the same family from Borneo, Perak, and other localities, in the collection of Mr. Alexander Fry. Twenty-eight species were described as new.—Prof. G. B. Howes read a paper on the coracoid of the terrestrial vertebrates. Prof. Howes first spoke of the terminology of the bone commonly called "the coracoid," and then proceeded to the discussion of the mammalian coracoid in particular. He came to the conclusion that it would be best to call the whole ventral coracoidal bar the "coracoid," and to distinguish the doubly ossified type as "bicoracoidal" from the singly ossified or "unicoracoidal" type.—Lieut.-Col. H. H. Godwin-Austen, F.R.S., read the descriptions of some new species of land-shells of the genus *Alycæus* from the Khasi and Naga Hill countries, Assam, Munipur, and the Ruby Mine district, Upper Burmah.—This meeting closed the present session. The next session (1893-94) will commence in November.

PARIS.

Academy of Sciences, July 3.—M. Lœwy in the chair.—Tidal and atmospheric waves due to the action of the sun and of the moon, by M. Bouquet de la Grye. The results are given of a series of determinations of the tides, barometric pressures, and winds made by a French commission at Orange Bay, Cape Horn, ranging at half-hourly intervals from November 1, 1882, to August 31, 1883. A first study of these results confirms the facts, announced previously, relating to luni-solar influence upon the atmosphere. This action is very apparent at Cape Horn, since the water and air at lat. 56° south have a uniform temperature at any given date, and the annual range of temperature is very small.—On the successive deformations of the front of an isolated air wave, during the propagation of the wave along an indefinitely long empty water-pipe, by M. J. Boussinesq.—On birational transformations of algebraic curves, by M. H. Poincaré.—On the observation of the total eclipse of the sun of April 16, made at Joal (Senegal), by M. A. de la Baume Pluvinel.—On a self-registering hydrokinemometer, by M. Clerc. This consists of two vertical cylinders communicating with the water at the stem and the stern of the vessel respectively. The difference of level in the two cylinders is proportional to the square of the velocity with which the boat is travelling. The cylinders are provided with floats, each of which takes a share in actuating the recording pencil, with which they are connected by strings passing over pulleys, disposed in such a manner as to let the record be unaffecting by any heeling or plunging of the boat.—Experimental researches on shipbuilding material, by M. F. B. de Mas.—Radiation of different refractory bodies, heated in the electric furnace, by M. J. Violle.—Auto-conduction, or a new method of electrifying living beings; measurement of magnetic fields of high frequency, by M. A. d'Arsonval.—Additional remarks by M. Cornu.—On chromopyrosulphuric acid, by M. A. Recoura. After showing that the molecule of chromic sulphate can be combined with one, two, or three molecules of sulphuric acid, M. Recoura has succeeded in combining the sulphate with a larger quantity of acid, and has obtained new compounds presenting properties completely different from those of the three former acids, and characters not found in any other chromium compounds. One of these, "chromopyrosulphuric acid," contains five molecules of sulphuric acid.—Constitution of the colouring matters of the fuchsine group, by MM. Prud'homme and C. Rabaut.—On cinchonibine, by MM. E. Jungfleisch and E. Léger.—On mercuric salicylates, by MM. H. Layoux and Alexandre Grandval.—On metallic combinations of Gallanilide, by M. P. Cazeneuve.—On topinambour carbohydrates, by M. Ch. Tanret.—On essence of lavender (*Lavandula Spica*), by M. G. Bouchardat.—Heat of combustion of oil-gas and its relation to illuminating power, by M. Aguitton.—On the genus *Homalogyra*, a type of gasteropod prosobranch molluscs, by M. Vayssière.—On certain physiological effects of unipolar faradisation, by M. Ang. Charpentier.—Experiments on the transmission and evolution of certain epithelial tumours in the white mouse, by M. Henry Morau.—Observations on the preceding note, by M. Verneuil.—Laws of evolution of the digestive functions, by M. J. Winter.—On the histological structure of yeasts and their development, by M. P. A. Dangeard.—On a new process of *Champignon de couche* culture, by MM. J. Costantin and L. Matruchot.—On the glaciers of Spitzberg, by M. Charles Rabot.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Royal University of Ireland Calendar for 1893 (Dublin, Thom).—The Law of Cremation: A. Richardson (Reeves and Turner).—Ostwald's Klassiker der Exakten Wissenschaften, Nos. 41 and 42 (Leipzig, Engelmann).—The Points of the Horse: M. H. Hayes (Thacker).—The Life of a Butterfly: S. H. Scudder (New York, Holt).—Brief Guide to the Commoner Butterflies of the Northern United States and Canada: S. H. Scudder (New York, Holt).—Katechismus der Meteorologie: Dr. Bebber (Leipzig, Weber).—Results of Rain, &c., Observations made in New South Wales during 1891: H. C. Russell (Sydney, Potter).—Results of Meteorological Observations made in New South Wales, 1890: H. C. Russell (Sydney, Potter).—Prodromus Faunæ Mediterraneæ, Vol. 2, Pars 3—Vertebrata: J. V. Carus (Stuttgart, Koch).—Manual of Bacteriology: Dr. S. L. Schenck, translated by W. R. Dawson (Longmans).—Researches on the Zodiacal Light, &c.: Prof. Pickering (Cambridge, Wilson).

PAMPHLETS.—Erster Jahres-Bericht des Sonnblick-Vereines für das Jahr 1892 (Wien).—Transactions of the Astronomical and Physical Society of Toronto for the Year 1892 (Toronto).—Studies on the Life-History of some Bombycine Moths, &c.: A. S. Packard (New York).—Life-Histories of certain Moths of the Families Ceratocampidæ, Hemileucidæ, &c.: A. S. Packard (New York).—Life History of certain Moths of the Family Cochliopodidæ, &c.: A. S. Packard (New York).—Studies on the Transformations of Moths of the Family Saturniidæ: A. S. Packard (New York).—The Migrations and Habits of the Pilchard; M. Dunn (Falmouth, Lake).

SERIALS.—Engineering Magazine, July (New York).—Geographical Journal, July (Stanford).—Natural Science, July (Macmillan).—Gazzetta Chimica Italiana, Anno xxiii., 1893, Vol. 1, Fasc. vi. (Palermo).—The Observatory, July (Taylor and Francis).—Geological Magazine, July (K. Paul).—Journal of the Chemical Society, July (Gurney and Jackson).—Encyklopædie der Naturwissenschaften, Dritte Abthg. 14 und 15 Liefg (Williams and Norgate).—Goldthwaite's Geographical Magazine, May–June (New York).—Journal of the Anthropological Institute, May (K. Paul).—Mind, July (Williams and Norgate).—Essex Institute Historical Collections, October to December, 1891, January to September, 1892 (Salem, Mass.).—Records of the Geological Survey of India, Vol. xxvi., Part 2 (Calcutta).—Journal of the Royal Statistical Society, June (Stanford).—American Journal of Science, July (New Haven).—Quarterly Journal of Microscopical Science, July (Churchill).—Bulletin de la Société Impériale des Naturalistes de Moscou, 1893 No. 1 (Moscou).—Physical Review, No. 1 (Macmillan).—Bulletin of the American Museum of Natural History, Vol. 4, 1892 (New York).

CONTENTS.

PAGE
Order or Chaos? 241
The Causes of Glacial Phenomena. By Prof. T. McKenny Hughes, F.R.S. 242
Dynamo-Electric Machinery. By Prof. A. Gray . . 244
Our Book Shelf:—
Cross and Cole: "Modern Microscopy: a Handbook for Beginners."—Dr. W. H. Dallinger, F.R.S. . 246
Blyth: "Lectures on Sanitary Law" 246
Letters to the Editor:—
The Royal Society.—Prof. E. Ray Lankester, F.R.S.; W. T. Thiselton-Dyer, C.M.G., F.R.S. 247
Ice as an Excavator of Land and a Transporter of Boulders.—Sir Henry H. Howorth, M.P., F.R.S. 247
Abnormal Weather in the Himalayas.—F. C. Constable 248
Peculiar Hailstones.—Kanhaiyalal 248
Crocodile's Egg with Solid Shell.—J. Battersby . . 248
University and Educational Endowment in America. By W. T. Thiselton-Dyer, C.M.G., F.R.S. 248
Antipodean Retrenchment 249
Science in the Magazines 249
Notes 251
Our Astronomical Column:—
A New Comet 254
Comet Finlay (1886 VII.) 254
Meteor Showers this Month 254
L'Astronomie for July 254
Himmel und Erde for July 254
Museums Association. II. By Sir William H. Flower, K.C.B., F.R.S. (*With Diagram.*) 254
The Distribution of Marine Floras 257
University and Educational Intelligence 258
Scientific Serials 259
Societies and Academies 260
Books, Pamphlets, and Serials Received 264