

Preston.—On the Fowlerite variety of rhodonite from Franklin and Stirling, N.J., by L. V. Pirsson.—Some observations on the beryllium minerals from Mount Antero, Colorado, by S. L. Penfield.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 11, 1890.—“On Stokes's Current Function.” By R. A. Sampson, Fellow of St. John's College, Cambridge. Communicated by Prof. Greenhill, F.R.S.

In a liquid any irrotational motion which is symmetrical about an axis may be regarded as due to the juxtaposition at the origin and upon the axis of symmetry of sinks and sources.

Let us consider the system formed by a line source and a line sink, of equal strengths, extending along the axis from an arbitrary origin to infinity in opposite directions. Such a system I shall call an *extended doublet*, of strength  $m$ , where  $m$  is the strength per unit length of that part which lies on the positive side of the origin.

By the superposition of two extended doublets, of equal but opposite strengths, we can produce a sink or a source upon the axis. Hence, in a liquid, any irrotational motion which is symmetrical with respect to an axis may be produced by superposition of extended doublets, whose origins depart but little from an arbitrary point on the axis of symmetry.

Now, for an extended doublet of strength  $m$ , we find Stokes's current function  $\psi$ , for any point distant  $r$  from the origin =  $-2mr$ . Whence, if  $r \sin \theta = \varpi$ ,  $r \cos \theta = z - \zeta$ ,  $\mu = \cos \theta$

$$\frac{d^2\psi}{d\varpi^2} + \frac{d^2\psi}{dz^2} - \frac{1}{\varpi} \frac{d\psi}{d\varpi} = 0 = \frac{d^2\psi}{dr^2} + \frac{1 - \mu^2}{r^2} \frac{d^2\psi}{d\mu^2}.$$

Thus it will be seen that the direct distance of any point from a point on the axis of symmetry plays the same part in the theory of Stokes's current function that is played by its reciprocal in the theory of the potential function belonging to symmetrical distributions of matter.

And if  $r_0, 0, r, \theta$ , be the co-ordinates of a point upon the axis, and of any other point, the distance between these points,  $\sqrt{(r_0^2 - 2r_0r \cos \theta + r^2)}$ , may be developed in a convergent series, say

$$\sum_{n=0}^{\infty} - \frac{r^n}{r_0^{n-1}} I_n(\cos \theta),$$

or

$$\sum_{n=0}^{\infty} - \frac{r_0^n}{r^{n-1}} I_n(\cos \theta),$$

according as  $r_0$  is greater or less than  $r$ ,  $I_n(\cos \theta)$  being a certain function of  $\theta$ , satisfying

$$(1 - \mu^2) \frac{d^2 I_n(\mu)}{d\mu^2} + n(n-1) I_n(\mu) = 0.$$

It is evident from the analogue of zonal harmonics that it is proper to discuss the function  $I_n(\cos \theta)$ , and other solutions of this equation, before considering the applications of Stokes's current function to the motion of liquids. As might be expected, the theory closely resembles that of spherical harmonics.

The applications to hydrodynamics which I here give are chiefly in connection with the motion of viscous liquids. In *Crelle-Borchardt*, vol. lxxxi, 1876, Oberbeck has given the velocities produced in an infinite viscous liquid by the steady motion of an ellipsoid through it, in the direction of one of its axes, and from these Mr. Herman (*Quart. Journ. Math.*, 1889, No. 92) has found the equation of a family of surfaces containing the stream lines relative to the ellipsoid. I obtain Stokes's current function by a direct process for the flux of a viscous liquid past a spheroid, and it is shown that the result differs only by a constant multiple from the particular case of Mr. Herman's integral.

Some minor applications are also given—namely, the solutions are obtained for flux past an approximate sphere, and past an approximate spheroid. The solution is also obtained for flux through a hyperboloid of one sheet, where it appears that the stream surfaces are hyperboloids of the confocal system. A particular case is that of flux through a circular hole in a wall,

and this is interesting because we see that, by supposing internal friction to take place in the liquid, we find an expression which gives zero velocity at the sharp edge, and thus avoids the difficulty which is always present in the solution of such problems on the supposition that the liquid is perfect.

The paper concludes with an attempt to discuss the flux past a spheroid, or through a hyperboloid at whose boundary there may be slipping. The current function is not obtained, all that appears being that it probably differs from the parallel case of the sphere in being far more complicated than when there is no slipping. From this we except the case of the flux through a circular hole in a plane wall, when the solution for no slipping satisfies the new conditions.

Chemical Society, November 6, 1890.—Dr. W. J. Russell, F.R.S., President, in the chair.—The following papers were read:—The magnetic rotation of saline solutions, by Dr. W. H. Perkin, F.R.S. The remarkable results given by solutions of the halohydrates and their compounds with ammonia and organic bases when examined as to their magnetic rotatory power (*Chem. Soc. Trans.*, 1889, 740) made it important to study the solutions of metallic salts in a similar manner. The substances which have been examined up to the present are chiefly chlorides, bromides, iodides, nitrates, a nitrite, sulphates, and phosphates, also hydroxides of alkali metals. For haloid metallic salts in aqueous solution, the rotations were found to be practically 2.2 times greater than the calculated values for the dry substances, and greater therefore than those of the analogous ammonium compounds. A similar remarkable increase of rotation was observed with the hydroxides of the alkali metals, but with sulphates and phosphates numbers agreeing much more closely with the calculated values were obtained. In the discussion which followed the reading of the paper, Dr. Gladstone, F.R.S., said that similar excessive values were obtained on determining the refractive powers of solutions of metallic chlorides, &c., although the differences between the calculated and observed values were much smaller than in the case of Dr. Perkin's measurements. It was all-important to determine the difference in behaviour to light of a substance in its solid state and when in solution, but this was difficult as few solids were uniaxial; as an example of the difference he mentioned that in the case of sodium chloride the solid has a refraction of 1.474, while that of the dissolved substance is 1.53.—Note on normal and isopropylparatoluidine, by Mr. E. Hori and Dr. H. F. Morley.—The action of light on ether in the presence of oxygen and water, by Dr. A. Richardson. In a recent paper by Dunstan and Dymond (*Chem. Soc. Trans.*, 1890, 574) it is stated that hydrogen peroxide is not formed when carefully purified ether is exposed at a low temperature in contact with air and water to the electric light or diffused daylight. Employing ether which had been purified by some of the methods of Dunstan and Dymond, the author found that hydrogen peroxide is formed in the liquid in every case after exposure to sunlight in contact with moist air or oxygen, but not in the dark at the ordinary temperature.—Action of ammonia and methylamine on the oxylepidens, by Dr. F. Klingemann and Mr. W. F. Laycock.—Condensation of acetone-phenanthraquinone, by Mr. G. H. Wadsworth.—Action of phosphorus pentachloride on mucic acid, by Dr. S. Ruhemann and Mr. S. F. Duffon.—Halogens and the asymmetrical carbon atom, by Mr. F. H. Easterfield. The author has endeavoured to prepare optically active haloid derivatives similar in constitution to Le Bel's optically active secondary amyl iodide, which at present stands alone as the only active compound in which a halogen is united to the asymmetric carbon atom. The results obtained with optically active mandelic acid were negative.

November 20.—Dr. W. J. Russell, F.R.S., President, in the chair.—The following papers were read:—A new method of determining the specific volumes of liquids and of their saturated vapours, by Prof. S. Young. When a tube closed at both ends and partly filled with a liquid is raised in temperature, the liquid expands, but the apparent expansion is less than the real, for a certain amount of the substance separates and occupies the space above the liquid in the form of saturated vapour. If the density of the vapour were known, it would be possible to apply the necessary correction; but at high temperatures and pressures this is not the case. If, on the other hand, the upper part of the tube (enclosing the vapour and a portion of the liquid) be heated to a high temperature, the lower part being kept at a constant low temperature, and if subsequently a greater length of the tube be heated to the high temperature, there will again be expansion, but in this case the observed expansion will be greater than

the real, for in consequence of the diminution in volume of the saturated vapour, a portion of it must have condensed. In both cases there are the same two unknown values, the true volume of the liquid and the specific volume of the vapour, and from the two equations involving the experimental data it is, therefore, possible to calculate both values. The experimental method based on these principles possesses the following advantages: it is applicable to substances such as nitrogen peroxide or bromine which attack mercury; it is available for a very wide range of temperature and pressure, even to the critical point of many substances; the data obtained serve to determine not only the specific volume of the liquid, but also that of its saturated vapour.—The molecular condition of metals when alloyed with each other, by Messrs. C. T. Heycock and F. H. Neville. The authors in their earlier experiments (*Chem. Soc. Journ.*, 1890, 376) showed that one atomic proportion of a metal when dissolved in tin produces a fall in the freezing-point that on the theory of osmotic pressure should be produced by one molecular proportion, and therefore concluded that when metals are dissolved in tin their molecules are monatomic. Further experiments with other metals as solvents have led to the following results:—Of fourteen metals dissolved in bismuth, seven (*viz.* lead, thallium, mercury, tin, palladium, platinum, and cadmium) have monatomic molecules; of fifteen metals dissolved in cadmium, seven (*viz.* antimony, platinum, bismuth, tin, sodium, lead, and thallium) have monatomic molecules; and of fourteen metals dissolved in lead, five (*viz.* gold, palladium, silver, platinum, and copper) have monatomic, and three (*viz.* mercury, bismuth, and cadmium) have diatomic molecules.—The estimation of cane sugar, by Messrs. C. O'Sullivan, F.R.S., and F. W. Tompson.—The spectra of blue and yellow chlorophyll, with some observations on leaf-green, by Prof. W. N. Hartley, F.R.S. The author draws the following conclusions from the results of his investigation of the different colouring-matters described under the name chlorophyll:—(1) Living tissues which are fresh and young, and which therefore contain the leaf-green unaltered, exhibit no trace of a band close to D, such as is usually attributed to chlorophyll, and there is no indication of one in the green. (2) Yellow chlorophyll has a distinct absorption-band in the red differing from that of blue chlorophyll. It has likewise a distinct fluorescence. (3) When light is concentrated on living tissues the absorption spectrum of the green colouring-matter is soon altered. (4) Blue chlorophyll may be extracted from minced leaves by cold absolute alcohol, and may be precipitated by addition of baryta. Yellow chlorophyll is not so precipitated, or not precipitated so readily. A warm solution of boracic acid in glycerine, mixed with a little alcohol, liberates the unchanged blue chlorophyll from the dried barium compound. (5) Blue chlorophyll exhibits two absorption-bands in the red, close together; in the less refrangible region of rays one overlies B and the other overlies C. There is a feebler band near D. (6) Concentrated solutions of yellow chlorophyll in benzene are brownish in colour, and exhibit a magnificent red fluorescence. (7) When blue and yellow chlorophyll are separately treated with formic acid and ether, there are produced two new substances showing absorption-bands in the green. It is believed that when these bands have been observed, either in preparations of chlorophyll or in living tissues, the chlorophyll has been altered by oxidation of formic aldehyde in the plant. This oxidation could be caused in living tissues by an excessive degree of illumination, which causes the destruction of the tissues, and otherwise by exposure of the contents of the plant-cells to air or oxygen. An excessive illumination causes an exceedingly great activity in decomposing carbonic acid, and probably oxygen cannot be respired sufficiently rapidly; hence there may be a reverse action, or an oxidation of formic aldehyde to formic acid. (8) The leading characteristics of unaltered leaf-green are those of blue chlorophyll—namely, an intense absorption in the red, stronger even than in the violet or ultra-violet.—Note on dibenzanilide, by Dr. J. B. Cohen.

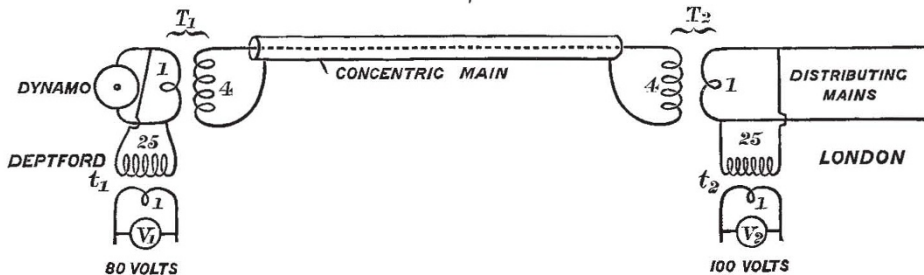
December 4.—Dr. W. J. Russell, F.R.S., President, in the chair.—The following papers were read:—The action of heat on ethylic  $\beta$ -amidocrotonate, by Dr. J. N. Collie.—The action of heat on nitrosyl chloride, by Messrs. J. J. Sudborough and G. H. Miller. An account is given of a series of determinations of the vapour-density of nitrosyl chloride at various temperatures. At temperatures from 15° to 693°, the values obtained so nearly coincide with the theoretical value  $32\frac{1}{2}$  that it is to be supposed that no dissociation takes place below 700°. At higher temperatures the compound is no longer stable. The results show

that in comparison with nitrogen dioxide, which is completely decomposed below 620°, nitrosyl chloride is a highly stable compound.—The volumetric estimation of tellurium, by Dr. B. Brauner.

Physical Society, December 12, 1890.—Prof. W. E. Ayrton, President, in the chair.—Mr. Shelford Bidwell, F.R.S., showed some experiments with selenium cells. The crystalline variety of selenium was, he said, most interesting to physicists, owing to its electrical resistance being greatly diminished by light. This property was shown experimentally with different forms of cells, the construction of which was explained. The form recommended was that in which two copper wires are wound near each other round a slip of mica, and the spaces between the wires filled with selenium. The wires form the terminals of the so-called "cell," which, before being used, is annealed for several hours at a temperature above 200° C. Many such cells were made in 1880, 1881, and their sensitiveness to light remained unimpaired during 1882. In 1885, however, several were found less sensitive, and others totally useless; only one out of thirteen retained its sensibility till September 1890. The loss of sensitiveness Mr. Bidwell believes due to an excessive amount of selenide of copper being formed, for, although some selenide is essential to the satisfactory working of the cell, too much is fatal to its action. The selenide of one defective cell was electrolyzed, red tufts of amorphous selenium appearing on the anodes. A white substance resembling moist calcium chloride was also present; this he believed to be oxide or hydroxide of selenium. Small polarization currents had been obtained from selenium cells. A lecture apparatus illustrating the properties of selenium cells was exhibited. It consisted of a cell connected in series with a relay and a battery. The relay was arranged so that it might either ring a bell, or light an incandescent lamp. When the bell was joined up, it remained silent so long as the selenium cell was illuminated, but on screening the cell, the bell rang. By using various coloured glasses as screens, the effect was shown to be due to the red and yellow rays. A similar experiment with the glow lamp was very striking, for on turning down the gas-lamp illuminating the cell, the electric lamp lighted, and was extinguished on turning up the gas. This demonstrated the possibility of an automatic lamp-lighter, which would light or put out lamps according as they are required or superfluous. Amongst the other practical applications suggested were, announcing the accidental extinction of railway-signal lamps or ships' lights, and the protection of safes and strong rooms. Prof. Minchin said he had lately constructed cells of a different kind from those shown by Mr. Bidwell, and found that they gave an E.M.F. when exposed to light. For his purposes the long annealings, &c., were quite unnecessary, and a complete cell could be made in ten minutes. One of his cells gave an E.M.F. of over 0.25 volt as measured by an electrometer, by the light of a fog. Their promptness of action falls off in a day or two, but if they are kept on open circuit a week has no effect on the final E.M.F. On closed circuit, however, they deteriorate. Prof. S. U. Pickering said both oxides of selenium were deliquescent, and the author's conclusion as to the white substance formed by electrolysis was probably correct. Prof. S. P. Thompson believed Prof. Graham Bell had tried platinum instead of copper, and found that the selenium cracked off in annealing. He also found that it was only necessary to carry on the annealing until the characteristic slate colour appeared. Mr. Bidwell's experiments, he said, showed the possibility of seeing at a distance, and had also suggested to him that the effect of screening might be utilized for driving a completely detached pendulum electrically. Prof. Forbes said that silver sulphide when electrolyzed presented appearances resembling those noticed by Mr. Bidwell in copper selenide. In reply to questions from the President and Prof. Perry, as to whether the low resistance and unsensitiveness of old cells was due to moisture, Mr. Bidwell said drying them had no effect, but baking restored the resistance but not their sensitiveness. Speaking of the effect of annealing cells, he said this reduced their resistance considerably. Prof. Graham Bell, he believed, gave up using platinum because the resistances of such cells were very high.—Mr. James Swinburne read a paper on Alternate Current Condensers. It is, he said, generally assumed that there is no difficulty in making commercial condensers for high-pressure alternating currents. The first difficulty is insulation, for the dielectric must be very thin, else the volume of the condenser is too great. Some dielectrics 0.2 mm. thick can be made to stand up to 8000 volts when in

small pieces, but in complete condensers a much greater margin must be allowed. Another difficulty arises from absorption, and whenever this occurs the apparent capacity is greater than the calculated. Supposing the fibres of paper in a paper condenser to be conductors embedded in insulating hydrocarbon, then every time the condenser is charged the fibres have their ends at different potentials, so a current passes to equalize them and energy is lost. This current increases the capacity. One condenser made of paper boiled in ozokerite took an abnormally large current and heated rapidly. At a high temperature it gave off water, and the power wasted and current taken gradually decreased. When a thin plate of mica is put between tin foils, it heats excessively; and the fall of potential over the air films separating the mica and foil is great enough to cause disruptive discharge to the surface of the mica. There appears to be a luminous layer of minute sparks under the foils, and there is a strong smell of ozone. In a dielectric which heats, there may be three kinds of conduction: viz. metallic, when an ordinary conductor is embedded in an insulator; disruptive, as probably occurs in the case of mica; and electrolytic, which might occur in glass. In a transparent dielectric the conduction must be either electrolytic or disruptive, otherwise light vibrations would be damped. The dielectric loss in a cable may be serious. Calculating from the waste in a condenser made of paper soaked in hot ozokerite, the loss in one of the Deptford mains came out 7000 watts. Another effect observed at Deptford is a rise of pressure in the mains. There is as yet no authoritative statement as to exactly what happens, and it is generally assumed that the effect depends on the relation of capacity to self-induction, and is a sort of resonator action. This would need a large self-induction, and a small change of speed would stop the effect. The following explanation is suggested. When a condenser is put on a dynamo, the condenser current leads relatively to the electromotive force, and therefore strengthens the field magnets and increases the pressure. In order to test this, the following experiment was made for the author by Mr. W. F. Bourne. A Gramme alternator was coupled to the low-pressure coil of a transformer, and a hot-wire voltmeter put across the primary circuit. On putting a condenser on the high-pressure circuit, the voltmeter wire fused. The possibility of making an alternator excite itself like a series machine, by putting a condenser on it, was pointed out. Prof. Perry said it would seem possible to obtain energy from an alternator without exciting the magnets independently, the field being altogether due to the armature currents. Mr. Swinburne remarked that this could be done by making the rotating magnets a star-shaped mass of iron. Sir W. Thomson thought Mr. Swinburne's estimate of the loss in the Deptford mains was rather high. He himself had calculated the power spent in charging them, and found it to be about 16 horsepower, and although a considerable fraction might be lost, it would not amount to nine-sixteenths. He was surprised to hear that glass condensers heated, and inquired whether this heating was due to flashes passing between the foil and the glass. Mr. A. P. Trotter said Mr. Ferranti informed him that the capacity

of his mains was about  $\frac{1}{3}$  microfarad per mile, thus making  $2\frac{1}{3}$  microfarads for the seven miles. The heaping up of the potential only took place when transformers were used, and not when the dynamos were connected direct. In the former case the increase of volts was proportional to the length of main used, and 8500 at Deptford gave 10,000 at London. Mr. Blakesley described a simple method of determining the loss of power in a condenser by the use of three electro-dynamometers, one of which has its coils separate. Of these coils, one is put in the condenser circuit, and the other in series with a non-inductive resistance  $r$ , shunting the condenser. If  $a_2$  be the reading of a dynamometer in the shunt circuit, and  $a_3$  that of the divided dynamometer, the power lost is given by  $r(Ca_3 - Ba_2)$  where  $B$  and  $C$  are the constants of the instruments on which  $a_2$  and  $a_3$  are the respective readings. Prof. S. P. Thompson asked if Mr. Swinburne had found any dielectric which had no absorption. So far as he was aware, pure quartz crystal was the only substance. Prof. Forbes said Dr. Hopkinson had found a glass which showed none. Sir W. Thomson, referring to the same subject, said that many years ago he made some tests on glass bottles, which showed no appreciable absorption. Sulphuric acid was used for the coatings, and he found them to be completely discharged by an instantaneous contact of two balls. The duration of contact would, according to some remarkable mathematical work done by Hertz in 1882, be about 0.0004 second, and even this short time sufficed to discharge them completely. On the other hand, Leyden jars with tin-foil coatings, showed considerable absorption, and this he thought due to want of close contact between the foil and the glass. To test this he suggested that mercury coatings be tried. Mr. Kapp considered the loss of power in condensers due to two causes: first, that due to the charge soaking in; and second, to imperfect elasticity of the dielectric. Speaking of the extraordinary rise of pressure on the Deptford mains, he said he had observed similar effects with other cables. In his experiments the sparking distance of a 14,000-volt transformer was increased from  $\frac{1}{16}$  of an inch to 1 inch by connecting the cables to its terminals. No difference was detected between the sparking distances at the two ends of the cable, nor was any rise of pressure observed when the cables were joined direct on the dynamo. In his opinion the rise was due to some kind of resonance, and would be a maximum for some particular frequency. Mr. Mordey mentioned a peculiar phenomenon observed in the manufacture of his alternators. Each coil, he said, was tested to double the pressure of the completed dynamo, but when they were all fitted together their insulation broke down at the same volts. The difficulty had been overcome by making the separate coils to stand much higher pressures. Prof. Rücker called attention to the fact that dielectrics alter in volume under electric stress, and said that if the material was imperfectly elastic some loss would result. The President said that, as some doubt existed as to what Mr. Ferranti had actually observed, he would illustrate the arrangements by a diagram. Speaking of condensers he said he had recently tried lead plates



$T_1$  and  $T_2$  are large transformers;  $t_1$  and  $t_2$  are small transformers or voltmeters  $v_1$  and  $v_2$ . The numbers 1, 4, 1, 25, represent their conversion ratios.

in water to get large capacities, but so far had not been successful. Mr. Swinburne, in replying, said he had not made a perfect condenser yet, for, although he had some which did not heat much, they made a great noise. He did not see how the rise of pressure observed by Mr. Ferranti and Mr. Kapp could be due to resonance. Mr. Kapp's experiment was not conclusive, for the length of spark is not an accurate measure of electromotive force. As regards Mr. Mordey's observation, he thought the action explicable on the theory of the leading con-

denser current acting on the field magnets. The same explanation is also applicable to the Deptford case, for when the dynamo is direct on, the condenser current is about 10 amperes, and this exerts only a small influence on the strongly magnetized magnets. When transformers are used the field magnets are weak, whilst the condenser current rises to 40 amperes. Mr. Blakesley's method of determining losses was, he said, inapplicable except where the currents were sine functions of the time; and consequently could not be used to determine loss due to

hysteresis in iron, or in a transparent dielectric.—Mr. Swinburne's note on electrolysis was postponed till the next meeting.

**Linnean Society,** December 18, 1890.—Prof. Stewart, President, in the chair.—Prof. T. Johnson exhibited and made remarks on the male and female plants of *Stenogramme interrupta*.—Mr. Clement Reid exhibited specimens of *Helix obvolvata* from new localities in Sussex, and by aid of a specially prepared map traced the present very local distribution of this mollusc in England.—Mr. E. M. Holmes exhibited some examples of galls formed on *Styrax benzoin* by an Aphis (*Ategopteris styracophila*). He also exhibited and described some new British Algæ, *Mesogloia lanosa* and *Myriocladia tomentosa*.—A paper was then read by Prof. R. J. Harvey Gibson on the structure and development of the cystocarps in *Catantella opuntia*, and critical remarks were offered by Messrs. D. H. Scott, E. M. Holmes, and others.—Mr. G. F. Scott Elliot then read an interesting paper on the effect of exposure on the relative length and breadth of leaves, upon which a discussion followed.

**Mathematical Society,** January 8.—Prof. Greenhill, F.R.S., President, in the chair.—Mr. H. Perigal, in a communication on geometrical metamorphoses by partition and transformation, exhibited a great number of interesting dissections, starting from his now classical dissection of Euc. i. 47, which dates from the year 1835.—Major Macmahon, R.A., F.R.S., then gave an account of a theory of perfect partitions and the compositions of multipartite numbers.—Mr. Tucker read a paper, by Prof. G. B. Mathews, on a certain class of plane quartics.

#### PARIS.

**Academy of Sciences,** January 5.—M. Duchartre in the chair.—M. d'Abbadie was elected Vice-President for the year 1891.—On the waves caused by explosions, the characteristics of detonations, and the velocity of propagation in solid and liquid bodies, and especially in methyl nitrate, by M. Berthelot. Methyl nitrate,  $\text{CH}_3\text{NO}_2$ , may give by explosion  $\text{CO}_2 + \text{CO} + \text{N}_2 + 3\text{H}_2\text{O}$ , or  $2\text{CO}_2 + \text{N}_2 + \text{H}_2 + 2\text{H}_2\text{O}$ . In both cases the volume of the gas generated is the same, viz. 102.8 litres for 1 kilogramme, the heat of decomposition being 1451 calories. These numbers are very nearly the same as those furnished by nitro-glycerine and gun-cotton. The pressure developed when 1 kilogramme of methyl nitrate is exploded in a vessel of 1 litre capacity, is no less than 11,000 kilogrammes per square centimetre. The author has attempted to measure the velocity of propagation of the waves, but the vessels employed were always broken by the shock. A calculation shows that the resistance offered by the vessels only increases with the thickness up to a certain limiting pressure. The pressure developed above this limit has infinite force, hence nothing can resist it.—On a class of modular equations, by M. Brioschi.—On some linear differential equations capable of transformation among themselves by a change of a function and a variable, by M. Paul Appell.—On the value of the magnetic elements in absolute measure on January 1, 1891, by M. Th. Moureaux. The values are given for the Observatories of Parc Saint-Maur and Perpignan, together with the secular variation obtained by a comparison with those found on January 1, 1890.—On the absorption spectra of solutions of iodine, by M. H. Rigollot. The author has studied the absorption spectra of various iodine solutions with reference to the displacement of the absorption bands and the quantity of light transmitted. The general result arrived at is, that for similar substances, or for compounds of the same radicle used as solvents for iodine, and submitted to experiment, with an increase of molecular weight (1) the absorption band is shifted slightly towards the violet end of the spectrum; (2) the minimum amount of light received diminishes in value.—The influence of tempering on the electrical resistance of steel, by M. H. Le Chatelier. The experiments show that the measure of electrical resistance may be used to determine the state of carbon in iron, and also to find the proportion transformed in tempered steel. This method will be adopted in further researches on the mechanical properties of steel.—Influence of the *covolume* of gases on the velocity of propagation of explosive phenomena, by M. Vielle. (See M. Berthelot's paper above.)—On the conductivities of isomeric organic acids and their salts, by M. Daniel Berthelot. From the observation at  $17^\circ \text{C}$ . of the conductivities of dilute solutions of oxybenzoic, of

amidobenzoic, of maleic and fumaric, of itaconic, metaconic, and citraconic, and of racemic, dextro-rotatory tartaric, and inactive tartaric acids in solutions containing the free acids alone and with varying quantities of potash, the author concludes that the rule given by M. Arrhenius for the calculation of the conductivities of isohydric solutions is rigorously true in the case of monobasic acids.—On trithienyl, by M. Adolphe Renard. The analyses of this body indicate that its formula is  $\text{C}_4\text{H}_2\text{S} - \text{C}_4\text{H}_2\text{S} - \text{C}_4\text{H}_2\text{S}$ . Its vapour density is 8.6 by Meyer's method; theory requires it to be 8.68.—Action of sodium benzylate upon camphor cyanide, by M. J. Minguin.—On a general method of analysis applicable to the spirits and alcohols of commerce, by M. Ed. Mohler.—The method described is asserted to permit of the determination of not only the alcohol, extract, acidity, and furfural, but, in addition, the ethers, aldehydes, higher alcohols, and nitrogenous bodies.—On the urinary function of acephalian mollusks—viz. the Bojanus organ and the Keber and Grobben glands, by M. Augustin Letellier.—On the development of the chromatophores of octopodan cephalopods, by M. L. Joubin.—On *Atlantonema rigida*, v. Siebold, the parasite of various Coleoptera, by M. R. Moniez.—On the position of the chalk of Touraine, by M. A. de Grossouvre.—Contributions to the geological knowledge of the Alpine chains between Moutiers (Savoie) and Barcelonnette (Lower Alps): formations prior to the Jurassic, by M. W. Kilian.—Soundings of Lake Leman, by M. A. Delebecque. This lake is composed of two parts—the great lake, between Nernier and Villeneuve; and the little lake, between Nernier and Geneva. The great lake has a mean depth of 310 metres. At the junction with the Geneva lake the transverse barrier of an old moraine rises, and the depth is only about 70 metres. The mean depth of the whole lake appears to be about 153 metres.

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