abundance of seeds, grains, nuts, acorns, &c., plainly indicates the vegetable character of the diet of these lake-dwellers, the appearance of masses of husked wheat and barley proves that they practised agriculture, and understood how to thrash and winnow the grain. Considerable interest attaches to the discovery below the peat, in what is characterized as the archaic bed, of large masses of seeds, determined by Prof. Sordelli as identical with those of the cultivated so-called Indian poppy (*Papaver somniferum*). Heer has recorded in the Swiss pile-dwellings the presence of poppy seeds which he referred to *P. seligerum*, but whether the Italian and the Swiss remains belong to the same or different species of poppy, the use to which they were put by primæval men in the two countries remains an unsolved problem.—On the Polynesians, their origin, migrations, &c., by MM. Lesson and Martinet. The purpose of this work is to refute the three most generally accepted theories regarding the origin of these races, viz. whether they are survivals from an almost wholly submerged continent, or whether they are of American, or of Asiatic descent; and to maintain the novel hypothesis that they are descendants of Maoris of the Middle Island of New Zealand. These views the authors endeavour to support by showing close analogies of language between the two peoples, affinities between certain names of places and of deities used by both, and frequent identity in forms of belief, rites, and superstitions. They further point out that the natives of the Marquesas, who are regarded as of the purest Polynesian race, use the same word, Havaiki, as the Maoris to denote their original ancestral home. From these and numerous other linguistic affinities the writers conclude that the Maoris are the autochthonic ancestors of the Polynesians, and that the Maori language is the mother speech of all the Polynesian dialects.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 24.—"On the Motion of a Sphere in a Viscous Liquid." By A. B. Basset, M.A. Communicated by Lord Rayleigh, D.C.L., Sec.R.S.

The determination of the small oscillations and steady motion of a sphere which is immersed in a viscous liquid, and which is moving in a straight line, was first effected by Prof. Stokes in his well-known memoir "On the Effect of the Internal Friction of Fluids on the Motion of Pendulums" (Camb. Phil. Soc. Trans., vol. ix. part 2, p. 8); and in the appendix he also determines the steady motion of a sphere which is rotating about a fixed diameter. The same subject has also been subsequently considered by Helmholtz and other German writers; but, so far as I have been able to discover, very little appears to have been effected with respect to the solution of problems in which a solid body is set in motion in a viscous liquid in any given manner, and then left to itself.

In the present paper I have endeavoured to determine the motion of a sphere which is projected vertically upwards or downwards with given velocity, and allowed to ascend or descend under the action of gravity (or any constant force), and which is surrounded by a viscous liquid of unlimited extent, which is initially at rest excepting so far as it is disturbed by the initial motion of the sphere.

In solving this problem, mathematical difficulties have compelled me to neglect the squares and products of velocities, and quantities depending thereon, which involves the assumption that the velocity of the sphere is always small throughout the motion; and I have also assumed that no slipping takes place at the surface of the sphere. The problem is thus reduced to obtaining a suitable solution of the differential equation—

$$D\left(D - \frac{1}{\mu}\frac{d}{dt}\right)\psi,$$

where $$D = \frac{d^2}{dr^2} + \frac{\sin\theta}{r}\frac{d}{d\theta}\left(\operatorname{cosec}\theta\frac{d}{d\theta}\right).$$

ψ is Stokes's current function, and μ is the kinematic coefficient of viscosity. The required solution is obtained in the form of a definite integral by a method similar to that employed by Fourier in solving analogous problems in the conduction of heat; the resistance experienced by the sphere is then calculated, and the equation of motion written down and integrated by successive approximation on the supposition that μ is a small quantity. The values of the acceleration and velocity of the sphere to a third approximation are found to be

$$v = f\epsilon^{-\lambda t} - V\lambda\epsilon^{-\lambda t} - fka\sqrt{\frac{\mu}{\pi}}\{(\tfrac{1}{2} - \lambda t)\phi(t) + \sqrt{t}\} + fk^2a^2\mu t\epsilon^{-\lambda t}(1 - \tfrac{1}{2}\lambda t),$$

$$\dot{v} = \frac{f}{\lambda}(1 - \epsilon^{-\lambda t}) + V\epsilon^{-\lambda t} - fka\sqrt{\frac{\mu}{\pi}}\left\{\left(t + \frac{1}{2\lambda}\right)\phi(t) - \frac{\sqrt{t}}{\lambda}\right\} + \tfrac{1}{2}fk^2a^2\mu t^2\epsilon^{-\lambda t},$$

where

$$f = \frac{(\sigma - \rho)g}{\sigma + \frac{1}{2}\rho}, \quad k = \frac{9\rho}{a^2(2\sigma + \rho)}, \quad \lambda = k\mu,$$

$$\phi(t) = \int_0^t \epsilon^{-\lambda\tau}(t - \tau)^{-\frac{1}{2}}\,d\tau,$$

ρ being the density of the liquid, σ that of the sphere, and a its radius.

It thus appears that, after a very long time has elapsed, the acceleration will vanish and the motion will become steady. The terminal velocity of the sphere is $f\lambda^{-1}$, which is seen to agree with Prof. Stokes's result.

If the sphere were projected with velocity V, and compelled by means of frictionless constraint to move in a horizontal straight line, the values of the acceleration and velocity would be obtained from the preceding formulæ by expunging the terms $f\epsilon^{-\lambda t}$, $f\lambda^{-1}(1 - \epsilon^{-\lambda t})$, in the expressions for $\dot{v}$ and v respectively, and then changing f into $-V\lambda$.

The preceding results can only be regarded as a somewhat rough representation of the actual motion, for (1) the square of the velocity has been neglected; (2) no account has been taken of the possibility of hollow spaces being formed in the liquid; (3) if the velocity of the sphere became large, the amount of heat developed would be sufficient to vaporize the liquid in the immediate neighbourhood of the sphere, and the circumstances of the problem would be materially changed.

In the latter part of the paper I have considered the problem of a sphere, surrounded by a viscous liquid, which is set in rotation with given angular velocity, Ω, about a fixed diameter, and similar results are obtained. To a first approximation the angular velocity is equal to $\Omega\epsilon^{-\lambda t}$, where λ is a positive constant, which shows that the motion ultimately dies away.

December 8.—"The Sexual Reproduction of *Millepora plicata*." By Dr. Sydney J. Hickson.

Considerable attention has of recent years been paid by naturalists to the phenomena connected with the sexual reproduction of the Hydromedusæ. Stimulated by the brilliant results obtained by Allman and Weismann, several naturalists have investigated the structure of the various Medusæ and medusoid gonophores found in the group, the origin of the sexual cells, and the development of the embryo. These results have, on the whole, been so interesting and important that it was confidently anticipated that an investigation of the phenomena connected with the sexual reproduction of Milleporidæ would yield results of considerable interest. The systematic position of this family has always been a doubtful one, and naturalists were agreed that until the sexual reproduction was described, the position assigned to them could only be considered a temporary one.

It was my good fortune when in Talisse Island, North Celebes, to find on the reef just opposite my hut a fine specimen of *Millepora plicata* in vigorous growth. I visited it whenever the tide allowed, in the hopes of seeing the polyps fully expanded, and of being able to search them for any form of gonophore they might possess. In this, however, I was disappointed. Notwithstanding all my precautions, I never succeeded in finding the polyps more than partially expanded, and I could find no gonophores.

Having collected some specimens and dissolved the calcareous skeleton in strong acid, I discovered in the canals of the cœnosarc both the ova and the spermospores; but the unforeseen difficulties to be met with in working in a hot little bamboo hut in a tropical island prevented me from making any satisfactory series of sections, and I was reluctantly obliged to leave the further investigation of the subject until I returned to a laboratory in Europe.

Since my return home I have made a large number of preparations, and the results I have obtained may be summed up as follows:—

Both the male and female sexual cells arise in the ectoderm of the cœnosarcal canal system. At an early stage they perforate the mesoglœa and take up a position in the endoderm.

The ova at an early stage become stalked. The stalk of the ovum, which is simply a modified pseudopodium, serves to keep the ovum attached to the mesoglœa. The stalk is sometimes completely withdrawn, and the ovum by amœboid movements migrates along the lumen of the canals to a more favourable locality.

Maturation and impregnation occur while the ovum is still in the canals.

The mature ovum is very small (1/100 mm. in diameter), and is alecithal; nevertheless, it does not segment.

The germinal vesicle of the fertilized ovum splits up into a number of fragments, which, after a curious series of movements in the ovum, are eventually scattered over its substance.

By the time these fragments are thus scattered over the ovum, they have reached a considerable size, and, from faint markings in the substance of the ovum, no doubt can be retained that they are in reality the true nuclei of a morula stage in the development of the embryo. The embryo next assumes the form of a solid blastosphere, and its subsequent history is lost.

It will be a very interesting point to determine the precise mode of discharge of the embryo. I am very strongly of opinion that the embryo is discharged by the mouth of the gastrozooid, but I was, of course, unable to observe this in the living state. Whether this is correct or not, the fact remains that I have been unable to find in any of my preparations any trace of a free or fixed gonophore, containing either embryos or ova.

In the development of the spermatoza, a similar phenomenon is found to that in the development of the embryo. The spermospore does not divide into a sperm-morula, the nucleus alone fragments, and the subsequent formation of spermoblasts does not occur until a very late stage. When the spermoblasts are mature they are found in simple *sporosacs* on the dactylozooids. The sporosacs exhibit no traces of any medusoid structure.

These researches tend to prove that the Milleporidæ belong to a separate stock of the Hydrozoa from the Hydromedusæ, a stock which probably never possessed free-swimming medusiform gonophores.

There seems to be no true relationship between Millepora and Hydractinia. The absence of segmentation in the developing embryo may probably be accounted for by the amœboid movement which it exhibits after development has commenced. The evidence before us does not support the view that the ovum of Millepora formerly contained much yolk, and has subsequently lost it.

Physical Society, November 26.—Dr. Balfour Stewart, President, in the chair.—Mr. Asutosh Makhopadhyay was elected a member of the Society.—The following communications were read:—On the analogies of influence-machines and dynamos, by Prof. S. P. Thompson. The author pointed out that in nearly all influence-machines there are two stationary parts ("inductors") electrified oppositely, which are analogous to the field-magnet of dynamos, and a revolving part carrying "*sectors*" which correspond to the "*sections*" of an armature. To prevent ambiguity Prof. Thompson proposes to call the inductors "*field plates*," and the revolving parts as a whole an "*armature*." In the Wimshurst machine both field plates and armature rotate, and each acts as field plates and armature alternately. In the two field plate influence-machines there are four and sometimes six brushes. Two of these act as potential equalizers, two as field plate exciters, and the remaining two (if any) are generally placed in the "discharge" or external circuit. The Holtz machine having only four brushes, two serve the double purpose of potential equalizers and discharge circuit, and this machine excites itself best when the discharging rods are in contact. In this respect it resembles a series dynamo which only excites itself when the external circuit is closed, but on opening the circuit (say by inserting an arc lamp) produces remarkable effects. So in the Holtz machine on separating the discharging knobs a shower of sparks results. The Toepler machine (made by Voss) having six brushes resembles a shunt dynamo, and excites itself best on open external circuit. Analogies were traced between Thomson's replenisher and the Griscom motor. Armatures of influence-machines, as in dynamos, can be divided into ring, drum, disk, and pole armatures, and examples of each kind were mentioned. The "Clark Gas Lighter" is a good example of a drum armature, and a diagram showing the internal arrangements was exhibited. An example of an analogue to the compound dynamo was mentioned as existing at Cambridge, in the form of a Holtz machine believed to have been modified by Clerk Maxwell. Another analogue with dynamos is found in the displacement of the electric field when the armature is rotated, just as the magnetic field of a dynamo is shifted round in the direction of rotation. Further analogies were traced between "critical velocity" of dynamos (which depends on the resistances in the circuit) below which they do not excite themselves, and a similar critical velocity of influence-machines; *e.g.* in a Wimshurst or Voss machine, the potential equalizing circuit should have a low resistance if they are to excite themselves readily. Self-exciting dynamos excite better when the iron is bad and retains the magnetism, and influence-machines excite better when the field plates are made of paper or such substance as can well retain a residual charge. Finally an apparatus analogous to Thomson's "water-dropping accumulator" was exhibited, in which an electric current was generated by mercury falling down a tube between the poles of a magnet.—On the effect produced on the thermo-electric properties of iron when under stress or strain by raising the temperature to a bright red heat, by Mr. Herbert Tomlinson. In June last the author described some remarkable "effects of change of temperature on twisting and untwisting wires which have suffered permanent torsion," of which the present paper is a continuation. It is found that at or about the critical temperature (a bright red heat) mentioned in the previous paper, a sudden E.M.F. is generated at the junction of two iron wires, one of which is under stress or has suffered permanent strain, and the other in an unstrained state. By suddenly bringing a red-hot iron wire in contact with cold iron, an E.M.F. of about 1/20 volt is produced. If copper be used the E.M.F. is about $\frac{1}{4}$ volt. The author also showed that if one part of an annealed iron wire is heated to a bright red by a bunsen flame, an E.M.F. is generated if the position of the flame is slightly altered, the direction of the E.M.F. depending on the direction of the displacement. Prof. Ayrton believed the high E.M.F. exhibited by hot and cold copper was really due to oxide of copper; and Prof. S. P. Thompson said that different effects could be produced by using the oxidizing or reducing parts of the flame in heating the wire.—On the method of discriminating real from accidental coincidences between the lines of different spectra, with some applications, by Mr. E. T. J. Love.

December 10.—Prof. W. E. Ayrton, Vice-President, in the chair.—Mr. E. A. C. Wilson, and Mr. W. E. Sumpner were elected members of the Society.—Mr. H. G. Madan described the optical properties of phenyl-thio-carbimide. This body, derived from aniline, is a colourless liquid, density 1·35° C., and of high boiling-point 222° C. The refractive indices for the A and G lines are 1·639 and 1·707 respectively. It is thus seen to be a highly refractive liquid, and to have about the same dispersive power as carbon-bisulphide, whilst its use in prisms is unattended by many of the risks and inconveniences experienced with carbon-bisulphide. The dispersion at the blue end of the spectrum is very marked. Being less mobile than carbon-bisulphide, it is less affected by convection currents. The "refractive equivalent" calculated from its chemical constitution differs considerably from the observed value, and this difference the author believes due to the presence of the phenyl radicle and sulphur atom. A polarizing prism made on Jamin's plan, but using phenyl-thio-carbimide as the liquid, gives a fairly wide angular field (about 25°). Mr. Hilger stated that there was no great need of liquid prisms now, for very dense flint glass could be obtained with mean index of about 1·8. Dr. Perkin has recently supplied him with Canada balsam perfectly colourless, and which does not tarnish the polished faces of spar; hence one of the greatest objections to the use of Canada balsam in spar polarizing prisms has been removed. Dr. Gladstone pointed out that the constants for the phenyl radicle and for sulphur atoms had been determined, and thought the calculated "refractive equivalent" obtained by including these would be much nearer the observed value than the one given by Mr. Madan.—On the recalescence of iron, by Mr. H. Tomlinson. If an iron bar which has suffered permanent strain be heated to a white heat and allowed to cool, the brightness at first diminishes and then reglows (recalesces) for a short interval. Under favourable circumstances as many as seven reglows have been observed during one cooling. Generally two decided ones are observed, one between 500° and 1000° C., and the other below 500° C. The effects the author believes due to "retentiveness" of the material, somewhat similar to the causes of residual magnetism and residual charge of a Leyden jar. A table of experimental results, giving the torsional elasticity and internal friction at different temperatures, for iron wire, showed sudden increases in internal friction at temperatures of about 550° and 1000° C. The table also shows that the torsional elasticity slowly decreases as the temperature increases, whereas the internal friction increases enormously. This explains why bells cease to emit musical notes when heated. The author finds that the recalescence at the higher temperature is not appreciably accelerated by mechanical vibration such as hammering, &c., but those occurring at lower temperatures are greatly influenced by such treatment and by magnetic disturbances. Prof. Forbes believed the explanation of recalescence given by himself about 1873 is sufficient to account for the effects observed. This explanation postulates a sudden increase in thermal conductivity about the temperature at which recalescence occurs, which permits the heat from the inside to reach the outside more readily, and thus raise the temperature of the surface. The subsequent reglows observed by Mr. Tomlinson he believes due to convection currents of air. Prof. Rücker suggested that calorimetric experiments might determine which view was the true one, and Prof. Ayrton thought the question might be decided by having two half-round bars nearly in contact at their flat sides, heated up and allowed to cool, and noting whether any sudden change in the bending of each bar (due to unequal temperature at the inner side and outer sides) took place about the critical temperature.—On the rotation of a copper sphere and of copper wire helices when freely suspended in a magnetic field, by Dr. R. C. Shettle. The author exhibited the apparatus with which his experiments "on the supposed new force" were made, the results of which were published in the *Electrician*, vol. xix. Dr. Hofford has recently made similar experiments, using brass disks, and his results seem to point to "diamagnetic non-uniformity" of the disks as the cause of the phenomena he observed.

Linnean Society, December 1.—W. Carruthers, F.R.S., President, in the chair.—There was exhibited for Mr. O. Fraser, of Calcutta, a specimen supposed to be a weather-worn seed of a palm, picked up on the Madras coast. Opinions given at the meeting referred it to the consolidated roe of a fish, doubts being thrown on its vegetable nature.—Sir John Lubbock read a paper, an account of which we have already printed, on the habits of ants, bees, and wasps.—A paper was read by Mr. C. B. Clarke, on a new species of *Panicum* with remarks on the terminology of the Gramineæ.

Geological Society, November 23.—Prof. J. W. Judd, F.R.S., President, in the chair.—The following communications were read:—Note on a New Wealden Iguanodont, and other Dinosaurs, by R. Lydekker.—On the Cae Gwyn Cave, by Prof. T. McKenny Hughes, who contended that the drift outside the cave was a marine deposit *remanié* from older beds of glacial age, but was itself post-glacial and of approximately the same date as the St. Asaph drift. He maintained that the marine drift was deposited before the occupation of the cave by the animals whose remains have been found in it; that at the time of the occupation of the cave the upper opening now seen did not exist, but the animals got in by the other entrance; that against the wall of the cave where it approached most nearly to the face of the cliff, the drift lay thick as we now see it; that by swallow-hole action the cave was first partially filled, and then the thinnest portion of its wall gave way gradually, burying the bone-earth below it, and letting down some of the drift above it, so that some of it now looks as if it might have been laid down by the sea upon pre-existing cave-deposits. The reading of this paper was followed by a discussion, in the course of which Dr. Hicks argued strongly against the author's conclusions.

Mathematical Society, December 8.—Sir J. Cockle, F.R.S., President, in the chair.—Messrs. W. B. Allcock, J. W. Mulcaster, and I. Beyens, Cadiz, were elected members.—The following communications were made:—The algebra of linear partial differential operators, by Capt. Macmahon, R.A.—On a method in the analysis of ternary forms, by J. J. Walker, F.R.S.—Confocal paraboloids, by A. G. Greenhill.—Note on the solution of Green's problem in the case of the sphere, by A. R. Johnson.—Uni-Brocardal triangles and their inscribed triangles, by R. Tucker.

Chemical Society, November 17.—Mr. William Crookes, F.R.S., President, in the chair.—The following papers were read:—Zinc-copper and tin-copper alloys, by A. P. Laurie.—The halogen substituted derivatives of benzalmalonic acid, by C. M. Stuart.—Note on a modification of Traube's capillarimeter, by H. S. Elworthy.—The formation of hyponitrites: a reply, by Edward Divers, F.R.S.—Reply to the foregoing note, by W. R. Dunstan.

Royal Microscopical Society, November 9.—Rev. Dr. Dallinger, F.R.S., President, in the chair.—Mr. E. M. Nelson called attention to a suggestion for supplying a want which many had felt of a really good achromatic single lens or loupe for microscopic purposes, of ½-inch focus. He had found that the want was met by a Seibert No. III. objective, having its adjusting screw removed.—Mr. Nelson further said that, having lately obtained an improvement in optical power, he had been able to do a little more in the matter of resolution, and one of the first objects he had tried was striped muscular fibre. In the early days of microscopy a muscular fibril used to be represented as a series of light and dark bands, the dark band being about twice the diameter of the white band. In 1854 Messrs. Huxley and Busk discovered a dark stripe in the middle of the bright band, and subsequently Hensen placed a similar darker stripe in the middle of the dark band. With his latest optical appliances he had been able to see a faint white stripe on either side of Hensen's dark stripe. He estimated the diameter of the stripes to be all equal. Although he saw evidences of longitudinal breaking up, he could see nothing of Schäfer's "beads."—The third point noticed by Mr. Nelson was Mr. Francis' method of improving definition of such an object as *Amphipleura pellucida* by using the analyzer. He had tested the plan, and found that it did intensify the resolution in a very marked degree.—Mr. Nelson also exhibited and described a new portable microscope made by Messrs. Powell and Lealand from his drawings, and the new photomicrographic camera designed by Mr. C. L. Curties and himself.—Mr. Nelson further exhibited a new eye-piece which he had devised. Having for some time past made a great many experiments with achromatic eye-pieces of double, triple, and other forms, he had not succeeded in producing any combination whose defining power surpassed that of the Huyghenian. The best results were obtained by achromatizing the eye-lens—*i.e.* by making it of a biconvex and a plano-concave, with its convex side towards the eye. The aperture of the diaphragm was reduced until the diameter of the field was equal to that of the Abbe compensating eye piece. This eye-piece, with the achromatized eye-lens, gives the sharpest images he had seen. It works perfectly well with the 24 mm. and 3 mm. Zeiss apochromatic objectives.—Mr. C. R. Beaumont then exhibited and described his new form of slide for observing living organisms, and read a paper on the metamorphoses of *Amœbæ* and *Actinophrys*, in which he claimed to have observed the development of an *Amœba* into an *Actinophrys*, and then into a *Difflugia* and an *Arcella*.—Mr. H. B. Brady's paper, a synopsis of the British recent Foraminifera, was communicated to the meeting by Prof. Bell.

PARIS.

Academy of Sciences, December 5.—M. Janssen in the chair.—Letter to M. Bertrand in connection with his previous note on a theorem relative to errors of observation, by M. Faye. It is pointed out that, if we consider all the combinations of errors, the relations of the sums corresponding to the greatest and smallest of these errors are comprised between the extremes 1 and 3·915. Both of these are infinitely improbable in themselves, while their mean, 2·457, differs little from the number 2·414 given by M. Bertrand.—Reply to M. Mascart on the subject of the deviation of the winds on the synoptical charts, by M. Faye. The author insists that he has nothing to modify in what he has written during the last thirteen years on the descending spiral motion of cyclones. The synoptical charts, which have been multiplied during the last few years, when properly interpreted, are shown to be in no way opposed, but, on the contrary, lend additional support, to his theory.—On the synchronism of accurate time-pieces, and on the distribution of time, by M. A. Cornu. A description is given of the construction and properties of a very simple electric appliance, which is applicable to all kinds of oscillating apparatus, and which realizes the theoretic conditions under which the problem of synchronism has been solved. This system has already been at work for several years in the École Polytechnique, and has been applied with complete success in the Paris Observatory for the synchronizing of the two clocks in the Department of Longitudes. The problem of the distribution of time with a precision approaching the hundredth part of a second is thus satisfactorily solved. The apparatus is extremely simple and easily regulated, and may be worked with feeble currents.—Remarks in connection with a work entitled "Les Ancêtres de nos Animaux dans les Temps géologiques," presented to the Academy by M. Albert Gaudry. In this work the fossil mammals are tabulated in the ascending order according as they appeared on the earth from the Lower Miocene through all the intervening geological epochs up to the present time. A concluding chapter is devoted to an historic survey of palæontology in the Paris Museum.—On magnetizing by influence, by M. P. Duhem. The questions here discussed are: the quantity of heat liberated in the transformation of a system including magnets, and the heat liberated in the displacement of a magnetic mass.—New nebulæ discovered at the Paris Observatory, by M. G. Bigourdan. The right ascension and polar distance, with miscellaneous remarks, are given of the nebulæ consecutively numbered 51 to 102. Observations are appended on thirteen other nebulæ previously discovered.—On the division of an arc of a circle, by M. A. Pellet. The approximate division of an arc in a given relation is determined by means of rule and compass.—On the expansion of compressed fluids, and especially on that of water, by M. E. H. Amagat. The compressibility and expansion of water, ordinary ether, methylic, ethylic, propylic, and allylic alcohols, acetone, chloride, bromide and iodide of ethyl, sulphide of carbon, and chloride of phosphorus, have been studied between zero and 50°, and from the normal pressure up to 3000 atmospheres. For all except water, which behaves exceptionally, the coefficient of expansion diminishes with increased pressure, the decrease being still very perceptible at the highest point. The coefficient of water increases very rapidly at first, but afterwards diminishes gradually, disappearing altogether towards 2500 atmospheres.—On a new method of quantitative analysis for carbonic acid in solution, by M. Léo Vignon. By the process here described the presence may be detected of 1 cubic centimetre of carbonic acid in 1 litre of water.—Influence of natural or superinduced sleep on the activity of the respiratory combustions, by M. L. de Saint-Martin. It is shown that, apart from the state of fasting, natural sleep lowers by about one-fifth the quantity of carbonic acid exhaled, and by only one-tenth the quantity of oxygen absorbed; also, that in sleep brought about by morphine the proportion exhaled falls to one-half, and in sleep caused by chloral or chloroform to one-third, of the quantity exhaled during the same lapse of time in the normal state.—On the absence of microbes in the human breath, by MM. J. Straus and W. Dubreuilh. These researches fully confirm the conclusions already arrived at by Lister and Tyndall regarding the freedom of exhaled breath from the presence of pulmonary or other microbes.

Berlin.

Physical Society, Nov. 11.—Prof. von Helmholtz, President, in the chair.—Dr. Weinstein spoke on the determination of the electrical resistance of tubes of mercury. He employs two methods for measuring the length of the tubes, one in which the tube is completely filled with mercury, the other in which it is only partially filled, and in which the convexity of the ends of the column of mercury is taken into account. The first method is the more exact, but is less simple; the difference between the methods is small. The measurement of the diameter of the tube is of great importance, and is made under the assumption that the tube is either a cylinder or a cone; the latter is the more correct assumption when the tube is long, and necessitates calibrational corrections, for which Dr. Weinstein deduced the formulæ. Taking into account the want of accuracy in the constants involved in the above, he considers it far better to determine the volume from the heights of the capillary rise of fluids in the tube.—Prof. Pictet, who was present as a guest, gave a detailed account of the experiments he has made with his ice-machines, which have led to results which do not agree with Carnot's theories as far as the second law of thermodynamics is concerned. He described the action of a perfect ice-machine, consisting of a refrigerator, pump, and condenser. In the refrigerator a quantity of heat is taken from the salt-water bath surrounding it, which causes some of the fluid to evaporate; this vapour, at the temperature of the surroundings, passes unchanged into the pump, where it is compressed, and forced, at high pressure, into the condenser, where it at once becomes a liquid, and gives up all its heat to the surroundings. This condensed fluid then flows back to the refrigerator. In a real machine of finitely small dimensions, the temperature in the refrigerator falls, the vapour meets with resistance in passing over into the pump, and in passing from the latter into the condenser, and there is a fall of temperature as the heat passes out into the surroundings from the liquid formed in the condenser. The speaker determined by careful experiments the tension of the vapour with which he worked between − 20° C. and + 30° C., and then he measured the temperatures in the several parts of the working machine by means of manometers which registered the pressures in the several parts, and from this he arrived at the result stated above. The measurements were made when the pump was working both rapidly and slowly, and also when it was stopped. Prof. von Helmholtz drew attention to two sources of error which cannot be avoided in Prof. Pictet's experiments, and which might account for the results obtained being in opposition to Carnot's law. In the first place, the vapour might contain air; this would influence the pressure existing in the machine, without itself undergoing any condensation, and hence it is impossible to determine the temperature of the vapour accurately from measurements of its pressure. The second source of error is, however, still more important. In Pictet's ice-machines, the liquid used is a mixture of liquefied carbonic acid gas and sulphur dioxide. From such a mixture as this the more volatile carbonic acid gas must pass over into the refrigerator in larger quantities than the less volatile sulphur dioxide. Hence both the vapour and the liquid resulting from its condensation have a composition markedly different from that of the original liquid. Now the calculations are made on the assumption that the liquid undergoes no change of composition, hence the temperatures determined from the pressures cannot correspond to those really existing in the several parts of the apparatus. Prof. Helmholtz hence considers that the temperatures in the refrigerator and condenser should be measured with thermometers, in which case only it would be possible to test the truth of Carnot's laws on the basis of the heat-values obtained in the experiments.

November 25.—Prof. von Helmholtz, President, in the chair.—Dr. Stapff spoke on his measurements of the temperature of the earth in South Africa. From his observations on the temperature in the St. Gothard Tunnel, and a comparison of these with the temperatures observed at the earth's surface, he had deduced an empirical formula for the difference of temperature between the air and the earth: according to this formula, the difference is greater the lower the temperature of the air, and disappears when the temperature of the air rises to 11° C. It hence became a matter of interest to determine whether the difference is negative when the temperature of the air is very high. Dr. Stapff had made use of a sojourn in South Africa, near Whale Bay, while engaged in geological studies, for the purpose of carrying out observations on the temperature of the earth. The district in which he worked lies in the Tropic of Capricorn, about in the same meridian as Berlin, and the soil is sandy with a current of water running beneath it towards the sea. The observations were made in borings with English mining-thermometers, which were allowed to remain about twelve hours at the depth where the temperature was to be determined, thus insuring that they had taken up the temperature of the surroundings. The measurement of the temperature at the earth's surface presented very great difficulties, and was only rendered possible by covering the bulb of the thermometer with a layer of sand 5 cm. thick. The greatest depth at which the temperature of the earth was measured was 17 metres. From the determinations thus made it appeared that the temperature diminished down to that depth, a result undoubtedly dependent upon the fact that the measurements were made during the hottest time of the year. The speaker found that the depth down to which the temperature varies with that of the air is about 13·6 metres, the temperature at this depth being about 25° C. The changes in temperature of the earth were very considerable, greater than those of the air, amounting in the sand to some 30° to 40° C. His measurements, however, did not show any negative value for the difference in temperature of the air and earth.—Dr. Sieg gave an account of his experiments for the determination of the capillary constants for large drops and bubbles. On account of the marked divergence in the results obtained by Quincke as compared with the older measurements, the speaker was led to subject Quincke's method to a detailed examination. He found that the determination of the height of the drop is exact, but that the measurement of its width by means of the micrometer is too uncertain. Instead of this method, he therefore employed the reflection of a flame from the side of the drop in order to determine the convexity of the same, and using Poisson's method of calculating the results instead of that of Quincke, he obtained as the value of the capillary constant, not 54 as given by Quincke, but 44·5, thus agreeing with the older determinations. The mercury was purified and examined by Quincke's method. In addition Dr. Sieg has determined the capillary constants for water, alcohol, oils, and a series of salt-solutions of varying concentrations. One result may be mentioned as shown by these experiments, that the capillary constant of mercury sinks to forty-two when the mercury has stood for some time, and that the same fall is observed if the mercury is put to earth; the constant is also altered if the drop is electrified or is impure. With salt-solutions the constants were dependent upon both composition and concentration. Water was also found to be very sensitive to the presence of any impurities, and while the solution of salts in water was not found to alter its capillary constants, the solution of gases produced a very appreciable alteration

Physiological Society, November 18.—Prof. du Bois Reymond, President, in the chair.—After the statutory election of the Council, Dr. Benda demonstrated a malformation as occurring in a three-months' embryo, in which two strongly marked prominences on the lower portion of the forehead gave to its countenance a curiously contemplative appearance.—Prof. Kossel next spoke on adenin. The most recent researches on the importance of the nucleus to the life of the cell, especially the knowledge that when unicellular organisms are artificially cut into pieces only those parts exhibit a complete regeneration which contain a portion of the nucleus, and the importance of the nucleus in impregnation have given an increased importance to the chemistry of the nucleus. Among the chemical substances which compose the nucleus, adenin, which has recently been discovered by the speaker, appears to possess a special importance, since, on account of its composition, $C_5H_5N_5$, it belongs to the cyanic group of bodies. This substance was obtained from tea-leaves in large quantities, and from it a series of compounds were obtained, which were exhibited as extremely fine preparations; namely, the salts with hydrochloric, sulphuric, and nitric acids, as also some compounds with platinum. Adenin was found to be extremely resistant to feebly oxidizing agents, but on the other hand to be easily acted upon by reducing agents. The substances which are produced by these means were not very well characterized from a chemical point of view. The speaker however thinks that, owing to the ease with which it can be reduced, adenin plays an extremely important part in the physiological action of the nucleus. When adenin is reduced in presence of oxygen, a brownish-black substance is obtained, which appears to be identical with the azocuminic acid which is produced when hydrocyanic acid is exposed to the air for a long time. In conclusion, Prof. Kossel pointed out that adenin makes its appearance in large quantities under certain pathological conditions, and that he has succeeded in detecting it in the urine of persons suffering from leuchæmia.—Dr. Rawitz gave an account of his investigations on mucous cells in Invertebrates. He has found in the mantle of mussels goblet-cells, of which some are small with a large central nucleus and granular protoplasm; others are large with a small central nucleus, the rest of the cell-contents being uniform in appearance; and others again are large, with a small nucleus situated at the base of the cell, the protoplasm having oily granules scattered throughout itself. This last kind of cell allows the oily granules and mucous contents to pass out at the apex of the cell into the surrounding water. A careful investigation has shown that the above three different kinds of cells are merely different stages in the secretory activity of the mucous cells, and that during this activity the cell-contents not only undergo a change of minute structure, but also of chemical composition, the latter being evidenced by the changed reactions which they give with staining agents. During secretion the cell itself is not broken down, but only a portion of its protoplasm is excreted, in the form of oily drops and mucous threads, the nucleus remaining intact. Dr. Rawitz considers that special importance must be assigned to the nucleus in connection with the nutrition of the cell, as during the secretory activity of the cell it undergoes changes not only in its shape, but in its behaviour towards taining reagents.

STOCKHOLM.

Royal Academy of Sciences, November 9.—Plantæ vasculares Yenessenses inter Krasnojarsk urbem et ostium Yenisei fluminis tractenus lectæ, by Dr. N. J. Scheutz.—On additive characters of diluted solutions of salts, by Dr. S. Arrhenius.—On the theory of the unipolar induction, by Dr. A. Rosén.—Some formulæ of electrodynamics, by the same.—The phænogamous plants of Bergjum, enumerated in the sequence of their inflorescence, by the Rev. B. Högrell.—On hyalotekit from Långbau, by G. Lindström, Assist. Min. Cab. State Mas.—On the scientific results of the expedition of the *Vega*, by Baron Nordenskiöld.—Contributions to the theory of the undulatory movement in a gaseous medium, by Prof. A. V. Bäcklund.—Contributions to the knowledge of the exterior morphology of the Acridioideæ, especially with respect to the specimens found in Scandinavia, by Dr. B. Haij.—Generalization of the functions of Bernouilli, by Dr. A. F. Berger.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Les Ancêtres de Nos Animaux: A. Gaudry (Baillière et Fils).—British Journal Photographic Almanac, 1888 (Greenwood).—The Elements of Chemistry: Ira Remsen (Macmillan).—British Discomycetes: W. Phillips (Kegan Paul).—Vaccination Vindicated: J. C. McVail (Cassell).—Flower Land, an Easy Introduction to Botany: Rev. R. Fisher (Heywood).—A Course of Quantitative Analysis: W. N. Hartley (Macmillan).—Teneriffe and its Six Satellites, 2 vols.: O. M. Stone (Marcus Ward).—Annual Report on the Working of the Registration and Inspection of Mines and Mining Machinery Act during the year 1886 (Melbourne)—Digging, Squatting, and Pioneering Life: Mrs. D. D. Daly (Low).—China; its Social, Political, and Religious Life: from the French of G. Eug. Simon (Low).—Through the West Indies: Mrs. G. Layard (Low).—A Text-book of Paper Making: Cross and Bevan (Spon).—Proceedings of the Linnean Society of New South Wales, vol. ii part 2.—Quarterly Journal of the Geological Society, vol. xliii. pt. 4, No. 172 (Longmans).—Annals of Botany, vol. i. No. 11 (Clarendon Press).

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