passage of winged insects? by Felix Plateau. The difficulty experienced by insects in passing through a net with meshes three or four times their own size has been variously explained. Some attribute it to the resemblance to a spider's web, others to the apparent multiplicity of obstacles. Experiments made with nets of various shapes and materials show conclusively that the peculiarity of insects in this respect is due to the construction of their eyes, which are more adapted to the perception of motions or changes in surrounding objects than to the perception of form. When flying, insects are incapable of distinguishing a net from a continuous translucid surface, and it is therefore only very rarely that an insect will fly straight through it. It must strike the meshes or alight on them, and will then pass through as it would through any hole of the same size.

SOCIETIES AND ACADEMIES.

LONDON.

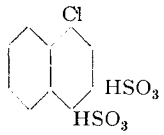
Royal Society, January 16.—"The Rotation of an Elastic Spheroid." By S. S. Hough, Isaac Newton Student in the University of Cambridge.

Recent researches on latitude-variation have brought to light the phenomenon of a periodic motion of the earth's axis of rotation in a period of 427 days. This period being in excess of the theoretical period of 305 days hitherto accepted, Prof. Newcomb has proposed to account for the extension by the failure of the old theory to take into consideration the flexibility of the solid parts of the earth. The author gives an analytical investigation of the motion of a solid body when slightly disturbed from a motion of simple rotation about a principal axis, taking into account elastic distortions due to variations in centrifugal force; the results are found to agree in the main with those obtained by Prof. Newcomb from geometrical considerations. The analysis deals with the case of a homogeneous spheroid of revolution, the ellipticity being such that the body is free from strain when rotating uniformly. Such a spheroid, if of the same size and mean density as the earth and rotating with the same angular velocity, would oscillate in a period of 232 days if perfectly rigid; it is shown that this period would be extended to 335 days in virtue of elastic distortions if the rigidity were equivalent to that of steel. In the case of the earth the period would be still further prolonged in consequence of variations in density, and the period which corresponds to the above degree of rigidity is estimated at about 440 days; whence it is concluded that the observed period may be accounted for by supposing that the earth is capable of elastic deformation, and that its effective rigidity is slightly in excess of that of steel.

Physical Society, January 24.—Captain Abney, President, in the chair.—Mr. Campbell Swinton exhibited some photographs which he had taken by Prof. Röntgen's method. These included several of metal objects inside wooden and cardboard boxes, and a very clear and sharp photograph of the bones of the hand.—Mr. E. Scott showed some geometrical instruments invented by himself and Signor Monticolo. The instrument designed by Signor Monticolo is intended for drawing arcs of circles of such large radius that compasses cannot be employed. It can be used to trace arcs of circles of which the radii vary from 50 cm. to infinity. The second instrument exhibited was a modified form of hatchet planimeter, which Mr. Scott has devised with a view of avoiding some of the defects of the ordinary form of instrument; thus, to avoid the cutting of the paper, which occurs when the knife-edge is sharp, and the side-slip, which occurs when the knife-edge is blunt, the author uses a wheel with a sharp edge. To avoid the inclination of the instrument to one side, which may easily occur with the ordinary form, a flat celluloid plate with a dot at the centre is used as the "tracing point," this plate being kept pressed flat on the surface of the paper. A small wheel with a recording disc is attached, and may be used to measure the distance between the first and last position of the knife-edge. Mr. Scott also described a form of planimeter which he had invented, and in which the l c and cylinder movement is used to perform the integra on. Mr. C. V. Boys said that an instrument designed by Mr. Clarkson had been exhibited before the Royal Society, which was capable of drawing arcs of circles of large radius. This instrument only drew an approximation to a circle, but the approximation was so close that it nowhere was more than the thickness of a thin ink line away from the truth. It would be interesting to hear from the author whether Signor Monticolo's instrument drew a rigorously exact circle or not. The upright position of the hatchet planimeter might be secured by using two wheels in place of one. The planimeter described was really a modified form of one he (Mr. Boys) had described before the Society in 1881. Mr. Blakesley gave a short geometrical proof showing that the curve traced by Signor Monticolo's instrument was rigorously an arc of a circle. Mr. Blakesley also drew attention to the fact that the instrument in its present form cannot be used to trace the arc on both sides of the zero line.—Dr. C. V. Burton described an idea for an instrument for drawing circular arcs, which had occurred to him, depending on the use of two wheels of different radii connected by an axle carrying a tracing-point. In the absence of the author, a paper by Prof. J. D. Everett on resultant tones was read by Dr. Burton. The author, after giving a short summary of the Helmholtz theory of the production of resultant tones, goes on to discuss his objections to this theory, and to elaborate a theory of his own. This theory depends on the consideration that, if you analyse into a Fourier series a periodic curve which is compounded of two simple harmonic motions of frequencies n and m, then only two terms are obtained. If, however, some error has been originally made in adding the two simple harmonic motions together, this error being repeated for each wave, then in addition to the two terms of frequency n and m there will be obtained, when the curve is analysed, a term of frequency f, where f is the greatest common measure of n and m. This term of frequency f the author calls the common fundamental of the tones n and m. The "error" in the production of the compound curve the author supposes to be produced during the transmission of the sound by the ossicles of the ear. In support of his theory the author finds that in the violin where the sound-post, like the ossicles of the ear, transmits the vibrations from one portion of the instrument to another, it is easy by sounding two strings in conjunction to obtain combination tones which agree in frequency with those required by this theory. Thus, when the major sixth (3 : 5), the major second (8 : 9), or the minor seventh (5 : 9) are sounded, the fundamental (1) is clearly heard and also felt by the hand holding the instrument. The author has also succeeded in picking out and strengthening this resultant tone by holding a Helmholtz resonator in contact with the body of the violin.—Dr. C. V. Burton, after explaining several portions of Prof. Everett's paper, said that he (Dr. Burton) considered that the author's view in many ways seemed to fit in with the observed facts better than the accepted theory, but still did not appear itself quite free from objection. Prof. Everett supposes that the first term in a Fourier series is always the most important, and although in most cases which occur in practice this may be so, it hardly seems legitimate to take this as a characteristic of a Fourier series.—The thanks of the Society having been given to Prof. Everett and Dr. Burton, the meeting adjourned to February 14.

Chemical Society, December 19, 1895.—Mr. A. G. Vernon Harcourt, President, in the chair.—The following papers were read: The liquefaction of air and research at low temperatures, by J. Dewar.—Researches on tertiary benzenoid amines. (1) Derivatives of dimethylaniline, by Miss C. de B. Evans. On heating dimethylaniline with chlorosulphonic acid only the para-sulphonic acid is formed; fuming sulphuric acid must be used in order to obtain the meta-sulphonic acid. The bromination and nitration products of these sulphonic acids are described.—Experiments on the formation of the so-called ammonium amalgam, by J. Proude and W. H. Wood. Solutions of phenols in aqueous ammonia contain ammonium salts because they give ammonium amalgam on addition of sodium amalgam; no mercurial froth is obtained from ammoniacal aqueous solutions of several inorganic salts, so that these contain no ammonium salts. Ammonium salts, when fused or dissolved in anhydrous solvents, cause no swelling of the sodium amalgam; the presence of water seems essential to the formation of ammonium amalgam.—The molecular volumes of organic substances in solution, by W. W. J. Nicol. The atomic volumes of the various elements may be accurately determined from the molecular volumes of organic substances in solution; the constants thus obtained differ somewhat for different solvents.—2 : 1 β-naphthylaminesulphonic acid and the corresponding chloronaphthalenesulphonic acid, by H. E. Armstrong and W. P. Wynne. The 2 : 1 β-naphthylaminesulphonic acid is converted, by the Sandmeyer method, into 2 : 1-β-chloronaphthalenesulphonic acid of which a number of derivatives are described; 2 : 1 : 4′-δ-naphthylaminedisulphonic acid is ob-

tained by sulphonating the amido-acid with fuming sulphuric acid.—1 : 3-α-naphthylaminesulphonic acid and the corresponding chloronaphthalenesulphonic acid, by H. E. Armstrong and W. P. Wynne.—Studies on the constitution of tri-derivatives of naphthalene, No. 15. The disulphonic acids obtained by sulphonating 1 : 3-α-naphthylamine- and 1 : 3-α-chloronaphthalene-sulphonic acids, by H. E. Armstrong and W. P. Wynne. On sulphonating these two acids with fuming sulphuric acid, disulphonic acids of corresponding constitutions are obtained; the acid prepared from the amido-acid may be converted by Sandmeyer's method into the acid having the constitution



obtained from the 1 : 3-α-chloro-acid.

Zoological Society, January 14.—Dr. W. T. Blanford, F.R.S., Vice-President, in the chair—A communication was read from the Rev. W. J. Holland, containing a preliminary revision and synonymic catalogue of the butterflies of the family Hesperiidæ of Africa and the adjacent islands, with descriptions of some apparently new species. The total number of species of African Hesperiidæ catalogued by Mr. Holland was 349, of which twenty-one were new to science. Fourteen new genera were characterised.—A communication was read from Dr. Arthur G. Butler, which gave an account of a collection of butterflies obtained by Mr. R. Crawshay in Nyasa-land between the months of January and April 1895. Many of the species in this consignment had been obtained at considerable altitudes. It was therefore surprising that comparatively few of them proved to be undescribed, though some of the new forms were of exceptional interest. Nine species altogether were characterised as new.—Mr. P. Chalmers Mitchell read a paper on the intestinal tract of birds.—Mr. F. G. Parsons read a paper on the myology of rodents, in continuation of a former paper read before the Society in 1894.—Mr. F. E. Beddard, F.R.S., gave an account of some earthworms from the Sandwich Islands collected by Mr. R. L. Perkins, and appended descriptions of some new species of *Perichæta*. Of the nine species of earthworms of the Sandwich Islands Mr. Beddard was unable to say that any one was indigenous.—A communication from Mr. Oscar Neumannn gave the description of a new species of antelope obtained during his expedition to East Africa in 1892-95, which he proposed to name *Adenota thomasi*, in honour of Mr. Oldfield Thomas.

Royal Microscopical Society, January 15.—Annual meeting.—A. D. Michael, President, in the chair.—After the annual report and the Treasurer's statement of accounts had been read and adopted, the following were elected as officers and Council for the ensuing year:—President: Albert D. Michael. Vice-Presidents: Rev. Edmund Carr, Frank Crisp, Dr. Richard G. Hebb, Edward Milles Nelson. Treasurer: William Thomas Suffolk. Secretaries: Prof. F. Jeffrey Bell, Rev. W. H. Dallinger, F.R.S. Members of Council: Conrad Beck, Alfred W. Bennett, Dr. Robert Braithwaite, Thomas Comber, Edward Dadswell, George C. Karop, the Hon. Sir Ford North, Thomas H. Powell, Charles F. Rousselet, Prof. Charles Stewart, John Jewell Vezey, Thomas Charters White.—The President, Mr. A. D. Michael, then delivered his annual address. The subject taken was the anatomy of the Acari. It was pointed out that the ordinary text-book definition of an Acarus as a creature in which abdomen and cephalothorax are completely fused is not correct, but that still the great characteristic of the anatomy is concentration; this was illustrated by the author's recent researches relative to the brain and nerves of the Hydrachnidæ (water mites) and other families. The address then dealt with the alimentary organs fully, and several remarkable modifications of the different organs to meet the wants of various creatures were explained.

PARIS.

Academy of Sciences, January 20.—M. A. Cornu in the chair.—On two new invariants in the general theory of algebraic surfaces, by M. E. Picard.—On keeping up the motion of a pendulum without interference with its time of oscillation, by M. G. Lippmann. In a pendulum clock certain minute impulses must be given by the movement to the pendulum to overcome the energy losses due to friction, and these interfere to a slight extent with the natural period of vibration. In an ordinary precision clock, attention is directed rather to keeping this disturbance constant than to eliminating it. That a given instantaneous impulse, however, considered by itself, should give rise to no disturbance, it is necessary and sufficient that it should take place exactly at the instant that the pendulum passes through its position of equilibrium. An electrical arrangement is described which fulfils this condition.—On the circulation of the air in the soil, by MM. P. P. Dehérain and Demoussy. A description of an apparatus for the experimental study of the porosity of soils. Air is sucked out from the bottom of a layer of soil of fixed dimensions, and the steady difference of pressures hereby set up is measured, this increasing with the porosity of the soil. The same apparatus serves for the study of the passage of water through soils.—The law of equivalence in the transformations of energy in animals, by M. A. Chauveau. Experimental details of the relation between the work (positive and negative) done by the muscles and the carbon dioxide excreted by the lungs. The conclusion is drawn from these experiments that the mechanical work done by the muscles in lifting a weight requires only an equivalent expenditure of energy. This is stated by the author to be the first experimental demonstration of the law of equivalence for work arising in the activity of animal tissues.—On the specific heats of gases and the properties of the isotherms, by M. E. H. Amagat.—A note on some experiments of M. Witowski on the thermal constants of air between 0 and − 140°.—Morphology of the limbs of the bony fishes, by M. A. Sabatier.—On the problems of variations relating to double integrals, by M. G. Kœnigs.—On the flexure of beams, by M. M. Duplaix.—Difference in the action of ultra-violet light on static and dynamic critical potentials, by M. R. Swyngedauw. Some experiments in support of a law announced in a previous note.—On a spherical Crookes' tube, showing the reflection of the kathode rays by glass and metal, by M. G. Séguy.—On the reflection and refraction of polarised light, by M. E. M. Lémeray. A geometrical interpretation of some formulæ of Fresnel.—On the solubility of sodium thiosulphate in alcohol, by M. P. Parmentier. Ordinary sodium thiosulphate has been obtained in two modifications, melting at 32° and 47°·9 respectively. Solubility determinations on these, and also on the superfused salt, gave results which are not in agreement with the experiments on the same subject previously published by M. Brunner. The conditions of equilibrium are very complex, and do not appear to follow any simple law.—On the nitrosulphides of iron, by MM. C. Marie and R. Marquis. A new method of preparing Roussin's salt. Sulphide of iron and sodium nitrite are treated at 100° with carbon dioxide. On cooling the pure salt crystallises out, the results of the analyses of which best agree with the composition $Fe_3S_2N_5O_6 + 1{\cdot}5\ H_2O$. The reactions towards boiling alkali solutions, and water at 200° were examined, but the complete study of the products is reserved for a future paper.—Action of carbonyl chloride upon some hydrogen compounds, by M. A. Besson. The reaction with phosphonium bromide is given by the following equation

$$6PH_4Br + 5COCl_2 = 10HCl + 6HBr + 5CO + 2PH_3 + P_4H_2.$$

Hydriodic acid gives carbon monoxide, hydrogen chloride, and free iodine only, no derivative corresponding to carbonyl iodide being formed. With phosphonium iodide the principal reaction is

$$4PH_4I + 8COCl_2 = 16HCl + 8CO + P_2I_4 + 2P.$$

Hydrogen phosphide, PH_3, is without action upon carbonyl chloride, as is also H_2S in the cold. At 200°, however, the latter gives carbon oxysulphide, COS.—On dichloralglucose and monochloralglucosane, by M. J. Meunier. A study of the condensation products obtained from chloral hydrate and glucose under the action of sulphuric acid.—The weight and composition of the dead covering layer of forests, by M. E. Henry. Figures are given for two classes of deposit, under fully-grown trees, and under brushwood. The weight of the dead layer gradually increases with time for about ten years, and then remains very nearly constant (about 7000 kg. to 8000 kg. per hectare). Complete chemical analyses are given, rendering it possible to construct a chemical balance-sheet for the forest.—The volcanic tufas of Ségalas (Ariège), by M. A. Lacroix. These tufas present a remarkable analogy with the basaltic tufas of Auvergne. A microscopical examination showed that they are undoubtedly volcanic, consisting of labroadorite and andesitic scoria.—On the discovery of a tertiary stratum bearing land

fossils in the neighbourhood of Liverdun (Meurthe-et-Moselle), by M. Bleicher. The fossils include the bones of large mammals and terrestrial shells, including one species of Helix. The shells are rarely intact. As regards the age of this deposit, the evidence points to its being Tertiary, or possibly Pliocene, certainly not Quaternary. This is the first proof of the formation of purely continental land deposits at that time, and in the east of France.

BERLIN.

Physical Society, November 22, 1895.—Prof. von Bezold, President, in the chair.—Prof. Thiesen gave an account of some of his scientific publications; of these, the first deals with a comparison of various mercurial thermometers, of which two were made of Jena glass and one of hard French glass. The others deal with the thermal expansion of solids and liquids. Among these the first treats of the so-called thermic after-effect. and this the author explained by the assumption of minute non-conducting particles distributed throughout the conducting substance. He further developed this hypothesis into mathematical formulæ. The second deals with the linear expansion of rods of glass and zinc, and the third with the relative coefficients of expansion of water, mercury and glass between 0° and 100° C.

DIARY OF SOCIETIES.

LONDON.

THURSDAY, JANUARY 30.

ROYAL SOCIETY, at 4.30.—On the Rhythmic Contractility of the Spleen: Prof. Schäfer, F.R.S., and B. Moore.—The Electrical Measurement of Starlight. Observations made at the Observatory of Daramona House, Co. Westmeath, in January 1896. Second Report: Prof. G. M. Minchin, F.R.S.—Contributions to the Chemistry of Chlorophyll. No. VII. Phylloporphyrin and Hæmatoporphyrin: a Comparison: E. Schunck, F.R.S., and Dr. L. Marchlewski.

INSTITUTION OF MECHANICAL ENGINEERS, at 7.30.—Telemeters and Range-Finders for Naval and other Purposes: Profs. Barr and Stroud.—Calculation of Horse-power for Marine Propulsion: Lieut.-Colonel Thomas English.

SOCIETY OF ANTIQUARIES, at 8.30.

FRIDAY, JANUARY 31.

ROYAL INSTITUTION, at 9.—National Biography: Sidney Lee.

INSTITUTION OF MECHANICAL ENGINEERS, at 7.30.—Notes on Steam Superheating: William H. Patchell.

INSTITUTION OF CIVIL ENGINEERS, at 8.—(1) Ironfounding in Green Sand; (2) Malleable Cast-Iron: F. A. Lart.

SUNDAY, FEBRUARY 2.

SUNDAY LECTURE SOCIETY, at 4.—Rubbish: Dr. T. W. Drinkwater.

MONDAY, FEBRUARY 3.

SOCIETY OF ARTS, at 8.—Alternate Current Transformers: Dr. J. A. Fleming, F.R.S.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Manufacture of Linoleum: W. F. Reid.

MEDICAL SOCIETY, at 8.30.

VICTORIA INSTITUTE, at 4.30.—Mount Sinai: Prof. Hull.

TUESDAY, FEBRUARY 4.

ROYAL INSTITUTION, at 3.—The External Covering of Plants and Animals: Prof. C. Stewart.

SOCIETY OF ARTS, at 8.—The Garden in Relation to the House: F. Inigo Thomas.

ZOOLOGICAL SOCIETY, at 8.30.—Second Report on the Reptiles and Batrachians collected by Dr. A. Donaldson Smith on his Expedition to Lake Rudolf: G. A. Boulenger, F.R.S.—On a Collection of Fishes made by Dr. Donaldson Smith during his Expedition to Lake Rudolf: Dr. A. Günther.—Remarks on the System of Coloration and Punctuation in the Beetles of the Genus Calligrapha: Martin Jacoby.—On the Oblique Septa in Passerines and other Birds: F. E. Beddard, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Recent Developments in Gas-Engines: Dugald Clerk.—Monthly ballot for Members.

ROYAL VICTORIA HALL, at 8.30.—Rubies: Prof. J. W. Judd.

WEDNESDAY, FEBRUARY 5.

SOCIETY OF ARTS, at 8.—The Mexican Drainage Canal: F. H. Cheesewright.

GEOLOGICAL SOCIETY, at 8.—On the Morte Slates and Associated Beds in North Devon and West Somerset: Dr. Henry Hicks, F.R.S.—Evidences of Glacial Action in Australia in Permo-Carboniferous Times: Prof. T. Edgeworth David.—On the Structure of the Plesiosaurian Skull: C. W. Andrews.

ENTOMOLOGICAL SOCIETY, at 8.—On the Relation of Mimetic Patterns to the Original Form: Dr. F. A. Dixey.—The Rhynchophorous Coleoptera of Japan. Part IV. Dr. D. Sharp, F.R.S.—The Diptera of St. Vincent: Prof. Williston. Communicated by Dr. D. Sharp, F.R.S.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Determination of Oxygen in Commercial Copper: Bertram Blount.—The Composition of Milk and Milk Products: H. Droop Richmond.—A New Form of Carbonic Acid Apparatus: Cecil H. Cribb.—Laboratory Notes: Alfred H. Allen.

BRITISH ARCHÆOLOGICAL ASSOCIATION, at 8.

THURSDAY, FEBRUARY 6.

ROYAL SOCIETY, at 4.30.

LINNEAN SOCIETY, at 8.—On Polystelic Roots of certain Palms: B. J. Cormack.—On a Remarkable Use of Ants in Asia Minor: R. Morton Middleton.

SOCIETY OF ANTIQUARIES, at 8.30.

CHEMICAL SOCIETY, at 8.

FRIDAY, FEBRUARY 7.

GEOLOGISTS' ASSOCIATION, at 7.30.—Presidential Address: Some Structural Characteristics of the Granite of the North-West Himalayas.

QUEKETT MICROSCOPICAL CLUB, at 8.

SATURDAY, FEBRUARY 8.

ROYAL BOTANIC SOCIETY, at 3.45.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—The Collected Mathematical Papers of Arthur Cayley, Vol. ix. (Cambridge University Press).—Evolution and Man's Place in Nature: Prof. H. Calderwood, 2nd edition (Macmillan).—Ice-Work Present and Past: Prof. T. G. Bonney (K. Paul).—Traité de Chirurgie: A. Le Dentu and P. Delbet, tome i. (Paris, Baillière).—Graphic Arithmetic: H. D. Ellis, charts 1 and 2 (Philip).—Géométrie Descriptive: A. Gouilly (Paris, Gauthier-Villars).—Remarkable Comets: W. T. Lynn, 4th Edition (Stanford).

PAMPHLETS.—Die Gletscherlawine an der Altels am 11 Sept., 1895 (Zürich).—Misure Assolute degli Elementi del Magnetismo Terrestre: Dr. L. Palazzo (Roma).

SERIALS.—Annuaire de L'Académie Royale des Sciences, &c., de Belgique, 1896 (Bruxelles).—Bulletin Ditto, tome 30, No. 11 (Bruxelles).—Journal of Malacology, Vol. 4 (Dulau).—Revista Sperimentale di Freniatria e di Medicina Legale, Vol. xxi. Fasc. 4 (Reggio Nell' Emilia).—Astrophysical Journal, January (Chicago).—Quarterly Review, January (Murray).—English Illustrated Magazine, February (198 Strand)—Good Words, February (Isbister).—Sunday Magazine, February (Isbister).—Longman's Magazine, February (Longmans).—Chambers's Journal, February (Chambers).—Natural Science, February (Rait).

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