into their system of education the principles and methods of science," and goes on to urge that the universities can do much to promote and encourage improvement in these matters. It is suggested that the universities might expand and improve their general tests, so as to make these correspond with the education, both literary and scientific, which a student, matriculating at the age of nineteen years, should be expected to have acquired. Commenting on these communications from the Royal Society, Prof. Case, in a letter to the *Times*, remarks "that the real contention is that while Greek is not, 'science' is, an essential part of general education." But as his letter shows, Prof. Case means by "science" some single subject such as mechanics, whereas the Royal Society is pleading for instruction in the methods of science. It may fairly be asserted that no general education can be complete in which scientific method takes no part; yet, in the past, there has been a compulsory examination in Greek and none in science. Though men of science do not ask for compulsory examinations in single subjects of science, nor advocate these as essential parts of the school curriculum, yet they urge strongly that the spirit of scientific observation and inquiry should be fostered because it promotes both the material and the intellectual progress of the nation.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 18, 1903. (Received in revised form January, 1904.)—"The Longitudinal Stability of Aërial Gliders." By G. H. **Bryan**, Sc.D., F.R.S., and W. E. **Williams**, B.Sc., University College of North Wales.

The object of the investigations was (1) to show that the longitudinal stability of aëroplane systems *can* be made the subject of mathematical calculation; (2) to direct the attention of those interested in the problem of artificial flight to the necessity of acquiring further experimental knowledge concerning the quantities on which this stability is shown to depend.

The conclusions reached were as follows:—

(1) For a glider or other body moving in a vertical plane in a resisting medium of any kind whatever, the small oscillations about a state of uniform rectilinear motion are determined by an equation of the fourth degree, so that the conditions for stable steady motion are those obtained by Routh.

(2) The coefficients in the period equation involve, in addition to the ordinary dynamical constants, nine quantities $X_u \ldots G^q$, which, when referred to rectangular axes fixed in the body, represent the differential coefficients of the forces and couple due to the aërial resistances with respect to its translatory and rotatory velocity components.

(3) In the case of a system of aëroplanes these nine quantities can be expressed for the separate planes in terms of $f'(\alpha)$ and $\phi'(\alpha)$, where $f(\alpha)$ and $\phi(\alpha)$ are functions determining the resultant thrust, and the position of the centre of pressure when the direction of the relative motion of the air makes an angle α with the plane. These functions have been tabulated for certain different forms of surfaces, but further data are greatly needed.

(4) *The longitudinal stability of the gliders is thus seen to be capable of mathematical investigation*, and it is of paramount importance that the present methods should be practically applied to any aërial machines that may be designed or constructed before any actual glides are attempted.

(5) The methods of calculation are exemplified by numerical determinations of the criterion of stability in the cases of a single plane lamina, and a pair of planes one behind the other. Most of the calculations have been performed for an angle of gliding of 10° with the horizon, and it has been necessary to assume arbitrary values for the moment of inertia of the lamina.

(6) The condition that any steady linear motion may be stable in all these cases assumes the form $V^2 > ka$, where a is a constant depending on the linear dimensions of the glider, and k is a constant depending on its shape, the angle of gliding and the law of aërial resistance.

(7) For a pair of narrow slats, in which the variations in the positions of the centres of pressure of each are neglected, certain coefficients of stability vanish if the slats are in the same plane. If the planes are square so that the displacements of the centres of pressure are not neglected, the system is in general less stable than a single square plane.

(8) By inclining the planes at a small angle to each other the stability is much increased. On the other hand, if they are made to slope away from each other, the glider becomes unstable.

(9) Two square planes of equal size placed one behind the other at a small angle are less stable in the examples considered than a square of the same size as one of the two, but more stable than a single square the side of which is equal to the total length of the glider formed by the pair.

(10) A pair of unequal squares of which the smaller forms a rudder are more stable, in the examples considered, when gliding with the rudder behind than with the rudder in front.

(11) In the examples considered stability is increased by decreasing the moment of inertia of the glider.

February 4.—"Cultural Experiments with 'Biologic Forms' of the Erysiphaceæ." By Ernest S. **Salmon**, F.L.S. Communicated by Prof. H. Marshall Ward, F.R.S.

The author points out that through specialisation of parasitism "biologic forms" have been evolved in the Erysiphaceæ, and that the powers of infection, characteristic of each "biologic form," are under normal conditions sharply defined and fixed. Hitherto the result of the experiments of numerous investigators—both with regard to the present group of fungi and to the Uredineæ, where the same specialisation of parasitism occurs—has been the accumulation of evidence tending to emphasise the immutability of "biologic forms."

In a series of cultural experiments with "biologic forms" of *Erysiphe Graminis*, DC., the author has discovered that under certain methods of culture, in which the vitality of the host-leaf is interfered with, the restricted powers of infection, characteristic of "biologic forms," break down.

In these cultural experiments the leaf, previous to inoculation, was injured by the removal of a minute piece of leaf-tissue, or by touching the epidermis with a red-hot knife. The experiments proved that the range of infection of a "biologic form" becomes increased when the vitality of a leaf is affected by injury, so that the conidia of certain "biologic forms" are able to infect injured leaves of host-species which are normally immune against their attacks.

Further experiments showed that the conidia of the fungus produced on a "cut" leaf are able at once to infect uninjured leaves of the same host-species.

The author suggests that injuries to leaves, caused in nature by hail, storms of wind, attacks of animals, &c., may produce the same effect as the artificial injuries described above in rendering the injured leaf susceptible to a fungus otherwise unable to infect it.

Attention is directed to the close parallel between the behaviour of the fungus in the experiments and the biological facts obtaining in the class of parasitic fungi known as "wound parasites" (Nectria, *Peziza willkommii*, &c.).

"On the Effects of Joining the Cervical Sympathetic Nerve with the Chorda Tympani," By J. N. **Langley**, F.R.S., and H. K. **Anderson**, M.D.

The experiments have been directed to determine whether the cervical sympathetic, if allowed an opportunity of becoming connected with the peripheral nerve cells in the course of the chorda tympani, will in part change their function from vaso-constrictor to vaso-dilator. The superior cervical ganglion in an anæsthetised cat was excised and the central end of the cervical sympathetic nerve was joined to the peripheral end of the lingual, which contains the chorda tympani fibres. After allowing time for union and regeneration of the nerves, the cervical sympathetic was stimulated; it caused prompt flushing of the sub-maxillary glands, and the effect was repeatedly obtained.

The experiment shows (1) that vaso-constrictor nerve fibres are capable of making connection with peripheral vaso-dilator nerve cells, and becoming vaso-dilator fibres, and (2) that whether contraction or inhibition of the un-

striated muscle of the arteries occurs on nerve stimulation depends upon the mode of nerve-ending of the post-ganglionic nerve fibre.

The cervical sympathetic gave a less scanty and more prolonged secretion than normal, so that some of its nerve fibres had become connected with the peripheral secretory nerve cells of the chorda tympani.

Geological Society, January 20.—Sir Archibald Geikie, Sec.R.S., vice-president, in the chair.—On the jaws of Ptychodus from the Chalk: Dr. A. Smith **Woodward**, F.R.S. Hitherto no traces of the cartilaginous jaws of this fish have been found in association with the dentition, but recently a specimen of *Ptychodus decurrens* has been found in the zone of *Holaster subglobosus* of the Lower Chalk at Glynde. Fragmentary remains of both jaws are seen in the specimen, each bearing characteristic teeth arranged in natural order. There are four series, and one small displaced tooth (probably belonging to the fifth series), on the left of the large median series in the lower jaw, while in the upper jaw the teeth are arranged in six paired series. The specimen proves that Ptychodus resembles the Trygonidæ in its jaws. The probable explanation of the new discovery is that in the Cretaceous period the great rays of the "families" Myliobatidæ and Trygonidæ had not become fully differentiated. Prof. Jækel has proposed to place all these fishes in one family, termed Centrobatidæ. If this arrangement be adopted, Ptychodus represents a primitive subfamily, which still awaits definition, while the Trygoninæ, Myliobatinæ, and Ceratopterinæ are equivalent subfamilies which still survive. —On the igneous rocks at Spring Cove, near Weston-super-Mare: W. S. **Boulton.** A traverse from end to end of the exposure at the locality shows that the "basalt-mass" is by no means a simple lava-flow. It may be roughly divided into three portions. Beginning at the cliff-end to the north, the rock is a pillowy basalt, with tuff and limestone; then the rock is mainly a coarse "agglomerate," with lapilli and bombs of basalt and limestone; while the remaining part is a basalt-coulée, with few small lumps of burnt limestone. The limestone below is reddened and altered, and does not contain lapilli; the limestone above contains lapilli. The pillowy basalt probably represents a river of agglomeratic material possibly ejected from a vent. The intervening tuff may present an analogy with the "volcanic sand" of the West Indian eruptions. There is no evidence of the quiet deposition of ashy material. The large fragments of limestone found mainly in the lower part of the basalt-mass have not come in from above, but seem to have been picked up from the sea-bed in which it had been accumulating, and to have been involved with and altered by the volcanic material.

February 3.—Sir Archibald Geikie, Sec.R.S., vice-president, in the chair.—On a deep-sea deposit from an artesian boring at Kilacheri, near Madras: Prof. H. Narayana **Rau.** The boring, after penetrating the upper clays and sandstones, passed through carbonaceous shales, and at a depth of about 400 feet reached a blue homogeneous rock, effervescing with acid, and showing radiolarian tests under the microscope. One or two specimens of foraminifera have also been seen. The deposit underlies beds of the Upper Gondwána stage. The author concludes that the deposit is of abysmal origin, similar to those described in the *Challenger* reports. In the discussion that followed Dr. W. T. Blanford said that he was unable to agree with the author's conclusions, and he objected to the title of the paper, because the rocks described were, in his opinion, not deep-sea deposits. The mineral evidence brought forward was quite insufficient to show that the beds were oceanic, and the presence of radiolaria was no proof by itself of deep-sea conditions.—The Rhætic beds of the South Wales direct line: Prof. S. H. **Reynolds** and A. **Vaughan.** After a reference to the literature of the subject the following exposures are described—the Stoke-Gifford and the Lilliput or Chipping-Sodbury sections.

Entomological Society, February 3.—Prof. E. B. Poulton, **F.R.S., president, in the chair.—Mr. A. J. Chitty** exhibited two specimens of *Ptinus tectus*, Boisd., taken by him in a granary in Holborn in the winter of 1892–3, also a complete series of the red Apions to show *A. sanguineum* from the late Frederick Smith's collection.—Mr. O. E. **Janson** exhibited specimens of *Papilio weiskei*, Ribbe, and *Troides meridionalis*, Rothschild, recently taken by Mr. A. S. Meek near the Aroa River in the interior of British New Guinea. —Mr. E. C. **Bedwell** exhibited the following species of Coleoptera taken by him in north Wales (on Snowdon) in the first week of August, 1903:—a fine series of *Chrysomela cerealis*, L., a pair of them being of the curiously dull form, *Anthophagus alpinus*, Payk., *Acidota crenata*, F., *Arpedium brachypterum*, Grav.; and *Quedius longicornis*, Kr., hitherto unrecorded from the Principality.—The Rev. F. D. **Morice** exhibited a series of lantern slides illustrating the structure of concealed ventral segments in males of the hymenopterous genus Colletes.—Mr. W. J. **Kaye** exhibited a Müllerian association of black and transparent species from the Potaro Road, British Guiana, consisting of Ithomiinæ, *Ithomia zarepha*, *Ithomia florula*, *Heterosais sylphis*, and Napeogenes, n.sp., Erycinidæ, *Stalachtis phaedusa*, and *Stalachtis evelina*, Hypsidæ, *Lauron partita*, Geometridæ, Hyrmina, n.sp. The whole of the specimens had been caught on one single forest road, some 170 miles inland. Mr. Kaye directed particular attention to the new species of Napeogenes, and said it was a most remarkable divergence from the usual coloration of the genus Napeogenes as a whole, where orange-yellow and black were the prevailing colours, while the present insect was black and transparent only, and conformed in a wonderful way with many true members of the genus Ithomia.—The **President** exhibited a male and female of *Papilio dardanus*, captured by Mr. Geo. F. Leigh at Durban in 1902, and examples of the offspring reared from the eggs laid by the female. The latter was of the *cenea* form, as were the great majority of the female offspring; three, however, were of the black and white *hippocoon* form. More recently, in 1903, Mr. Leigh had captured a female of the rare *trophonius* form, and had bred from the seven eggs laid by it five butterflies, of which the two females were both of the commonest *cenea* form. The female *trophonius* was also exhibited, together with the five offspring.—Captain C. E. **Williams** read a paper on the life-history and habits of *Gongylus gongyloides*, a mantis of the tribe Erupasides and a floral simulator, and exhibited a living ♀ in the nymph stage, together with coloured drawings, photographs, and lantern slides showing both the adult and immature insect in various positions. The chief features of interest in the exhibitions lay in the peculiar modifications of shape and colouring by which this mantis conceals itself and attacks its prey, which consists of Lepidoptera and Diptera.—Mr. G. A. J. Rothney communicated descriptions of new species of Cryptinæ from the Khasia Hills, Assam, and a new species of Bembex, by Peter **Cameron.**—Mr. M. **Burr** contributed systematic observations upon the Dermatoptera.—Dr. T. A. **Chapman** read a paper on a new species of Heterogynis, and exhibited specimens of this and other allied species.—Mr. R. **Trimen,** F.R.S., read a paper on some new or imperfectly known forms of South African butterflies, and exhibited, among other specimens, illustrating his remarks, typical and aberrational forms of *Acraea rahira*, *Zeritis felthami*, a new species, *Z. molome*, Trim., and *Z. damarensis*, Trim.; typical *Colias electra*, Linn., from Natal, and a remarkable melanic aberration of the same species; also *Kedestas tucusa*, a very rare and unfigured Hesperiid ♀ and ♂ from Johannesburg.

PARIS.

Academy of Sciences, February 15.—M. Mascart in the chair.—The president announced to the academy the death of M. Callandreau, member of the section of astronomy. —On the simple fundamental solution and the asymptotic expression of temperature in the problem of cooling: J. **Boussinesq.**—The action of reduced nickel in the presence of hydrogen on halogen derivatives of the fatty series: Paul **Sabatier** and Alph. **Mailhe.** It has been shown in a previous paper that in the aromatic series the halogen may be readily replaced by hydrogen by the action of reduced nickel. In the fatty series the action is quite different; the saturated hydrocarbon is not produced, but the alkyl chloride is broken up into hydrochloric acid and the corresponding olefine, these partially recombining, giving secondary and tertiary chlorides where possible. Methyl

chloride behaves in an exceptional manner, giving hydrochloric acid, hydrogen, and carbon. The behaviour of bromine and iodine derivatives is generally similar to that of the chlorine compounds, methyl iodide being exceptional, giving methane and a little ethylene.—On quasi-rational numbers, and ordinary or continued quasi-periodic arithmetical fractions: Edmond **Maillet.**—On the actinium radiation: A. **Debierne.** A detailed study of the law of disappearance of the emanation of actinium, and also of the decrease of radio-activity induced by this emanation.—The phenomenon of the transmission of the *n*-rays and its applications: Augustin **Charpentier.**—A description of a series of experiments on the conduction of the *n*-rays along copper and silver wires. A piece of string, moistened with collodion containing calcium sulphide in suspension, also conducts like a metallic wire.—On the conditions of the indifferent state: E. **Ariès.**—On the influence of complex ions in electrolysis by alternating currents: André **Brochet** and Joseph **Petit.** With alternating currents there may be the formation of complex ions, disengagement of detonating gas, solution of the electrodes, or oxidation or reduction in cases where the electrolyte is capable of oxidation or reduction.—On γ-chloroacetoacetic ester: M. **Lespieau.** This substance has been previously only obtained mixed with an isomer; by the oxidation of

$$CH_2Cl.CH(OH).CH_2.CO_2C_2H_5$$

by a mixture of potassium bichromate and dilute sulphuric acid which furnishes the ketonic ester in a pure state. It is characterised by its copper salt, which is insoluble in water, but can be crystallised from benzene.—On dichloromethylenedioxypropylbenzene and the carbonate of propylpyrocatechin: R. **Delange.** The halogen compound is obtained by the interaction of phosphorus pentachloride and dihydrosafrol, and is separated by distillation in a vacuum. It enters very readily into reactions, details of those with water, alcohol, phenol, acetic anhydride, and acetic acid being given.—On the glyoxylic ureides: allantoin and allantoic acid: L. J. **Simon.**—Some observations in the composition of potato starch: A. **Fernbach.** Phosphoric acid is an integral constituent of starch grains. Potato starch was separated by levigation into several fractions, corresponding to grains of varying size, and the amount of phosphate in each fraction determined. From the analytical figures thus obtained the conclusion is drawn that the nucleus of each grain is relatively rich in phosphorus, and upon this are gradually superposed layers of starch free from phosphorus.—On a new copal resin and kino, the first furnished by the fruit, the second by the bark of *Dipteryx odorata*: Edouard **Heckel** and Fr. **Schlagdenhauffen.**—Varieties of origin, nature and properties of the soluble active products developed in the course of a bacterial infection: A. **Charrin.**

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 25.

ROYAL SOCIETY, at 4.30.—Electromotive Phenomena in Mammalian Non-medullated Nerve: Dr. N. H. Alcock.—Further Observations on the *Rôle* of the Blood-Fluids in connection with Phagocytosis: Dr. A. E. Wright and Capt. S. R. Douglas.—On Mechanical and Electrical Response in Plants: Prof. J. C. Bose.—On the Compressibility of Solids: J. Y. Buchanan, F.R.S.—A Contribution to the Pharmacology of Indian Cobra-venom: Major R. H. Elliot.

ROYAL INSTITUTION, at 5.—Electrical Methods of Measuring Temperature: Prof. H. L. Callendar, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Transatlantic Engineering Schools and Engineering: Dr. R. M. Walmsley. (Adjourned Discussion.)

FRIDAY, FEBRUARY 26.

ROYAL INSTITUTION, at 9.—New Developments in Electric Railways: Alex. Siemens.

PHYSICAL SOCIETY, at 5.—A New Dilatometer: B. Bonniksen.—A Quartz-thread Vertical Force Magnetograph: Dr. W. Watson, F.R.S.—On Stresses in a Magneto-static Field: G. W. Walker.—Some Hints on the Preparation of Diagrams: Dr. W. Watson, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Boiler-house Design: L. G. Crawford.

SATURDAY, FEBRUARY 27.

ROYAL INSTITUTION, at 3.—The Life and Work of Stokes: Lord Rayleigh.

ESSEX FIELD CLUB, at 6.30 (at the Essex Museum of Natural History, Stratford).—A Disappearing Industry; Charcoal Burning in Essex: T. S. Dymond.—Recent Observations and Discoveries concerning London City Walls, the Walbrook and Moorfields: F. W. Reader

MONDAY, FEBRUARY 29.

SOCIETY OF ARTS, at 8.—Modern Book Printing: Charles T. Jacobi. (Cantor Lecture, II).

INSTITUTE OF ACTUARIES, at 5.—An Investigation into the Rates of Re-Marriage and Mortality amongst Widows in Receipt of Relief from the Patriotic (Russian War) Fund, 1854–1900: J. Burn and J. McDonald.

TUESDAY, MARCH 1.

ROYAL INSTITUTION, at 5.—Japanese Life and Character: E. Foxwell.

SOCIETY OF ARTS, at 4.30.—Nigeria: Lady Lugard (Miss Flora L. Shaw).

ZOOLOGICAL SOCIETY, at 8.30.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Papers to be further discussed*: The Construction of Railway-Wagons in Steel: J. D. Twinberrow.—The Construction of Iron and Steel Railway-Wagons: A. L. Shackleford.—Iron and Steel Railway-Wagons of High Capacity: J. T. Jepson.

WEDNESDAY, MARCH 2.

SOCIETY OF ARTS, at 8.—Physical Degeneration: Dr. Robert Jones.

ENTOMOLOGICAL SOCIETY, at 8.—Notes on Australian and Tasmanian Cryptocephalides, with descriptions of New Species: A. M. Lea.—A Revision of the Sub-family Pelidnotinæ of the Coleopterous family Rutelidæ, with descriptions of New Genera and Species: the late Frederick Bates, communicated by G. J. Arrow.—On some New Species of Eastern Australian and African Moths in the British Museum: Colonel C. Swinhoe.—An Entomological Excursion to Moncayo, Spain: G. C. Champion; with some Remarks on the Habits of *Xyleborus dispar.*, Fabr.: Dr. T. A. Chapman: Further Notes on Hydroptilidæ belonging to the European Fauna, with descriptions of New Species: K. J. Morton.—*Discussion*: What is a Species? Prof. E. B. Poulton, F.R.S., Mr. H. J. Elwes, F.R.S., Dr. F. A. Dixey and others.

THURSDAY, MARCH 3.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: An Inquiry into the Nature of the Relationship between Sunspot Frequency and Terrestrial Magnetism: Dr. C. Chree, F.R.S.—The Optical Properties of Vitreous Silica: J. W. Gifford and W. A. Shenstone, F.R.S.—A Radial Area Scale: R. W. K. Edwards.—The Origin of the Flutings in the Spectra of Antarian Stars: A. Fowler.

ROYAL INSTITUTION, at 5.—Electrical Methods of Measuring Temperature: Prof. H. L. Callendar, F.R.S.

RÖNTGEN SOCIETY, at 8.30.—Presidential Address: Some Laboratory Notes of the last Six Months.

LINNEAN SOCIETY, at 8.—List of the Species of Carex known to occur in Malaya: C. B. Clarke, F.R.S.—On some Species of the Genus Palæmon, Fabr., from Tahiti, Shanghai, New Guinea, and West Africa: Dr. J. G. de Man.

CHEMICAL SOCIETY, at 8.—Chemical Dynamics of the Alkyl Iodides: Miss K. A. Burke and F. G. Donnan: The Constitution of Phenolphthalein: A. G. Green and A. G. Perkin.—δ-Ketohexahydrobenzoic Acid: W. H. Perkin, junr.—Photochemically active Chlorine: C. H. Burgess and D. L. Chapman.

FRIDAY, MARCH 4.

ROYAL INSTITUTION, at 9.—Breathing in Living Things: Prof. W. Stirling.

SATURDAY, MARCH 5.

ROYAL INSTITUTION, at 3.—The Life and Work of Stokes: Lord Rayleigh.

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