rigorously the analogous theorems, so far as they exist, for the homogeneous linear differential equations of the second order. The article closes with some applications.—Space of constant curvature, by F. S. Woods, is an attempt to present Riemann's ideas (*cf.* the "Ueber die Hypothesen, welche der Geometrie zu Grunde liegen") in an elementary form. The paper is given in part and is useful, in addition to the results worked out, for its bibliographical references.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 23.—"The Affinity of Tmesipteris with the Sphenophyllales." By A. P. W. Thomas, M.A., F.L.S., University College, Auckland, New Zealand.

In the present paper the author deals with the nature of the synangium of Tmesipteris, as based on the study of variations observed in the sporophyll, beyond the limits already recorded by Bower.

The term "sporophyll" is used to denote the whole fertile structure, the term "synangium" restricted to the sporangiophore. Three types of variation are recorded, viz. (1) that of repeated dichotomy of the sporophyll with two to three synangia; (2) that in which the synangium is raised upon a pedicel or stalk; (3) that in which the synangium is replaced by a leaf-lobe of normal appearance. It is shown that abnormality in the sporophylls and synangia, which commonly occurs at the beginnings or ends of the fertile zones, is not found in cases where the sporophyll shows excessive leaf development. In these it occurs rather towards the middle region, and it is inferred that if the nutritive conditions remained equally satisfactory throughout, the whole sporophyll series should show repeated dichotomy.

Concerning the second type of variation, the synangium is found to have become so revolved upon a transverse axis that its longitudinal groove faces outwards between the leaf-lobes, assuming a position the more favourable to dispersal of the spores. In the third type the leaf is shown to be forked, although the synangium, if present at all, exists only in an abortive form. From the fuller study of this, the author suggests that the synangium is the morphological equivalent of a ventral leaf-lobe.

Passing to questions of classification, the author refers to the difficulties in reconciling the sporangium-bearing structures of the Psilotæ with those of the typical Lycopodinæ. He enters into a comparison with the extinct Sphenophyllales, with especial reference to Bowmanites and Cheirostrobus, and concludes that the relationships of Tmesipteris and Psilotum with this group are perhaps even closer than is supposed by Scott.

In an addendum, received since this paper was announced, the author makes good his desire to deal extensively with the Psilotum sporophyll, the leaves of which, though greatly reduced and xerophytic, are shown to be essentially similar to those of Tmesipteris.

Society for Psychical Research, January 31.—Dr. Oliver Lodge, F.R.S., delivered his presidential address. Dealing first with the phenomena of trance, lucidity and clairvoyance, he expressed the opinion that much more information was required before we could even formulate the problems raised by these faculties. With regard to physical phenomena, he thought much of the extra difficulty of accepting evidence for unusual phenomena was due to the *a priori* notion that such occurrences are contrary to natural law. We cannot, however, clearly tell that they are contrary to natural law; they are only contrary to and supplementary to our usual experience. The objection of science to psychical research is mainly due to the fact that it regards psychical phenomena as unintelligible. It is accustomed to simplify its problems by the method of abstraction and has got into the habit of thinking that it actually excludes disturbing causes; the abstraction cannot really exclude from the universe anything apparently disorderly. Theoretically, this is universally admitted; practically science has excluded psychical phenomena from its experimental area. He was not prepared to say that physical phenomena such as materialisations, the passage of matter through matter, and levitation were impossible and absurd, so that no testimony ought to produce any effect on our incredulity. Extreme caution was necessary and full control must be allowed to the observers. His personal belief was that man survived death, and this belief had been produced by scientific evidence. He did not attribute the physical phenomena of spiritualism to the agency of the departed, but was disposed to regard trance utterances as in some cases due to telepathic communication with some unconscious stratum of a departed person.

Royal Microscopical Society, January 15.—Mr. Wm. Carruthers, F.R.S., president, in the chair.—This being the annual meeting of the Society, the president gave an address on the scientific work of Nehemiah Grew, from 1641–1712, whom he defended from the charges of plagiarism which had been brought against him in respect to his discoveries as to plant structure.—Mr. E. A. Parsons gave an exhibition of malaria parasites under a number of microscopes, lent for the occasion by Messrs. Chas. Baker.—Messrs. Ross exhibited their new form of standard microscope, designed specially for the use of medical students, fitted with a new form of fine adjustment. Messrs. Ross also exhibited a simple lens for dark ground illumination. It consists of a meniscus lens bored through its centre to receive a spot made of vulcanite provided with a stem to drop into the hole in the centre of the lens.

Geological Society, January 22.—Mr. J. J. H. Teall, V.P.R.S., president, in the chair.—The fossiliferous Silurian beds and associated igneous rocks of the Clogher Head district (county Kerry), by Prof. S. H. Reynolds and Mr. C. I. Gardiner. The authors give a detailed description of the coast from Dunquin past Clogher Head to Coosglass (south of Sybil Point), and of the western side of Smerwick Harbour. They next deal with the inland exposures, which are not very frequent, but include considerable rock-masses at Croaghmarhin and Minaunmore Rock. The rocks consist of sandstones, slates, calcareous flags, ashes and ashy conglomerates, rhyolitic lava-flows and various intrusive rocks. The general structure is an S-shaped fold, inverted towards the north so that the dip of the beds is approximately south-easterly, and the oldest beds occur to the north, at Coosglass. Both anticline and syncline are faulted, and a patch of Old Red Sandstone is caught in under the synclinal thrust at Coosmore. Fossils, mainly corals, brachiopods, lamellibranchs and gasteropods are fairly abundant; but trilobites are rare and graptolites absent. The whole of the fossiliferous rocks are of Silurian age; the majority of those exposed on the coast are of Wenlock or Wenlock-Llandovery age, while the majority of those exposed inland are of Ludlow age.—A process for the mineral analysis of rocks, by Prof. W. J. Sollas, F.R.S. The method proposed is to obtain a quantitative estimation of the mineral composition of a rock, and from the known composition of the minerals to calculate the percentage-composition of the rock. The specific gravities of the minerals are first determined by means of a diffusion-column of methylene-iodide and beads of known specific gravity, and the presence or absence of particular minerals settled for a certainty. Next, the separation of the minerals in a weighed quantity of the powdered rock is undertaken by means of a special separator, the method being illustrated by the example of a rock containing orthoclase (sp. gr. 2·56), quartz (2·65), andesine (2·67), biotite (3·1), pyroxene (3·3) and magnetite. The first separation would be with a liquid of sp. gr. 2·885, the mean of that of andesine and biotite; the next with a liquid of sp. gr. 2·66; the next 2·605, and so on for the other constituents. The separated minerals are dried and weighed, the loss distributed, and the analysis checked by comparing the specific gravity of the rock in bulk with that calculated from the specific gravity and proportion by weight of its constituents.

DUBLIN.

Royal Irish Academy, January 13.—Prof. R. Atkinson, president, in the chair.—Prof. T. Johnson communicated, on behalf of the fauna and flora committee of the Royal Irish Academy, a paper by Mr. W. West and Prof. G. S. West entitled "A Contribution to the Freshwater Algæ of the North of Ireland." This paper gives the results of the examination of material collected by the authors in 1900 and 1901 in Lough Neagh and district, and in co. Donegal. 139 genera, 604 species and 106 varieties are recorded. Of these some twelve, described and illustrated, have been hitherto unknown, twenty-four others are new to the British Isles, many others new to Ireland, and the distribution of yet others, recorded by the late Mr. W. Archer, F.R.S., and Rev. E. O'Meara, is largely

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extended. The paper is illustrated by some ninety figures. Three desmids, *Micrasterias furcata*, Ag., *Staurastrum Arctiscon* (Ehrenb.), Lund., and *Staurastrum longispinum* (Bail.), Arch., are of particular interest in that they appear to be confined to the western shores of the British Isles—being known only as occurring in the small lakes in the hilly districts of Connemara and Donegal in Ireland, the lakes of the Snowdon range in North Wales, and from similar situations in the extreme north-west of Scotland. No species of Vaucheria were found, and *Botrydium granulatum* is recorded for the first time in Ireland.

Royal Dublin Society, December 18, 1901.—Dr. W. E. Adeney in the chair.—Sir Howard Grubb, F.R.S., on some new forms of geodetical instruments. The author applies the principle he recently described (*Scientific Transactions*, Royal Dublin Society, vol. vii. p. 321) for gun sights for large and small ordance to various forms of geodetical instruments.—Prof. J. Joly, F.R.S., on sedimentation experiments and theories. The rates of settlement of suspensions consisting of 5 grammes of finely powdered solid in 12 c.c. of water containing ions in various degrees of concentration, indicate that above a certain concentration the rate of fall of the surface of the suspension is fairly independent of the degree of concentration. Below certain concentrations (about five times greater for monad positive ions than for diad) a distinct surface to the descending suspension fails, and the sediment is only seen to collect from the bottom of the vessel upwards. A suspension precipitated at a concentration so low as to be near the point of failure to show surface will, if re-shaken, not again precipitate with a distinct surface. On removing the electrolyte from such an "exhausted" suspension after it has stood sufficiently long to settle, it is found that the liquid is as effective as at first in producing surface if a fresh sample of the powder is used. On the other hand, the original powder will not again show surface when treated with fresh electrolyte of the same strength, but it will require a much more concentrated electrolyte to do so. The failure is therefore to be traced to some alteration in the solid particles. On testing the fresh powder it is found that this is negative towards distilled water; the used powder is apparently quite neutral towards its salt solution. An explanation of sedimentation is advanced, based on the low specific inductive capacity of the solid particle compared with the specific inductive capacity of the water, the charges on the ions being assumed to exert an expulsive action consequent on the increased energy required to establish the electric field in the medium of low specific inductive capacity. In other words, the solid particles have a de-ionising influence, and experience a reaction in consequence, which will tend to retain in juxtaposition particles which from any cause are once approximated. A principal cause of aggregation upon first precipitation is to be ascribed to the negative sign of the particles leading to motions, all in the end favourable to aggregation, seeing that the state of aggregation is alone stable in the medium. On second disturbance the particles are neutral, and aggregates are not formed with sufficient rapidity to lead to a general and simultaneous descent of the suspension.—Lord Rosse, K.P., F.R.S., exhibited working models of apparatus for turning aside leaves in the water supply of a turbine.—Sir Howard Grubb exhibited the cœlostat constructed for the Royal Dublin Society and used at the solar eclipse of 1900.

January 22.—Prof. W. F. Barrett, F.R.S., in the chair.—Mr. W. E. Wilson, F.R.S., on the nebulæ surrounding Nova Persei.—Prof. Barrett, Mr. W. Brown and Mr. R. A. Hadfield, on researches on the electric properties of an extensive series of alloys of iron.—Mr. Richard J. Moss, on an improved volumetric method for the determination of sugar. In Pavy's modification of Fehling's method, cupric oxide is reduced in presence of a a large excess of ammonia, which prevents the precipitation of cuprous oxide. The temperature of the boiling liquid varies from about 70° C. to 90° C., and the rate of reduction varies to a corresponding extent. The author overcomes this objection to the method by using a much smaller quantity of ammonia, and conducting the titration under pressure, at the temperature of boiling water. The reduction of the cupric oxide is apparently instantaneous, and the results are very sharp and constant.

PARIS.

Academy of Sciences, February 3.—M. Bouquet de la Grye in the chair.—On a new synthesis of formic acid, by M. Henri Moissan. Potassium hydride absorbs carbonic acid at the ordinary temperatures producing potassium formate. The formation of formic acid was confirmed by the production of the free acid, which showed the ordinary reducing properties, and by the preparation and analysis of the crystallised lead salt. Carbon monoxide also reacts with potassium hydride at 150° C., potassium formate being formed and carbon set free.—On certain cases of adherence of a viscous liquid to the solid with which it is in contact, by M. P. Duhem.—New observations on the folds of the phosphatic chalk in the Somme, by M. J. Gosselet. The strongly inclined layers of phosphatic chalk discovered at Étaves in 1896 might have been looked upon as a local accident, but the same facts have now been noticed at Hargicourt, and at two places at a much greater distance, Éclusier, between Peronne and Albert, and at Crécy in Ponthieu. These layers are small, but are too widely extended to be the result of a purely local accident. The facts observed confirm the views of M. Marcel Bertrand on the slow and progressive formation of the folds of a geological basin.—Remarks by M. Albert Gaudry on presenting to the Academy a work on the comparison of the teeth of man and the anthropomorphic apes.—M. Alfred Picard was elected a free member in the place of the late M. de Jonquières.—Observations of the sun made at the Observatory of Lyons with the Brunner 16 cm. equatorial during the second quarter of 1901, by M. J. Guillaume. Tables are given showing the number of spots, their distribution in latitude and the distribution of the faculæ in latitude.—Researches on the Hertzian waves emanating from the sun, by M. Charles Nordmann. The experiments described were carried out at the Grand-Mulets on Mt. Blanc, the weather conditions being too unfavourable to utilise the observatory at the summit. The conclusions drawn from the experiments are that the sun does not emit electric radiations capable of affecting radioconductors, or that, if they are given off, they are completely absorbed by its atmosphere or by the upper portions of the terrestrial atmosphere.—Some remarks on entire functions, by M. Edmond Maillet.—The variation of the electromotive force and the temperature coefficient of the Daniell cell with the concentration of the zinc sulphate solution, by M. J. Chaudier. Starting with a saturated solution, the electromotive force of a Daniell cell increases when the concentration of the zinc sulphate diminishes, passes through a maximum for a ½ per cent. solution, and then again decreases for smaller concentrations. The temperature coefficient, which at first is negative, increases and becomes zero at a concentration of between 7 and 8 per cent.; but, after having attained a positive maximum, it falls off and vanishes a second time for a ½ per cent. solution. From this it follows that the Daniell cell furnishes a standard of electromotive force which is independent of the temperature when it is made up with a saturated solution of copper sulphate and a 7·5 per cent. or ½ per cent. solution of zinc sulphate.—On the galvanometric observation of distant storms, by M. J. J. Landerer. With the arrangement described the electrical disturbances due to distant storms have been observed up to a distance of 240 kilometres.—Comparison between the properties of hydrogen selenide and those of hydrogen sulphide, by MM. de Forcrand and Fonzes-Diacon. Data for hydrogen sulphide are given in the present paper. The boiling-point at a pressure of 773 mm. was found to be −61° C., and the melting-point −86° C. The density of liquid sulphuretted hydrogen at its boiling-point is 0·86. A comparison with the data previously given for hydrogen selenide shows great analogies between the two compounds. They have practically identical molecular volumes, their boiling-points expressed as fractions of their critical temperatures are the same, and the ratio of latent heat of vaporisation to the boiling-point is also nearly the same for the two gases.—On the action of lithium-ammonium on antimony, and on the properties of the antimonide of lithium, by M. P. Lebeau. Lithium-ammonium reacts upon antimony, giving a compound of the formula $SbLi_3$, identical with that previously obtained by electrolysis. This substance dissolves in liquid ammonia, uniting with it to form the compound $SbLi_3NH_3$. Lithium antimonide is less fusible than either of its constituents, and possesses very energetic reducing properties.—On oxy-isopropyl-hypophosphorous acid, by M. C. Marie.—On the hydrolysis of pyromucic urethane, by M. R. Marquis.—The action of nitric acid upon trichloro- and tribromo-veratrol, by M. H. Cousin. The action of nitric acid upon these substituted veratrols gives rise to mono-nitro-derivatives, the reaction being altogether different from the action of nitric acid upon the tetra-chloro- and tetra-

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bromo-veratrols.—On some derivatives of glutamine, by M. E. Roux. A description of the mode of preparation and properties of various derivatives of glucamine.—The action of aluminium chloride on some anhydrides in chloroform solution, by M. Marcel Desfontaines.—On the opisthobranchs collected in 1883 by the Talisman expedition, by M. A. Vayssière.—The lympho-myeloid constitution of the conjuctive stroma of the testicle of the young in *Raja clavata*, by M. A. Policard.—On the homologies of the interstitial cell of the testicle, by M. P. Stéphan.—On the structure of the tuberculous roots of *Thrincia tuberosa*, by MM. A. Maige and C. L Gatin.—On the *Ksopo* or *Tanghin de Ménabé*, the poison of *Menabea venenata*, by M. E. Perrot.—The chemical study of Flamanville granite, by M. A. Leclère. It is shown from the analyses given that the composition of an eruptive rock may differ very considerably in certain cases from that of the initial magma.—On the transformation of fatty materials into sugars in oleaginous seeds during germination, by M. P. Mazé. The experiments afford confirmation of the view that the digestion of fatty matters in the seed during germination is made with a slow fixation of oxygen, and, probably, with a slight loss of carbon.—Researches on the working of antagonistic muscles in voluntary movements, by M. I. Athanasiu.—Remarks on a note of M. Pizon on a mechanical theory of vision, by M. Raphael Dubois. In reply to the criticism of M. Pizon, the author maintains that his mechanical theory of vision is confirmed, not only by the researches of Deren Stort and Engehlmann, but also by those of Charpentier and d'Arsonval.—The vine and *Coepophagus echinopus*, by M. S. Jourdain. MM. L. Mangin and P. Viala have correlated a certain disease of the vine with the presence of a certain acarian, *C. echinopus*. The author advances reasons for doubting the correctness of this view, and believes that curative measures directed against this acarian will be useless.—A new case of trichosporia observed at Nancy, by M. Paul Vuillemin.—Contribution to the knowledge of the action of lecithine on the typical elements of the blood, by MM. H. Stassano and F. Billon.—The etiology of the cattle plague, by MM. Nicolle and Adil-Bey.—On a fall of rain observed at Périers, by M. Sebillaut. The rain-water from the shower in question was found to contain chalk, sulphates, chlorides and silica, the latter in sufficient quantity to cover the leaves of trees with a siliceous layer.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 13

ROYAL SOCIETY, at 4.30.—On the Sub-Mechanics of the Universe: Prof. O. Reynolds, F.R.S.—On Chemical Dynamics and Statics in Light: Dr. M. Wilderman.—Preliminary Note on a Method of Calculating Solubilities, Equilibrium Constants of Chemical Reactions, and Latent Heat of Vaporisation: Dr. A. Findlay.—The Refractive Indices of Fluorite, Quartz and Calcite: J. W. Gifford.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Researches on the Electrical Conductivity and Magnetic Properties of upwards of 100 different Alloys of Iron: Prof. W. F. Barrett, F.R.S., and W. Brown.—On some Conclusions deduced from the preceding Paper: Prof. W. F. Barrett, F.R.S.

MATHEMATICAL SOCIETY, at 5.30.—(1) On the Density of Linear Sets of Points; (2) On Closed Sets of Points defined as the Limit of a Sequence of Sets of Points: W. H. Young.—On Plane Cubics: Prof. A. C. Dixon.—On Boussinesq's Problem: Prof. H. Lamb, F.R.S.—On the Wave Surface of a Dynamical Medium, Æolotropic in all Respects: Prof. T. J. Bromwich.—On Quantitative Substitutional Analysis (second paper): A. Young.

FRIDAY, FEBRUARY 14.

ROYAL INSTITUTION, at 9.—Magic Squares and other Problems on a Chess Board: Major P. A. MacMahon, F.R.S.

PHYSICAL SOCIETY, at 5.—Annual General Meeting.—Address by the President, Prof. S. P. Thompson, F.R.S.—Mr. T. H. Littlewood will exhibit an Atwood's Machine.

ROYAL ASTRONOMICAL SOCIETY, at 3.—Annual General Meeting.

MALACOLOGICAL SOCIETY, at 8.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Some Public Health Aspects of the Question of Sewage Disposal: C. Johnston.

SATURDAY, FEBRUARY 15.

ROYAL INSTITUTION, at 3.—Some Electrical Developments: Lord Rayleigh, F.R.S.

MONDAY, FEBRUARY 17.

SOCIETY OF ARTS, at 8.—Personal Jewellery from Prehistoric Times: Cyril Davenport.

IMPERIAL INSTITUTE, at 8.30.—The Obstacles to Development in West Africa: Dr. C. F. Harford-Battersby.

VICTORIA INSTITUTE, at 4.30.—The Physical History of the Norwegian Fjords: Prof. Edward Hull, LL.D., F.R.S.

TUESDAY, FEBRUARY 18.

ROYAL INSTITUTION, at 3.—The Cell: its Means of Offence and Defence: Dr. A. Macfadyen.

ZOOLOGICA SOCIETY, at 8.30.—On *Mustela palaeattica* from the Upper Miocene of Pikermi and Samos: Dr. C. I. Forsyth Major.—On Two New Genera of Rodents from Potosi, Bolivia: Oldfield Thomas, F.R.S.—On some Characters distinguishing the Young of various Species of Polypterus: G. A. Boulenger, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Electrical Traction on Railways: W. M. Mordey and B. M. Jenkin.

ROYAL STATISTICAL SOCIETY, at 5.—A Statistical Review of the Income and Wealth of British India: J. Atkinson.

WEDNESDAY, FEBRUARY 19.

SOCIETY OF ARTS, at 8.—The Use of Balloons in War: E. H. S. Bruce.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Report on the Phenological Observations for 1901: E. Mawley.—La Lune mange les Nuages—a Note on the Thermal Relations of Floating Clouds: W. N. Shaw, F.R.S.

CHEMICAL SOCIETY, at 5.30.—Enzyme Action: A. J. Brown.—On the Velocity of Hydrolysis of Starch by Diastase, with some Remarks on Enzyme Action: H. T. Brown and T. A. Glendinning.—Polymerisation Products from Diazoacetic Ester: O. Silberrad.—Condensation of Phenols with Esters of Unsaturated Acids, Part VII.: S. Ruhemann and H. E. Stapleton.—The Union of Hydrogen and Oxygen: H. B. Baker.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Polarising with the Microscope: E. M. Nelson.

THURSDAY, FEBRUARY 20.

ROYAL SOCIETY, at 4.30.

LINNEAN SOCIETY, at 8.—(1) On some Gasteropoda (*Limnotrochus* and *Chitra*) from Lake Tanganyika, with the Description of a New Genus; (2) On the Nyassa Vivipara and its Relationship to Neothauma: Miss L. Digby.—On the Fruit of *Melocarina bambusoides*, an Exalbuminous Grass: Dr. A. Stapf.—On a West Indian Sea Anemone, *Bunodeopsis globulifera*: Dr. J. E. Duerden.

FRIDAY, FEBRUARY 21.

ROYAL INSTITUTION, at 9.—Musical and Talking Electric Arcs: W. Duddell.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting. Followed by discussion on Modern Machine Methods, with Reply by the Author, H. L. F. Orcutt, and, time permitting, Fencing of Steam- and Gas-Engines: H. D. Marshall.—Fencing or Guarding Machinery used in Textile Factories: S. R. Platt.—Protection of Lift-Shafts, and Safety Devices in connection with Lift-Doors and Controlling Gear: H. C. Walker.—Guarding Machine Tools: W. H. Johnson.

GEOLOGICAL SOCIETY, at 3.—Annual General Meeting.

EPIDEMIOLOGICAL SOCIETY, at 8.30.

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