servation of these bodies, for he and others were of the opinion that these faint shooting stars were at vastly greater distances than those visible to the naked eye, for their slowness of movement and diminutive size suggested such remoteness. While ordinary meteors rarely become visible at a greater height than about 100 miles, these telescopic objects require distances of 1000 to nearly 2000 miles to explain their appearance assuming as standard the ordinary velocity and length of flight of naked-eye meteors. From four objects Mr. Denning inferred heights of 1260 to 1820 miles, and these he states were "only examples of a class and not rarities." The whole question is interestingly summarised in this contribution, and the author describes in detail observations extending over the period 1881 to 1902, and reproduces numerous diagrams of various forms of trails observed.

A NEW PHOTOGRAPHIC CHART OF THE MOON.—In the April number of *L'Astronomie*, M. Camille Flammarion gives an account of the new photographic chart of the moon, which has recently been prepared by M. C. Le Morvan. M. Le Morvan during the last eighteen years has been associated with the production of all the plates for the great atlas of Loewy and Puiseux, and this important and unique collection of clichés, taken with the Paris equatorial coudé, provides him with a rich assortment of material. The object of the work is to provide in a more convenient form as perfect a representation of the lunar surface as is possible in every detail. The plates are reproduced in héliogravure, and are issued in two parts, each part consisting of twenty-four sections, and representing increasing and decreasing phases respectively. The publication of this chart is rendered possible by a grant of 4000 francs out of the Bonaparte funds by the Académie des Sciences. M. Le Morvan communicates also a brief account of the construction of lunar charts.

THE ROYAL SOCIETY CONVERSAZIONE.

THE annual May conversazione of the Royal Society was held on Wednesday, May 13, and was, as usual, largely attended. During the evening demonstrations were given in the meeting-room by Prof. J. P. Hill and Mr. P. Schilowsky. Prof. Hill gave a short account of the work of the Percy Sladen Expedition to Brazil, 1913, illustrated by lantern-slides of material collected and regions visited; and Mr. Schilowsky demonstrated the application of gyroscopes to locomotion on land, on sea, and in air. The gyroscope's stabilising property can be applied to unstable bodies like monorail cars or monotrack automobiles, making them stable; that property can be used for stable but oscillatory bodies like ships, submarines, flying machines, preventing their rolling movement and rendering them perfectly steady. A description of the application of the system to a two-wheeled motor-car appeared in NATURE of May 7 (p. 251). Dr. J. G. Gray exhibited gyrostats with accessories for showing the more obvious properties of the gyrostat, and a series of what may be called "animated" gyrostats. The latter consist of gyrostatic acrobats, bicycle riders, and gyrostatic motor-cars, both two-wheeled and four-wheeled. A two-wheeled car was provided with a gyrostatic "chauffeur," which stabilised the car and presided at the steering wheel. This car illustrated the action of directing and stabilising apparatus for use on torpedoes, airships, and aeroplanes. A further form of two-wheeled car demonstrated methods of stabilising and manœuvring an airship by means of forces derived from the propellers, which apply a direct push to the moving body. Dr. Gray's bicycles and motor-cars can be steered by the wireless transmission of electrical action. There were many other exhibits of objects and devices of scientific interest, and we give descriptions, from the official catalogue, of some of the most interesting grouped according to related subjects.

The Astronomer Royal: Transparencies of the Milky Way (selected from the Franklin-Adams chart). The whole sky was photographed on 206 plates by the late J. Franklin-Adams. The plates have been presented to the Royal Observatory, and the number of stars of different magnitudes from the 12th to the 17th have been determined. There are altogether fifty-five million stars on the plates, and from the sequence of the numbers for different magnitudes it is shown (S. Chapman and P. J. Melotte, Mem. R.A.S., vol. lx.), that the total number of stars in the sky is not less than 1000 millions, and cannot much exceed twice this amount, and that half the stars are brighter than the 23rd or 24th magnitude. *Mr. George H. Cobb:* A terrestrial globe, dated 1620, constructed to serve as a timepiece; supported by a gilt bronze figure of Atlas. Inside the globe is a movement of the verge type, so geared to the axial spindle that the globe revolves once in twenty-four hours.

The National Physical Laboratory (Mr. F. E. Smith): Photographic record of the variations in the horizontal intensity of the earth's magnetic field at the National Physical Laboratory. The record shows the variations in H from 1 p.m. on Saturday, April 19, to 11 a.m. on Sunday, April 20. The time scale (abscissa) is 43 cm. to the hour (7 mm. to the minute), and the intensity scale (ordinate) is 2·5 mm. for a change in H of 1γ (0·00001 c.g.s. unit). The sudden variations are principally due to the earth currents produced by the London United Electric Tramway system. These sudden changes are not in general greater than 5γ. *Mr. W. A. Douglas Rudge:* Electrification produced during the raising of a cloud of dust. During the raising of a cloud of dust by almost any method, considerable charges of electricity are produced. A charge of one sign is found upon the dust itself, and another charge of opposite sign, either upon the air, or else upon fine particles of dust which remain suspended in the air. Generally, dust of an acidic nature, such as silica or molybdic acid, give a negative charge to the air, metallic oxides and organic bases give positive charges to the air.

Dr. J. A. Fleming: An apparatus for the production of stationary vibrations on strings, loaded and unloaded. Various arrangements have been employed for the production of stationary vibrations on strings to illustrate the laws of wave motion. The apparatus exhibited consists of an electric motor having on one end of its shaft a counting mechanism, and on the other a disc to which is fixed a pin carrying the end of a rocking lever This lever has on it a hook to which a string can be attached. The other end of the string is fixed to a slide rest arrangement, by means of which any required tension can be put on the string. When the motor revolves it gives to one end of the string an irrotational motion in a circle and propagates waves along the string. By adjusting the tension these waves can be made stationary. By employing a cotton cord, either single or multiple, in various degrees, it is easy to prove the fundamental laws of wave motion along cords. By using strings loaded with glass beads the effects of reflection at loads, or the laws of vibration of loaded cords, can be shown. *Mr. W. Duddell:* Water model of the electric arc. One of the essential properties of the electric arc is that, when the current through the arc increases, the potential difference between its terminals decreases. The model exhibited consists of a mushroom

valve. The pressure tending to reseat the valve is so arranged that it diminishes very rapidly as the valve lifts. In this way, when the flow of water is increased through the valve, the difference of pressure between its two sides decreases and thus represents one of the properties of the electric arc. When a steady flow is established and a column of water having a definite periodic time is connected to the valve oscillations can be set up similar to those obtained with an electric arc. Other properties of the arc discharge can also be demonstrated.

The Cambridge Scientific Instrument Co.: An aerodynamic balance. Designed for the experimental investigation of the stability of aeroplanes. The main part of the balance consists of three arms mutually at right angles, each arm being counterbalanced. These arms meet in a point at which a steel centre is fixed, and the weight of the balance is taken on this point. The vertical arm passes through the underside of a wind channel and supports the model under test. The horizontal arms are arranged respectively parallel and at right angles to the wind direction. The arrangements allow of the measurement of the forces on the model along three fixed rectangular axes, and also of the three moments about these axes for any angle of incidence of the wind on the model. *Mr. F. W. Aston:* A simple microbalance for the determination of the densities of small quantities of gases. The balance is made entirely of fused quartz, and consists of a beam of the simplest possible construction, bearing at one end a small closed bulb and at the other a solid counterpoise. The whole is supported by a knife edge working on a polished quartz plate. The system is made to balance in air at some convenient pressure, and its sensitiveness made extremely high, turning at about one-millionth of a milligram. The gas is admitted to the balance case and the pressure determined at which it causes the beam to balance in a given position. The corresponding pressure for a gas of known density (*e.g.* oxygen) is then measured, the ratio of the pressures giving the inverse ratio of the densities.

Mr. E. Leitz: A new binocular microscope. The body consists of a flat casing containing the system of prisms. At the upper end are situated two eyepieces the distance apart of which can be regulated to suit the eyes of the observer by means of a milled head which actuates two levers inside the casing. The interpupillary distance can be varied between 54 and 70 mm. The eyepiece tubes slide in guides so that dust cannot enter the prism casing. The left eyepiece tube is provided with an independent adjustment to accommodate eyes of unequal vision. All kinds of eyepieces and objectives may be used, and the instrument can be employed for the same purposes as the ordinary monocular microscope. An important feature in this microscope is the parallel eyepieces which obviate the actions of accommodation and adjustment for convergence as is necessary in binocular microscopes constructed hitherto. *Prof. A. W. Bickerton:* The polyscope. A kaleidoscope rendered so optically perfect that a hundred reflections of a point or object may be seen. The angles of one are 30°. 60°, and 90°; of the other, two angles 45° and one of 90°. They produce two classes of patterns, one suitable for textile fabrics, cretonnes, etc., the other suitable for floor cloths, tiles, etc. *The Polychromide Company (The Dover Sreet Studios, Ltd.):* Instantaneous photographs on paper taken in natural colour by the polychromide system. The optical separation of the natural colour of the object photographed is accomplished by means of the Hamburger-Conrady colour separation camera, which exposes three plates simultaneously—representing the red, yellow, and blue sensations in the superposed positives on gelatino-silver emulsions, which constitute the complete colour records exhibited.

The National Physical Laboratory (Dr. W. Rosenhain and Mr. J. L. Haughton): A new reagent for etching mild steel for microscopic examination. The reagent consists of an acid solution of ferric chloride containing small proportions of chlorides of copper and tin. Iron or steel sections exposed to this solution become covered with a very thin adherent layer of copper by a process of electrochemical substitution. This film of copper is deposited upon and thus darkens the ferrite areas, leaving the pearlite areas white, this effect being the reverse of that obtained with other reagents, such as picric acid.

Prof. E. W. MacBride and Mr. H. G. Newth: Double tadpoles of the frog, and double sea-urchins. The duplicity in the frog larvæ is of varying degree, and was produced experimentally. Fertilised eggs were inverted immediately upon the completion of the first cleavage-furrow, and were kept inverted until gastrulation was complete. The duplicity in the sea-urchin larvæ consists in the development of an urchin-rudiment on both sides, or of pedicellariæ on both sides, whereas the normal larva has its rudiment on the left, its pedicellariæ on the right. *Dr. W. T. Calman: Bathynella natans,* a Crustacean of the order Anaspidacea. This minute Crustacean has hitherto been known only from a solitary specimen obtained in 1882, by Prof. Vejdovský from a well in Prague. It has recently been re-discovered in a well near Basle by M. Chappuis, by whom specimens have been sent to the British Museum (Natural History). It is a blind and otherwise degenerate member of the Anaspidacea, an ancient and primitive order of Crustacea represented by fossils in carboniferous rocks of Europe and America, and by three other recent species in Australia and Tasmania. *The Zoological Department of the British Museum (Nat. Hist.):* Cast of the "paddle" or fore limb of a humpback whale. The humpback is the species of whale which has been most hunted during the last few years in Subantarctic waters. Immense numbers of these animals have been killed annually, and it can scarcely be doubted that the number will be enormously reduced unless steps are taken to control the rate of destruction. The late Major G. E. H. Barrett-Hamilton was sent to South Georgia by the Colonial Office, at the end of 1913, in order to obtain information with regard to whales and whaling in the far south. He died during the progress of his investigations. The cast shown measures 14 ft. 6 in in length, and illustrates one of the most striking peculiarities of the humpback, the paddles of which are exceptionally long.

Dr. H. Eltringham: Preparations showing the urticating apparatus in *Porthesia similis* (gold tail moth). The female insect has long been known to possess urticating properties similar to those of the larva. It has lately been proved that the moth deliberately collects the spicules shed by its larva, and by means of a special apparatus stores them in the anal tuft. Thev subsequently serve as a protection for the eggs. *Prof E. B. Poulton:* A family of *Papilio dardanus,* bred by Mr. W. A. Lamborn, near Lagos, S. Nigeria. The family was bred from a captured female of the *hippocoon* form—the black and white butterfly, which is by far the commonest female form of this species in the locality. Six previous families, bred by W. A. Lamborn from the same female form, contained *hippocoon* females and no others. This, the seventh, contains approximately equal numbers of *hippocoon* and *dionysus,* a non-

mimetic female form occurring, but in very small proportions, along the tropical west coast. The facts are best explained by supposing that *hippocoon* is a Mendelian recessive, *dionysus* a dominant, and that the male parent was a heterozygote.

Dr. Vaughan Cornish: Photographs illustrative of landslides and upheavals on the Panama Canal. The photographs were taken in 1910, 1912, and 1914. That of the Culebra Cut in 1910 shows an upheaval of the solid rock of the canal bottom due to unbalanced pressure of the banks. That of the Naos I. breakwater, taken in 1912, shows the upheaval of the sea bottom at a distance from the subsiding mass of the breakwater. The photographs of the Cucuracha slide, in 1914, show the downward flow of inclined strata. The ground is broken for a height of 580 ft. above canal bottom.

Mr. Charles Dawson: Lower canine tooth of the Piltdown man (*Eoanthropus dawsoni*). This canine tooth was found on August 30, 1913, near the spot where the right mandibular ramus of Eoanthropus was discovered in 1912. As it is a lower canine of the right side, is of a new form, and has been much worn by mastication, it presumably belongs to the same jaw. It is relatively large, and is shown to have completely interlocked with the upper canine, as in the apes. *Mr. R. Elliot Steel:* Palæolithic engraving of a horse on a bone from Sherborne, Dorset. The bone is part of the rib of a horse, and was found in an old heap of débris from a quarry in the Inferior Oolite, near Sherborne. It was probably derived from a rock-shelter destroyed by quarrying. *Mr. W. N. Edwards:* "Paper coal" from the Coal Measures of Central Russia. The "paper coal" forms a bed 3–4 ft. thick, over an area of several square kilometres. It is composed exclusively of the practically unchanged cuticles of a Lepidodendroid plant, with a certain amount of carbonaceous matter. It has been suggested that the preservation of the cuticles alone was due to selective bacterial action, and Renault considers that a species of micrococcus is present.

CATALYSIS IN ORGANIC CHEMISTRY.

BY the invitation of the University of London, Prof. Paul Sabatier, of Toulouse, delivered two lectures on catalysis at King's College on May 14 and 15. On Wednesday evening, May 13, he was entertained by the Faraday Society at a complimentary dinner, at which Prof. Arrhenius and Prof. Heyn, of Berlin, were also present as guests. The two lectures were delivered in French, and were illustrated by a series of experiments in which the catalytic action of nickel, of copper, of alumina, of zinc oxide, of titanium dioxide, and of thoria were shown in actual operation. Prof. Sabatier is a whole-hearted advocate of the chemical as opposed to the physical theory of catalysis. He holds that in all cases intermediate compounds are formed, *e.g.* PtO in catalytic oxidations in presence of platinum, and NiH_2 in catalytic reductions in presence of finely divided nickel. He finds ample support for his views in the totally different effects that are often produced by catalysts which are almost identical in their physical properties. Thus formic acid vapour is decomposed wholly into hydrogen and carbon dioxide when passed over zinc oxide, but into water and carbonic oxide when passed over titanium dioxide :—

$$H_2+CO_2 \xleftarrow{ZnO} H.CO.OH \xrightarrow{TiO_2} H_2O+CO.$$

Ethyl alcohol in like manner may be converted into aldehyde and hydrogen by finely divided copper, or into ethylene and water by alumina :—

$$H_2+CH_3.CHO \xleftarrow{Cu} CH_3.CH_2OH \xrightarrow{Al_2O_3} H_2O+C_2H_4.$$

Different catalysts also differ very widely in their efficiency in promoting any given chemical change. Alumina can be used very effectively to convert alcohol into ethylene and water, but it becomes clogged with tarry matter which cannot be burnt off without destroying the catalytic properties of the oxide; thoria, on the other hand, becomes contaminated less readily, and can be purified by ignition without losing its activity. Again, thoria is a very useful catalyst for converting acids into ketones, *e.g.* :—

$$2CH_3.CO.OH \longrightarrow CH_3.CO.CH_3+CO_2+H_2O;$$

but titanium dioxide is so efficient and acts at so low a temperature that it can also be used to prepare aldehydes from mixtures of fatty acids with formic acid, and esters from acids (such as formic acid) or alcohols (such as the secondary and tertiary alcohols), which lose water so easily that it is difficult to esterify them without decomposition. On the other hand, the best catalyst for preparing ketones and other derivatives from benzoic acid is ordinary chalk. A very important catalyst is manganous oxide, which can be prepared easily and cheaply from manganous carbonate, and can be used in almost every case for the preparation of ketones in place of thoria or titanium dioxide.

Prof. Sabatier laid stress on the reversibility of catalytic actions. Thus nickel will promote dehydrogenation as well as hydrogenation, and very small differences of conditions are required to cause the reversal of actions such as those which are shown by the equations :—

$$C_2H_4O+H_2 \rightleftharpoons C_2H_6O$$
$$C_6H_6+3H_2 \rightleftharpoons C_6H_{12}.$$

An interesting account was given of the way in which acetylene in contact with nickel at different temperatures and in presence of varying proportions of hydrogen gives rise to complex products which are in every respect identical with natural petroleums. By varying the conditions the product can be made to resemble the four chief natural types as derived from North America, from the Caucasus, from Galicia, and from Roumania. These observations suggest a theory of the origin of petroleum that has a far higher claim to acceptance than most of those that have been put forward hitherto.

Prof. Sabatier touched only lightly on the technical applications of his new methods. The vast industry which has sprung up within the last two or three years, in this country, on the Continent, and in America, was illustrated by two small samples of oils that had been hardened by the action of hydrogen in presence of finely divided nickel; reference was also made to the fact that in the process of hardening the disagreeable taste and smell of the fish-oils are completely removed.

It is not too much to say that Prof. Sabatier has introduced a new era in organic chemistry. The advantages of catalytic methods are obvious: the catalyst will last for an indefinite period unless its activity is destroyed by overheating, which is generally fatal, or by "poisonous" impurities, such as sulphur or the halogens which quickly arrest the catalytic hydrogenation of organic compounds by nickel. The only materials required are those which are essential constituents of the products, and in almost every case the first effect of the successful introduction of catalytic methods is to bring about a great reduction in the cost of production. The rapid extension of these methods is therefore a matter of great scientific and technical importance. T. M. L.