THE ROYAL SOCIETY'S CONVERSAZIONE.

THE first soirée this year was held on the 11th inst. It was numerously attended, and a large number of objects had been brought together. We have not space to refer to all the exhibits.

Prof. Hele-Shaw exhibited experiments on the flow of water. We have already given an account of some of these (p. 34). Prof. Hele-Shaw also showed instruments for describing cycloidal curves and envelopes. By means of the instrument exhibited, two surfaces of cardboard or paper are made to revolve so that imaginary pitch circles on each roll upon one another. This is effected by employing auxiliary circles within or without the pitch circles, the auxiliary circles being made to move at the same velocity by passing between two pairs of equal wheels, each wheel being connected by an axle with the corresponding wheel for the other auxiliary circle. By a further combination of wheels the actual centres of rotation are dispensed with, only virtual centres being used Hence it is possible to draw with a small instrument cycloidal or involute curves for circles of any radius, however large, and to find envelopes or centrodes under any conditions of fixed or varying radii. A simple practical application is that to the teeth of wheels. examples of which were exhibited.

Mr. J. Mackenzie Davidson exhibited Rontgen ray apparatus for localisation purposes.

Mr. T. Andrews, F.R.S., exhibited (1) micrographic illustrations of deterioration in steel rails. These high power investigations of old rails, which have worn well, afford an indication of the microscopic structure and composition best adapted to ensure endurance and safety in rail service. (2) Micro-crystalline structure of iron. The micrographs indicate the existence of a primary and secondary crystalline formation in large masses of iron which have been slowly cooled.

Mr. C. Orme Bastian showed an electric current meter acting by electrolysis. The height of a column of liquid (sulphuric acid and water) contained in a glass tube is caused to decrease by electro-decomposition, and this decrease in height is utilised to indicate the quantity of current (in ampère hours) that has passed through the meter in any given time. Assuming the voltage of the supply to be constant, a perfectly accurate measure of the electric energy, which has passed through the meter, is recorded by means of a scale in front of the above-mentioned tube, which can be calibrated in Board of Trade or other units. A hole in a rubber plug at the top of the tube allows the gases resulting from the electro-decomposition of the liquid to pass away into the atmosphere, through the gauze tray and holes in the top of the meter case. Paraffin on the surface of the fluid prevents atmospheric evaporation. The instrument starts registering with an infinitely small current ; it is accurate at all temperatures and at all loads ; its accuracy is unaffected by temporary excess currents ; and it is not capable of being affected by outside disturbing influences.

Dr. Leonard Hill and Mr. Harold Barnard showed simple forms of sphygmo-manometers.

Admiral Sir W. J. L. Wharton, K.C.B., F.R.S., and Prof. J. W. Judd, C.B., F.R.S., exhibited, on behalf of the Coral-Reef Committee of the Royal Society, charts, sections and specimens, illustrating some of the results of the investigations carried on in the atoll of Funafuti (Ellice Group), South Pacific.

Prof. Poulton, F.R.S., showed insects captured in Canada and some adjacent States during a visit in connection with the meeting of the British Association in 1897. The insects in this collection are not of any special interest on account of rarity, but they serve to convey an impression of the general characteristics of this section of the fauna by which the traveller is surrounded as he proceeds, at the time of the year indicated in the labels, across the American Continent on a line not far distant from the Canadian southern boundary. The general similarity of the Lepidoptera to those of Europe is remarkable. Attention is directed to the geographical data on the small printed labels. The cases are arranged so that the left hand represents the westernmost locality (Vancouver Island), the right hand the easternmost (Quebec).

Dr. H. Gadow, F.R.S., and Mr. W. F. Blandford exhibited a series of models, illustrating the composition of vertebræ in the various groups of vertebrata.

Prof. T Rupert Jones, F.R.S., and Mr. J. Ballot showed a series of large stone implements, collected by Sidney Ryan, Esq., from the tin-bearing gravels of the River Embabaan, in Swaziland, South Africa.

Mr. Alan A. Campbell Swinton exhibited (1) experiments upon the circulation of the residual gaseous matter in Crookes' tubes. Radiometer mill wheels are employed to detect the direction and velocity of the gaseous streams, and the experiments indicate that in very highly exhausted tubes of the focus type, in addition to the well-known negative stream from the kathode, discovered by Crookes, there exists also a positively electrified stream from the anode, which travels in the opposite direction to the kathode stream, and is exterior to the latter. Mill wheels of various forms and of both non-conducting and conducting material show these effects. (2) Rontgen ray camera, showing the position, dimensions and form of the source of the X-rays in a Crookes' tube. (3) Kathode ray lamps. The kathode rays from two concave kathodes placed opposite to one another and supplied with an alternating electric current of about 20,000 volts pressure, are focussed upon a button of refractory material, which is thus raised to a very high temperature and becomes brilliantly incandescent. The efficiency in terms of the amount of light produced for a given quantity of energy supplied to the lamp, appears to be much superior to that obtained in ordinary incandescent electric lamps, and under suitable conditions may even exceed that of the arc.

Mr. J. Wimshurst showed improved apparatus for holding, and for the excitement of Rontgen ray tubes ; Mr. Killingworth Hedges, specimens of copper rapidly deposited at high current densities ; and Prof. J. P. O'Reilly, a set of fourteen original coloured drawings of the principal cromlechs existing in the vicinity of Dublin. The drawings being plans and sections to scale, tend to show that the cromlechs in question were oriented truly : (*a*) either as regards their side walls (Druid's Glen) (Shankell), or (*b*) present in their arrangement indications, which point to bearings either N. by S. and E. by W., or to the points of the summer and winter solstices ; or, as the case of the Glen Druid Cromlech, an inclination of the cap stone marking the altitude of the winter sun at the solstice (14° approx.), and consequently tending to prove that the cromlechs were designed, amongst other uses, to allow of astronomical observations being made with a view to the determination of fixed periods of the year or commencements of seasons.

The Rev. Walter Sidgreaves, S.J., showed the spectrum of Mira (*o* Ceti) compared with the spectra of other stars of Secchi's third type ; and Mr. K. J. Tarrant, photographs of electrical discharges.

Mr. W. Ellis, F.R.S , showed smoothed curves of sun-spot frequency (Wolf), compared with corresponding curves showing the variation in diurnal range of the magnetic elements of declination and horizontal force from observations made at the Royal Observatory, Greenwich. A graphical representation of the periodical variation in frequency of sun-spots, and of the amplitude of the diurnal magnetic movement. The average length of the period is about eleven years, subject, however, to a variation of one or two years or more, which the sun-spot and the magnetic curves alike exhibit. There is also a corresponding variation in intensity at the different epochs of maximum effect.

Mr. R. B. Roxby had on view specimens of "Naturographs" (prints produced by Dr. Selle's process of photography in natural colours).

Mr. C. V. Boys, F.R.S , showed phase reversal and silver zone plates made by Mr. R. W. Wood, of the University of Wisconsin. These plates are made with 230 zones. In consequence of the great number, their equivalence to a lens in image-making is very complete. Some are printed on bichromated gelatine. These are stated to be "phase reversal," *i.e.* the thickness is such that alternate zones are in opposite phases, so the whole surface is operative. Two of these, of about 70 and 13 cms. focus, are mounted as a telescope, and show a magnified image of incandescent electric lamps. Others are photographed upon metallic silver by coating a deposited film on glass with bichromated gelatine, exposing, washing, exposing to iodine, dissolving with "hypo," and finally washing off the remaining gelatine when the lines acted upon by light are left as bright silver, the rest being transparent glass. One is elliptical, with axes in the ratio of $\sqrt{2} : 1$. If this is placed on the hypothenuse of a right-angled prism with Canada balsam, it will give images due to the difference of phase between the light totally reflected and that metallically reflected on alternate zones.

Three photographs, taken with some of the plates, were exhibited.

Dr. Armstrong, F.R.S., exhibited coloured photographs of Yellowstone Park, U.S.A., by Mr. F. Jay Haynes, of St. Paul, Minn.; Mr. A. E. Tutton, an interference dilatometer of increased sensitiveness; and Mr. Edwin Edser, apparatus exhibiting peculiarities of interference fringes when formed between silvered surfaces. When interference bands similar to Newton's rings are formed with monochromatic light between two partially silvered surfaces, the appearance presented is that of narrow sharply defined bright bands separated by broad dark intervals. When the light used consists of two different wave-lengths (such as that from a Bunsen burner into which some salt of sodium has been introduced) the interference bands become alternately double and single as the distance between the silvered surfaces is increased. This principle has been used by MM. Fabry and Perot to confirm Michelson's results as to the homogeneity or otherwise of spectral lines incapable of resolution by spectroscopic methods.

Mr. Edwin Edser and Mr. C. P. Butler showed a simple interference method of calibrating a spectrometer. Two pieces of plate glass, each thinly silvered on one surface, are placed with these surfaces parallel and very nearly in contact. This arrangement is placed immediately in front of the collimator slit of a spectrometer. A ray of slightly convergent white light being directed on the slit through the air film between the silvered surfaces, the resulting spectrum consists of bright bands separated by dark intervals. If the wave-lengths corresponding to any two interference bands be known, that corresponding to any other band can be calculated or determined graphically with great accuracy. It is proposed to use such a system of interference bands as a reference spectrum, to facilitate the reduction of prismatic spectra in terms of wave-lengths.

Prof. W. C. Roberts-Austen, C.B., F.R.S., exhibited apparatus to illustrate M. Daniel Berthelot's interference method of measuring high temperatures. One of the beams of light in an interference apparatus traverses a heated porcelain tube, and the other beam traverses a tube of equal length containing rarefied air. When interference takes place it indicates that the air in the two tubes is equally rarefied, and therefore the temperature of the heated tube can be calculated from the pressure of the air in the other tube. The interference apparatus employed is that exhibited by Messrs. Edser and Stansfield at the conversazione last year. Prof. Roberts-Austen also showed a complete installation of apparatus for the microphotography of metals.

Mr. A. Stansfield exhibited (1) experiments of showing an exception to the law of Magnus; (2) a method of demonstrating the existence of an allotropic change in iron. An electric current may be generated by heating unequally a circuit composed of a single metal, if very steep temperature gradients are maintained in the wire of which it is composed. The Thomson E.M.F. must therefore be abnormal under these conditions. Experiments were arranged to demonstrate this in the case of platinum and other metals, and to show readily the allotropic change which takes place in iron at about 800° C.

Dr. Alexander Muirhead and Prof. Oliver Lodge, F.R.S., showed improvements in Hertz-wave space-telegraphy; Prof. Ewing, F.R.S., a magnetic balance for permeability tests of iron; Mr. J. E. Stead, specimen and photographs illustrating the crystalline structure of iron and steel; and Mr. Joseph Goold, experiments in relation to resonance.

An exhibit by the Hon. C. A. Parsons consisted of (1) one of the earlier Parsons steam turbines of three-horse power driving a dynamo; speed of working, 12,000 revolutions per minute; (2) photographs of the *Turbinia*; (3) screw propeller cavitating the water, the atmospheric pressure being removed from the surface by an air-pump. A small screw propeller is driven by an electric motor at a speed of 1000 revolutions per minute within a tank in the form of a hollow oval ring, around which the water flows under the action of the propeller, the conditions of flow resembling closely those in the case of an ordinary screw propeller driving a ship. The illumination is effected by a beam from an electric lamp reflected from a mirror attached to and rotating with the screw shaft, and again reflected on to the propeller by a concave fixed reflector. The propeller thus illuminated appears stationary, and the cavities in the water formed by and around the blades can be clearly seen or photographed. To facilitate the formation of cavities, and to reproduce the conditions of very fast ships at convenient speeds for observation, the whole of the atmospheric pressure is removed from the upper surface of the water by an air-pump. The pressure then remaining to hold the water together is that due to the head of water above the screw, plus capillarity. The relation holding between the model and screws on fast ships, with the same slip ratio, when cavities are formed appears to be—lineal speed of blade varies as the square root of the total pressure holding the water together.

Prof. W. A. Herdman, F.R.S., and Prof. R. Boyce, exhibited healthy and unhealthy green oysters, showing the causes of the coloration, and the connection between oysters and disease.

The Marine Biological Association had an exhibit showing the adaptations of marine animals to their environment, illustrated by living examples of the higher Crustacea.

The Joint Permanent Eclipse Committee and Eclipse Commission of the British Astronomical Association showed photographic and other observations made in India at the total solar eclipse of 1898, January 22.

Prof. Sherrington, F.R.S., exhibited specimens of sensorial organs, illustrated by the microscope.

Sir Richard T. Thorne, F.R.S., and Dr. Copeman had an exhibit illustrating the bacteriology of calf vaccine lymph.

Mr. Horace Seymour, Deputy Master of the Mint, exhibited a case of medals bronzed by Japanese methods. Various solutions are employed by the Japanese for this purpose, but "rokusho," or verdigris, is the main constituent of most of them. The medals shown are the result of experiments made in the Mint with a view to reproduce Japanese effects.

Dr. Russell, F.R.S., showed pictures taken on photographic plates by vapours from certain metals and certain organic bodies.

Sir David Salomons, Bart., exhibited the pseudoscope for producing stereoscopic effects by means of a single picture.

Prof. Unwin, F.R.S., exhibited apparatus for indentation tests of metals. The relative hardness is measured by the indentation per ton per inch of knife edge.

Dr. MacMunn showed microscopic preparations illustrating the structure of the digestive gland of Mollusca and Decaped Crustacea.

Electrical recording apparatus was shown by Prof. H. L. Callendar, F.R.S.

Mr. C. T. R. Wilson demonstrated production of cloud by the action of ultra-violet light. When the light from an arc lamp is brought by means of a quartz lens to a focus within a vessel containing moist, dust-free air, a bluish fog gradually develops along the path of the light. The effect is entirely prevented if the ultra-violet rays be cut off by interposing a sheet of glass or mica, no cloud or rain resulting under these conditions even when supersaturation is brought about by sudden expansion. Possibly the small particles which give rise to the blue of the sky are produced by the ultra-violet rays of sunlight absorbed in the upper layers of our atmosphere.

Prof. Oliver Lodge, F.R.S., exhibited improvements in magnetic space-telegraphy. The discharge of a condenser or Leyden round a large wire coil sets up an alternating magnetic field, which excites induced currents in another distant condenser-circuit tuned to the same frequency, causing the second Leyden either to overflow into a coherer, or to disturb a Rutherford detector or a telephone so as to give a signal.

The detector shown was a special series of small free coils and granular microphones, each coil in a permanent magnetic field and so connected to the microphone of the next that a very feeble alternating current in the first of the series is able to make a telephone in the last emit a loud sound, or, through a Langdon-Davies relay, to ring an electric bell and work a Morse sounder. A tone-telephone was also shown, which acts as a highly syntonised "call."

The magnetic vibrations in the sending current can be maintained in various ways, but the way shown is a device due to Dr. Pupin, with a vibrating string and battery contact. A signalling key enables the ordinary Morse alphabet to be sent without any connecting wire, and independently of obstacles. It may be regarded as, in some respects, a modification and improvement of the induction method of telegraphy inaugurated by Mr. Willoughby Smith and practised by Mr. Preece; but, with suitable circuits, the tuning must be nearly exact to evoke much response, and with enough copper in each circuit there is no assignable limit of distance.

Prof. A. Barr and Prof. W. Stroud exhibited range-finders.