plant to another, through the intercellular spaces, is governed by other laws. It was at first thought that the rate of movement would correspond to that in capillary tubes, according to the well-known law of Poisenille, that it is proportional to the fourth power of the diameter, divided by the length of the tube. But upon testing the matter two years ago, Wiesner found that owing to the extreme minuteness of the intercellular spaces, and their zigzagged and branched condition, this law does not hold, neither does the movement prove to be proportional to the density of the gases. The discovery of the law of the rate of movement of gases in intercellular spaces, that is, the transpiration of gases, is, therefore, yet to be discovered, together with other interesting facts pertaining to the subject. Poisenille's law does, however, hold good for the movement of gases in the woody ducts, but here it is of limited application, for these do not connect with one another, with the intercellular spaces, or with the exterior of the plant.

The walls of most cells, ducts, and surface covering of plants, except as already mentioned, are imperforate, that is without any openings that can be demonstrated by the microscope. If gases pass through them, it must be in accordance with some law of diffusion, or osmosis. Many experiments in this line have been tried, and the results have been of the most diverse character. It is impossible to give a fair idea of the subject in the time at my disposal, and it must suffice to mention a few bare facts.

The most astonishing and important results were obtained by Wiesner, in experiments conducted at Vienna, two years since. It would be a most natural interpretation, it seems to me, to think that the gases are forced from one cell to another, through the cell walls by differences in pressure. Wiesner found, however, that it is impossible to force gases through cell walls of any kind whatever, by any pressure they will stand, acting for any length of time. For instance, a bit of grape skin held up a column of mercury, 70 centimetres high, for seventy-five days, and a piece of cherry skin withstood a pressure of 3 atmospheres for twenty-four hours. Similar experiments were tried with cuticularised, suberised, liquefied and simple cellulose tissues from many sources, and with uniformly the same results, whether the tissues were moist or dry, alive or dead.

But in the same set of experiments it was found that if gases cannot be forced through cell walls, they will readily pass through by simple osmotic diffusion. All cells permit the passage of gases by diffusion when moist, dependent upon the coefficient of absorption and the density of the gas. Cuticular and corky formations also permit the passage of gases when dry. Thus we see that gases may be forced through the stomata, or breathing pores, by varying pressure, but can only pass through the epidermis and bark of plants by diffusion. We therefore arrive at the conclusion that the gases inside and outside of the plant are brought to an equilibrium by direct interchange through the stomata and intercellular spaces, aided by the comparatively slow process of diffusion through the whole surface of the plant, both above and below ground.

J. C. ARTHUR.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Curators of the Hope Collections will proceed to the election of a Hope Professor in Trinity Term 1893. Candidates for the Professorship, of which the emoluments are £480 per annum, are required to send in their applications, together with such evidence of their qualifications as they may wish to submit to the Curators, on or before May 1, 1893, to the Registrar of the University, Clarendon Buildings, Oxford. The duties of the Hope Professor are, to give public lectures and private instruction on zoology with special reference to the Articulata, to arrange and superintend the Hope collection of annulose animals, and to reside in the University for the term of eight months in every academical year between October 1 and July 15.

Physiological Department.—It is satisfactory to note that the number of students in this department is greater than in any previous corresponding term. The increase is due not only to the larger number of candidates for the M.B. degree, but also to a larger number of candidates for honours in Physiology in the Honour School of Natural Science. The course of study during the term has comprised lectures on the general subjects of the Honour School by the Waynflete Professor on the physiology of nutrition, by Dr. J. S. Haldane: and on the nervous System, by Dr. E. Starling. Mr. Leonard Hill has undertaken the course of lectures on elementary physiology. Practical instruction has been carried on under the superintendence of Dr. Haldane and Mr. M. S. Pembrey.

SCIENTIFIC SERIALS.

Bulletin of the New York Mathematical Society, Vol. ii. No. 4 (New York, 1893).—The contents of this number are an abstract of a paper (read before the Society, June 4, 1892) by Prof. W. Woolsey Johnson, entitled "On Peters's Formula for Probable Error" (pp. 57-61). A clear abstract of Engel and Sophus Lie's Theorie der Transformationsgruppen, by C. H. Chapman (pp. 61-71), and a similar account of U. Dini's work on the theory of functions of a real variable, by J. Harkness (pp. 71-76). Notes and new publications complete the number.

Bulletin de l'Académie Royale de Belgique, No. 12.—An unpublished corollary of Kepler's laws, by F. Folie. A deduction of Dewar's empirical formula for the ratios of the mean velocities of the planets from Kepler's third law.—On the common cause of surface tension and evaporation of liquids (preliminary note) by G. Van der Mensbrugghe. The author endeavoured to show in 1886 that the particles of a liquid are at distances apart which increase as we approach the surface, and that therefore the tension is greatest at the surface. Following up this view, he regards surface tension as the elastic force due to tangential displacement of surface particles, and evaporation as produced by molecular displacement beyond a certain limit in a direction normal to the surface. He predicts that a liquid of high surface tension will be able to evaporate across another liquid which has a lower density and surface tension, and does not mix with the former.—On a new optical illusion, by M. J. Delbœuf.—On the reduction of invariant functions in the system of geometric variables, by Jacques Deruyts.—Construction of a complex system of straight lines of the second order and the second class, by François Deruyts.—Contribution to the study of diastase, by Jules Vuylsteke.—Pupine, a new animal substance, by A. B. Griffiths.—Two experimental verifications relative to refraction in crystals, by J. Verschaffelt. Billet has calculated that if refraction takes place on a cleavage face of a crystal of Iceland spar, the angle of refraction for the extraordinary ray corresponding to normal incidence is 6°12′, and that the ray is normal with an incidence of 9° 49′. M. Verschaffelt has determined these angles experimentally, and found them to be 6° 9′ and 9° 45′ respectively, thus showing a close agreement with the theoretical values.—On the bacterian fermentation of sardines, by M. A. B. Griffiths.—On prejudices in astronomy, by M. F. Folie.—On the constitution of matter and modern physics, by P. de Heen.

Ann. dell' Ufficio Cent. Meteor e Geodinamico, ser. secund., part iii. vol. xi. 1889. Roma, 1892.—Fumo di Vulcano veduto dall' Osservatorio di Palermo durante l'eruzione del 1889, by A. Ricco.—From the obervatory terrace (72m. above sea level) the summits of some of the Lipari islands are visible, but that of Vulcano (140km. distant) is not so. Any smoke or vapour that exceeds 300m. in height can, however, be seen. The author was not successful in either photographing or measuring the dimensions of the smoke cloud, which were, however, estimated by comparison with the size of Alicuri, which had been carefully determined. At the commencement of the observations (January 6, 1889) the smoke column reached a height 10½km. and had the form of the pine tree. Several drawings are given, and the form assumed in some cases is very curious. The paper terminates with some thermodynamical calculations, which are very interesting, but unfortunately based on false premises. The author supposes that the eruption was caused by the access of the sea-water. He supposes this to be at sea level, and calculating the pressure at this point, concludes the vapour was produced from water heated to 196° C. only. He seems to be unacquainted with the solution of H_2O in the fluid volcanic glass, the vesiculation and escape of vapour from it, involving so many data with which the physicist has not yet supplied us, as to make any calculations of such a nature of a highly romantic rather than of practical use.

Mem. Soc. degli Spettroscopisti Ital. vol. xxi. 1892.—La Grandissima Macchia Solare del Febbrajo 1892, by A. Ricco.—This memoir is a description of an enormous sun-spot which developed from some small ones that had been noticed during three rotations before January 17. On February 5, they made their grand entry on the solar face on the east side, and by the 7th could be seen by the eye aided only by a smoked glass. The whole spot was composed of a very large one surrounded by smaller ones, and composed of great tongues of flame extending in towards the nucleus, sometimes arranged in a spiral manner. It attained its maximum on February 11, when the whole patch measured, in earth diameters, as follows: Total length, 20; total breadth, 8; the more compact extended 8 in each direction. After this the breaking up of the spot proceeded at a rapid rate, and by rotation the spot passed out of sight on the 18th. On the next rotation the diminution was much more marked. The author gives six observations of latitude, eight drawings, and several spectroscopic observations on the flames.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 23.—"On the Mimetic Forms of certain Butterflies of the Genus *Hypolimnas*." By Colonel C. Swinhoe, M.A. Communicated by Prof. E. Ray Lankester, F.R.S.

The object of this investigation is to study the changes undergone by the species of a small group of butterflies as they are traced from one locality to another, and to ascertain the bearing of these facts upon the theory of mimicry.

We find the representatives of the Indian *Hypolimnas bolina* in a long list of localities in Malaya, Polynesia, and Africa: the local representatives differ from each other and from the Indian form, but they agree in possessing in one or both sexes a more or less superficial resemblance to some conspicuous species belonging to a specially defended group and inhabiting the same locality; the same is true of the three forms of the female of *Hypolimnas misippus*.

The facts afford the most convincing evidence of the truth of the theory of mimicry enunciated by H. W. Bates.

The study of these numerous but closely-related forms belonging to the genus *Hypolimnas* also throws light upon such interesting questions as:—

(1) The special liability of the female to become mimetic.

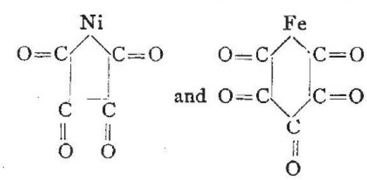
(2) The ancestral form from which the various mimetic varieties have been derived.

(3) The mimetic resemblance to different species in the same locality.

(4) The divergent conditions under which mimicry appears in closely-related species.

(5) The relation between selection and variation in the production of mimetic resemblance.

Physical Society, February 10.—Annual general meeting.—Mr. Walter Baily, Vice-President, in the chair.—The reports of the Council and Treasurer were read and approved, copies of the balance-sheet being distributed to members. From the former it appears that the society now numbers 371 ordinary members and 12 honorary members, and during the past year the society has lost six members by death, viz. the Rev. T. Pelham Dale, Dr. J. T. Hurst, B. Loewy, C. E. Walduck, G. M. Whipple, and P. W. Willans. Obituary notices accompany the report. — The treasurer's statement shows the financial condition of the society to be satisfactory. A cordial vote of thanks to the Committee of Council on Education for the use of the rooms and apparatus of the Royal College of Science was proposed by Mr. Shelford Bidwell, seconded by Mr. Blakesley, and carried unanimously. A similar vote was accorded to the auditors, Mr. H. M. Elder and Mr. A. P. Trotter, on the motion of Dr. Gladstone, seconded by Prof. S. P. Thompson. Prof. Ramsay proposed a vote of thanks to the officers of the society for their services during the past year; this was seconded by Prof. Fuller, and carried. Prof. Perry responded. The following gentlemen were declared duly elected to form the new council:—President: Prof. A. W. Rücker, F.R.S. Vice-Presidents: Walter Baily, Major-General E. R. Festing, F.R.S.; Prof. J. Perry, F.R.S.; Prof. S. P. Thompson, F.R.S. Secretaries: H. M. Elder, 50, City Road, E.C.; and T. H. Blakesley, 3, Eliot Hill, Lewisham, S.E. Treasurer: Dr. E. Atkinson, Portesbery Hill, Camberley, Surrey. Demonstrator: C. Vernon Boys, F.R.S., Physical Laboratory, South Kensington. Other members of Council: Shelford Bidwell, F.R.S., W. E. Sumpner, Prof. G. Fuller, J. Swinburne, Prof. J. V. Jones, Rev. F. J. Smith, Prof. G. M. Minchin, L. Fletcher, F.R.S., Prof. O. Henrici, F.R.S., James Wimshurst.—In response to invitations for suggestions regarding the working of the society, Prof. S. P. Thompson said all must appreciate the efforts of the late Council, and particularly of the honorary secretaries, in making the society better known. But he could not help thinking that there were many persons amongst teachers of physics and scientific amateurs whose active sympathies it was desirable to engage, who were not yet associated with the society. Perhaps the time of meeting was not convenient for all, but he thought much might be done by freely circulating particulars of what was going on at the meetings. The daily papers merely announced the meetings, but said nothing as to the place of meeting or the papers to be read. In his opinion the society did not take the position in the scientific world to which it was entitled, and he wished to inspire members with a determination to bring its claims prominently forward.—Mr. Blakesley pointed out that almost all the scientific and technical papers gave full announcements of the meetings and of the papers to be read.—Mr. W F. Stanley said Friday afternoon was not convenient for scientific men engaged in trade.—The meeting was then resolved into an ordinary science meeting.—Dr. J. H. Gladstone, F.R.S., read a paper on some recent determinations of molecular refraction and dispersion. The paper relates to the new metallic carbonyls, the metals indium and gallium, sulphur, and to liquefied oxygen, nitrous oxide, and ethylene. The carbonyls were found to be extremely refractive and enormously dispersive. For iron pentacarbonyl, $Fe(CO)_5$, the molecular refraction for the line α of hydrogen was found to be about 68·5, and the molecular dispersion between γ and α of hydrogen 6·6. For nickel tetra-carbonyl, $Ni(CO)_4$, the corresponding numbers are 57·7 and 5·93. In discussing the results it was pointed out that if the molecular refraction of CO be taken as 8·4, the value expected in organic substances, then the atomic dispersions of nickel and iron come out greatly in excess of the known values as determined from solutions of their salts. The author considers the most probable explanation of the excessive refractions and dispersions of the carbonyls is to be sought in the peculiar arrangement of the CO, and on optical as well as chemical grounds accepts the ring formulæ indicated by Mr. Mond in his lecture at the Royal Institution, viz.:—



On this supposition the molecular refraction of CO comes out 11·9 from the nickel compound and 11·3 from the iron ore, whilst the molecular dispersion (γ—α) is about 1·3 in each case. For indium and gallium the atomic refractions calculated from latest data are 13·7 and 11·6 respectively. Sulphur has been examined in the states of solid, liquid, and gas, and also in simple chemical combination and in solution, all the resulting numbers for its atomic refraction being remarkably concordant. For the line C this is about 16. The dispersions in all the different states are also in close agreement. Numbers relating to carbon and chlorine are also given. The specific refractions of oxygen, nitrous oxygen, and ethylene in the liquid states had been recently determined by Profs. Liveing and Dewar. For liquid oxygen the refraction equivalent (3·182) differs little from that deduced from gaseous oxygen at ordinary temperatures (3·0316), and also corresponds fairly closely to the 3·0 obtained by Landolt from organic compounds. Liquid nitrous oxide gave 11·418 and 11·840 as the molecular refractions for the red ray of lithium and the line G respectively. In discussing these numbers it was pointed out that nitrogen in nitrous oxide was not in the same condition as nitrogen in ammonia. The latest determinations with liquid ethylene gave the molecular refraction for the line A as 17·41, the theoretical value being 17·40, thus showing very close agreement.—Mr. E. C. C. Baly made a communication on separation and striation of rarefied gases under the influence of the electric discharge.