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THE BIOGRAPHY OF HELMHOLTZ.

Hermann von Helmholtz. By Leo Koenigsberger. In three volumes. Vol. i. Pp xi+375. Price 8 marks. Vol. ii. Pp. xiv+383. Price 10 marks. Vol. iii. Pp. xi+142. Price 3 marks. (Brunswick: Vieweg, 1903.)

I.

Education and Physiological Work.

THE third and last volume of Koenigsberger's biography of the great natural philosopher has now appeared. The whole work is worthy of its subject; the author made it his aim, as he tells us in his preface, to set forth Helmholtz's manifold and various achievements as a discoverer in such a way as to render them intelligible to all scientific readers. Helmholtz is best known by his discoveries in experimental physics, but during the first half dozen years after the completion of his professional education, the business of his life was that of an army surgeon. It was as an army surgeon that he published, between 1842 and 1848, those remarkable researches on fermentation, on the nature of muscular contraction, and on the production of heat therein, the results of which served as the foundation for the building up of a new science of physiology. Even the treatise on the "Erhaltung der Kraft," or, as we now call it, the conservation of energy, although mainly physical, exercised its chief influence on physiologists. In natural philosophy the principle set forth in it had been already recognised, but had not as yet been presented to the physiological student as a fundamental doctrine, or successfully applied to the phenomena of life.

The biography of a man of great intellectual pre-eminence fulfils its highest purpose by enabling us to form a just estimate of the antecedent and surrounding influences which made him what he was. Herr Koenigsberger has treated his subject in such a way as to afford the information that the scientific reader seeks. How can we account for the production of a man of such extraordinary endowments? Did Helmholtz owe his intellectual superiority to his innate qualities, to his parentage, to his education, and if to the latter, was it due to his teachers or to his contemporaries? Koenigsberger's indications lead us to believe that in each of these respects his life was influenced by circumstances exceptionally favourable to his intellectual development.

Nationally, Helmholtz was of mixed descent. It may be assumed that his father was German, but his mother was half English, half French. Her maiden name, Caroline Penn, was derived from the great Quaker of the seventeenth century, who himself was the son of an almost equally distinguished English admiral. On the female side she was of Huguenot descent.

There can, I think, be no doubt that the moral and intellectual atmosphere of the Helmholtz home was excellent. The little that we are told of his mother indicates that she was a woman of great simplicity of character, but at the same time of unusual intelligence, who devoted herself heart and soul to promoting the happiness of her husband and children. His father was at the head of the Gymnasium at Potsdam, a position which he had attained after many years of arduous struggle with adverse circumstances. He appears to have been an enthusiastic teacher, who made it his aim rather to evoke in his pupils a love for the classical writers than to drill them in grammatical niceties.

Of Helmholtz's childhood we are told that, although his mother recognised in her firstborn "Geist und Verstand," there was no other indication of infantile precocity. At nine he entered the lowest class in the Gymnasium, but in a year was half-way up the school. His progress, however, was retarded by the difficulty which he had in learning anything by heart. During his first three years he went through the regular classical work of the school, but he appears even at this early age (ten to thirteen) to have done much extra work under his father's direction, who encouraged him to extend his studies beyond the limits of the school course. At thirteen he began the study of mathematics under a teacher who appears to have had as great a faculty for exciting enthusiasm for work in natural science as the father had in literature. Helmholtz continued his classical work, but became more and more engrossed by his studies in mathematics and physics, the subjects which, he says in his "*Abiturientenvita,*" "omnium disciplinarum maxime a pueritiâ me delectavit," so much so that when the rest were engaged in construing, he "beguiled the tedious hour" by working problems "under the table." By the time he was fifteen, he had already made up his mind to devote his life to natural science.

His father's means were so limited that the only way in which this desire could be gratified was by taking the study of medicine "into the bargain." He therefore at sixteen, while still a "gymnasiast," became a pupil in the Friedrich-Wilhelm-Institut at Berlin (the Pépinière) for the training of army medical officers. Two years later (at eighteen) he passed the *Abiturienten-Examen*, showing "comprehensive and thorough knowledge in the elements of mathematics and physics." He obtained at the same time distinction in classics, exhibited a good knowledge of French, English, and Italian, and had made sufficient progress in Hebrew to be able to offer that language as an extra subject. It was thus that he was equipped for the business of his life. That he possessed extraordinary natural endowments cannot be questioned, but it is no less certain that he owed the early maturity of his intellect and his exceptional heuristic power to an almost perfect education.

Whatever be the place among contemporary physicists to which his achievements entitled him, it can scarcely be questioned that as a physiologist he was *primus inter pares*. He was the first to understand what is meant by the well-known definition of life as "organism in action," and thus to distinguish clearly between that branch of the science of life which deals with organism and that which relates to the chemical and physical processes by which its action manifests itself. In the former Helmholtz did not much interest himself, and consequently was not, in the modern sense of the word, a biologist. His aim was not to inquire *why* the animal (or plant) body assumes in its development the characters which it presents to the naturalist, but rather to discover in what processes vital action consists, and to prove that these processes are identical with those of inorganic nature, and can only be investigated by the methods of exact science. But Helmholtz was far from supposing that these methods could be applied either to organism and its evolution or to the study of mental processes, and expressed his distrust of the efforts made by others in this direction, with perhaps too great contempt.

Helmholtz's professional education began when he left school in 1838, and occupied four years. It is noteworthy that, notwithstanding the almost incredible amount of work which was imposed on the students of the Pépinière by a curriculum which not only included anatomy, physiology, pathology, and practice, and the sciences then regarded as ancillary to medicine, but also logic and metaphysics, ancient history, and modern languages, Helmholtz still found leisure for other pursuits. He was not only able to obtain that mastery of music of which he was afterwards to make so splendid a use, but also to pursue without any assistance, except such as he derived from books, the higher branches of mathematics, in the elements of which his schoolmaster (Meyer) had so thoroughly grounded him.

It need scarcely be said that during this period of ceaseless exertion he became intimate with the greatest of his teachers, J. Müller, and thus, as he said himself, had another opportunity of observing "wie die Gedanke selbstständiger Köpfe sich bewegen." This intimacy was, no doubt, of great value to him, but there is no sufficient ground for the conjecture which has often been made that it was from Müller that he derived his inspiration. The two men were cast in such different moulds that this was scarcely possible. The subject which Helmholtz selected for his Latin graduation essay ("The Structure of the Nervous System in Invertebrates") was no doubt suggested by Müller, but Helmholtz was no sooner himself free ("selbstständig") than he followed his own bent. It seems probable that, even when he was working assiduously with Müller as a biologist, he anticipated the direction in which his future studies would lead him, and was already aware that physics and chemistry, not biology, would afford him effectual methods of research.

Helmholtz graduated in 1842, and soon entered on his duties as a military surgeon. These happily gave him sufficient leisure for his scientific work. His first research, of which the results were published in Wagner's "Handwörterbuch," was on the relation between the work done and the heat produced in muscular contraction. It was important as setting forth one of the fundamental facts on which the new science was to be built, and as preliminary to the treatise on the "Erhaltung der Kraft," which appeared two years later. Of the genesis of this work Koenigsberger gives an interesting account. The introduction to it was written in 1846, the very same year in which, at the age of twenty-five, he passed his final *Staatsexamen* as a practitioner of medicine and surgery, his examiners possibly little guessing whom they had before them. The manuscript of the introduction was put for friendly criticism into the hands of du Bois-Reymond, who, however, would make no change in it, regarding it as an "historisches Document für alle Zeiten." It was forthwith communicated to the recently founded Physical Society of Berlin, the young and active members of which thus became acquainted with the law of the conservation of energy long before it had been discussed by academicians. By the Physical Society it was received with enthusiasm, but when offered to Poggendorff for publication in the *Annalen*, he declined it as being too theoretical, promising, however, to accept it as soon as experimental proofs were forthcoming.

The four years during which Helmholtz was charged with regimental duties were so productive that, in 1849, when a vacancy occurred in the University of Koenigsberg, he was selected by the Minister of Public Instruction among the four whom J. Müller had recommended, namely, Ludwig, Helmholtz, du Bois-Reymond, and Brücke, as the men most capable of advancing science in the "physico-physiological direction." All of these men, whose claims Müller estimated to be equal, were young, but Ludwig was the senior, and would have received the appointment had not a suspicion of radicalism, wholly unfounded, attached to him. So Helmholtz became, at twenty-eight, professor of physiology with the magnificent salary of 120*l*. a year!

Helmholtz's removal to Koenigsberg was followed by a period of astonishing fruitfulness in discovery. The first new subject to which he directed his attention was that of the measurement for physiological purposes of extremely short intervals of time, and the application of these methods to the determination of the rate of transmission in nerve. This he accomplished with such completeness and exactitude that his results can, even now, be accepted without question. In the meantime he continued those studies in physiological optics which led to the discovery of the ophthalmoscope. This, as well as the subsequent discovery of the mechanism of accommodation of the eye for distance, was communicated to the Physical Society. Then followed an investigation of the time-relations of induction currents, a research of great importance in the technique of experimental physiology. His first researches on colour-vision were published in Poggendorff's *Annalen* in 1852, in which journal also appeared, about the same time, another research of great value in its bearing on electro-physiological questions—an investigation of the "distribution of currents in bodily conductors."[1] It was towards the end of the Koenigsberg time that Helmholtz made his first visit to England. In his letters home he refers with evident pleasure to his intercourse with English physicists, and especially to the impression made upon him by Faraday's "herzgewinnendes Wesen," and observed with great interest how "old bits of wood and wire" sufficed him for the

[1] See vol. i. p. 177.

making of the greatest discoveries. He no less highly appreciated the friendly welcome given him by the Astronomer Royal, Airy, and the opportunity of exploring Greenwich Observatory, and of seeing in operation the first successful method of recording photographically the readings of magnetic and meteorological instruments. With Thomson, Helmholtz did not come into personal relation until August, 1855, when they met at Kreuznach. Helmholtz describes (in a letter to his wife) his astonishment when a man whom he knew as one of the first of living mathematical physicists appeared to him as a "Jüngling von ganz mädchenhaften Aussehen," but possessed of a degree of acuteness, clearness, and versatility which he had never before met with. It can well be imagined how these two young discoverers must have enjoyed and profited by the exchange of thought on fundamental questions which each of them had done so much to elucidate.

The same year Helmholtz accepted the chair of anatomy and physiology at Bonn, his motive for doing so being that his wife, whose health was precarious, might have the advantage of a milder climate. At that time the two subjects were still united, so that Helmholtz was obliged to resume the teaching of descriptive anatomy. This drawback was, however, of short duration, for two years later he was invited to Heidelberg, where the conditions were much more favourable. Notwithstanding the onerous nature of Helmholtz's professional engagements, the fifteen years of his residence at Bonn and Heidelberg were almost as productive as those which had preceded them. It was at Bonn that he sent to the press the first part of his famous treatise on physiological optics, which was not completed until 1895, and there also that he carried out many of the researches on musical sounds which were embodied in his treatise on "Sensations of Tone." At Bonn, too, he published his first mathematical paper "On the Movement of Fluids" (1858), which led on to his experimental researches at Heidelberg in 1860. During the whole period it appears that he published some forty-six papers of importance, of which thirty-seven, including those on optics and acoustics, were on physiological subjects, the remainder being physico-mathematical.

After his appointment to the chair of physics at Berlin, his only physiological publication was the essay entitled "Thought in Medicine," in which he illustrated in the most striking way the application of the scientific method to pathological questions. (The chapters of Koenigsberger's work which relate to Helmholtz as a mathematician will be treated by abler hands. Many readers who may not have leisure to look into this admirable biography would have been glad had it been possible to give some account of Helmholtz's views as to the limits of a scientific inquiry and the relation between the experimental sciences and philosophy. Want of space forbids this.)

In Koenigsberger's book the reader will find ample material for the decision of the question which presented itself at the outset, that of the conditions which led to the development of so splendid a character. To the present writer it seems evident that Helmholtz's personal qualities—his sagacity, modesty, truthfulness, and astonishing power of work—could be in great measure attributed to home and school influences, and that his success as an investigator was due in part to his having entered on his career as a physiologist at a time when the progress of the exact sciences had rendered their methods applicable to the investigation of vital phenomena, and in part to his singular good fortune in having as his fellow-students such men as du Bois-Reymond, Ludwig, and Brücke, each of whom was as enthusiastic as himself, and scarcely inferior to him in intellectual endowments.

J. BURDON-SANDERSON.

II.

PHYSICO-MATHEMATICAL RESEARCHES.

Herr Koenigsberger gives us an account of Helmholtz which is extremely interesting, and not unworthy of the investigator of whom he writes. Though he paints for us a fascinating picture of Helmholtz as a man, it is with work as a great physiologist and physicist that he chiefly deals.

A review of that part of the biography which deals with the education and physiological work of Helmholtz precedes this notice, which is confined to a brief account of that part of the book treating of his physico-mathematical writings. Helmholtz's first mathematical paper was "On the Integrals of Hydrodynamical Equations which correspond to Vortex Movements," and was published in 1858, during his short stay in Bonn as professor of anatomy and physiology. In the following year, after his migration to Heidelberg as professor of physiology, appeared his paper "On the Motion of Air in Pipes with Open Ends." These two papers contain some of his most brilliant mathematical deductions, and are characterised by their freedom from the artificial or inaccurate assumptions of his predecessors. Further work in this direction was for the time prevented by family troubles. In June, 1859, his father died of a sudden stroke, and Helmholtz, worn out with sorrow at his loss, with anxiety for his wife, and with his own bad health, was obliged to turn to work requiring less concentration of thought. At the end of the year his wife died. For some time his health remained in an unsatisfactory state, and he was subject to headache and fainting fits. However, he forced himself to work, "which alone could give him power to hold out," and continued his hydrodynamical investigations, publishing in April, 1860, his paper "On the Friction of Viscous Fluids." His experimental researches on sound then led him to study the mathematical theory of violin strings and reed organ pipes.

Continuing his researches in acoustics and optics, he was led by the consideration of the wave motion near the end of an open cylindrical tube to investigate the distribution of electricity near the circular intersection of two surfaces. However, in this, the first of his many papers on mathematical electricity, he had been anticipated by Thomson. He then for some years confined himself mainly to physiological work, and it was not until 1868 that he was again led by his acoustical researches to the study of hydrodynamics. Shortly after this his physiological work induced him to again attack electrical problems. From the study of electrical oscillations he proceeded to a discussion of the most general form of expression for the potential of single "Stromelemente," and of the differential equations which determine the motion of electricity. In this first treatise on electrodynamics, Helmholtz aimed at giving a clear summary of all results previously obtained.

In 1871 Helmholtz was appointed to the professorship of physics at Berlin in succession to Magnus, which post he held until 1888. From this time onward he confined himself almost entirely to physics, and did very little more physiological work. In the following year, after the marriage of his daughter Käthe, and a visit to Scotland (where he met Tait, Andrews, Huxley, Brown, Sylvester, &c., and found golf less easy to master than science), he published further papers "On the Theories of Electrodynamics." In these he replied effectively to the criticisms of Bertrand, Weber, &c., and, basing his researches on Neumann's potential law, he investigated the various theories that had been put forward, showing that Faraday's assumption of dielectric polarity was the only theory consistent with observed properties of open and closed circuits. For a short time after this he applied his versatile genius to the problem of artificial flight and guidable balloons, made valuable contributions to the theory of the microscope and anomalous dispersion, and turned his attention to the origin of thunderstorms. He then returned for some years to his researches in electricity, and applied Faraday's theories to electrochemistry, producing papers on electric currents in fluids and "elektrische Grenzschichten."

In 1878 commenced his lifelong friendship with Hertz, whose investigations led Helmholtz back to his electrodynamical researches, and to the discussion of the electromagnetic theory of light. In 1881 he again visited England, where he delivered his famous "Faraday lecture" (one of the best lectures he ever gave), which was received with the greatest enthusiasm. The delivery of this discourse led him to further investigations in electrochemistry, and in "The Thermodynamics of Chemical Processes," published in 1883, he discusses the relations of chemical combination, heat, and electrical potential, distinguishing between the "free" energy of a system which can be entirely converted into work and the "bound" energy which cannot be so converted. After journeys to Rome and England, he undertook a masterly development of the principle of least action, a principle which he considered as probably being the controlling law of all reversible processes of nature.

During the last year of his professorship at Berlin Helmholtz returned to his work on electrical and thermodynamical chemistry, and to the development of the "principle of the decrease of free energy in chemical processes." In 1888 he was appointed president of the newly-founded Physico-technical Institute, a position in which he had comparative freedom from routine work, and so was enabled still more thoroughly to devote himself to those investigations for which he was so peculiarly fitted. His first great work in his new position was the adaptation of the equations of hydrodynamics to the case of layers of gases of varying density, and the application of his results to meteorological phenomena. The remaining four years of his life were devoted to more work on the mathematical theory of electricity. The most important papers were those on the application of the principle of least action to Maxwell's electrodynamical equations, on the electromagnetic theory of colour dispersion, and on Maxwell's theory of the motion of the ether. He died, after two months' illness, in 1894.

HAROLD HILTON.

THE EARTH-HISTORY OF CENTRAL EUROPE.

Central Europe. By Prof. Joseph Partsch, Ph.D. Pp. xiv+358; with maps and diagrams. (London: William Heinemann, 1903.)

PROF. PARTSCH'S geography of Central Europe forms a volume of the series "Regions of the World," edited by Mr. H. J. Mackinder. Written in German, it has been well translated by Miss Clementina Black, and has also undergone a little condensation, probably to its advantage. On the east and part of the south, the region has fairly definite physical boundaries, in other directions they are more often political; but practically Central Europe includes the two great empires of Germany and Austro-Hungary, with Switzerland, Belgium and the Netherlands on the one hand, Montenegro, Servia, Bulgaria and Roumania on the other. But in the main there is a general correspondence between the political and the physical boundaries of the region, for Central Europe, geographically speaking, as Prof. Partsch remarks, is a three-fold belt of Alps, of inferior chains and of northern lowlands, and wherever one of these elements dies out Central Europe comes to an end. This is the best natural definition, though we should have preferred the term central highlands to "inferior chains," and a little clearer insistence on the fact that the great mountain chains of Europe—the Alps, Pyrenees and Carpathians—are comparatively modern physical upstarts, the highlands being much more ancient regions, which, like some old families, have come down in the world. Still, Prof. Partsch makes it clear, in a chapter which certainly would not stand any more compression, that the development of Central Europe was a long and complicated story. His remarks on traces in the Alps of valley systems older than the present, illustrated by some rough but sufficient diagrams after Prof. Heim, will be very suggestive to students, though full justice can hardly be done to the subject within the limits of this volume, because mountain making in this region was a complicated and intricate process, involving many speculative elements. He does well also in calling attention to the aggressive habit of some rivers; the more active one cutting back through the old water parting and capturing the other's tributaries. The Maloya Pass affords, of course, a typical example of this process, but it has probably occurred on an even greater scale under the shadow of Monte Rosa, where the depths of the Upper Val Anzasca have replaced summits which once connected the former peak with the ranges about the head of the Saaser Visp.

But before Alps, Pyrenees, or Carpathians existed, Europe had its river systems, which, notwithstanding their revolutionary effects, may still be traced. For these we must look to the great zone of the central highlands, which, in earlier days, must have marked the watershed of Europe so far as it then existed. We can, indeed, infer this history from Dr. Partsch's chapters, but its geographical outlines might well have been drawn with a firmer pencil. But his sketches of the different regions of Europe are clear and graphic, not forgetting the scenery and structure of the great Alpine chain, among which we may mention that of the Karsh region of the south-east, with its singular system of underground drainage, outliers of which may be found here and there farther west, notably in the Steinerne Meer, near the König See, and sometimes even in the Western Oberland. The chapters on the North German lowland and adjacent seas, on climate, ethnology, and economic geography are particularly good, and the value of the last is increased by small maps showing the chief productive areas of cereals, potatoes, vines, and other useful plants, as well as of minerals. The growth and relations also of the States into which Central Europe is now divided are briefly sketched, and the professor, in remarks upon the zeal lately shown by Switzerland in fortifying the heart of the Alps, takes some little pains to assure this State that the Teutonic Codlin, not the Gallic Short, is the friend. Who lives, will see.

We think Prof. Partsch makes "block" mountains and fractures a little too prominent, and object to his use of the term rift valley, though aware that he can quote precedents. If the Upper Rhine is a rift valley, we are unable to see how it differs from a "fault valley," *i.e.* one the general line of which has been determined by a fault or set of faults. Rift valley, in the most proper sense of that epithet, belongs to an extinct phase of geology, when the Alpine lakes were located in gaping fractures; it becomes almost absurd, as Prof. Partsch's own diagram shows, when applied to the above-named region or to the valley of the Jordan, but there are now geologists who take much pleasure, first in coining a dubiously appropriate term and then misapplying it with a lavish hand. One or two other dubious matters may as well be mentioned. It would be more correct to say that the crystalline rocks of the Mont Blanc *massif*, on their underground course towards the Bernese Oberland, plunge under the Alps of Vaud than of Fribourg; it is misleading to speak of schistose rocks being associated with the *nagelfluh*, and it would have been well to have spoken more dubiously about ancient coral reefs as origins of the East Alpine Dolomites. These, however, are but details. The book displays a temperate avoidance of extreme views, is well printed and illustrated, is clearly and attractively written, and will be most useful to both teachers and learners.

T. G. B.

OUR BOOK SHELF.

A Treatise on the Theory of Solution, including the Phenomena of Electrolysis. By W. C. D. Whetham. Pp. x+488. (Cambridge: University Press, 1902.) Price 10*s*. net.

THE present work is a rewritten and greatly expanded version of the author's book on "Solution and Electrolysis," published in 1895. It embraces practically all the material on the subject of solutions which is dealt with in the ordinary text-books of physical chemistry, except that part concerned with velocity of reaction and purely chemical equilibrium. The treatment throughout is characterised by great clearness, especially in the physical and mathematical portions, so that the volume may be warmly recommended to students of chemistry who desire to increase their knowledge of this department of the subject. The first chapter is on the general principles of thermodynamics, so far as they are necessary for subsequent developments, and is followed by chapters on the phase-rule and on solubility. Then comes the discussion of the phenomena of osmotic pressure, and the related magnitudes of the lowering of vapour pressure and of the freezing point, to be succeeded by a judicious chapter on the theory of solutions in which the hypotheses of molecular bombardment and of chemical combination are weighed and compared. Thereafter come four chapters on electrolytic conductivity and electromotive force, leading to an exposition of the theory of electrolytic dissociation. Two useful chapters on diffusion in solution, and on solutions of colloids, conclude the work.

A valuable appendix consists in the tables of electrochemical data compiled by the Rev. T. C. Fitzpatrick, and reprinted from the British Association Report of 1893. This extends to nearly 80 pages, and gives the conductivity, migration, and fluidity data which had at that time been determined for aqueous solutions. The book is also provided with an excellent index, which adds to its value as a work of reference.

The Study of Mental Science. By Prof. J. Brough. Pp. 129. (London: Longmans, Green, and Co., 1903.) Price 2*s*. net.

THIS very readable little book is a collection of five lectures in which Prof. Brough has urged with force and eloquence the claims of logic and psychology to take their place in every curriculum designed to give a liberal education. He claims that the study of logic develops and brings clearly before the consciousness of the student the "natural sense of method" which in the scientific specialist too often works in devious subterranean fashion. Logic, treated as a study of scientific method, should be taught at that stage in the educational course at which a general survey of knowledge has been made, and before the student enters upon one of the more specialised courses of study prescribed by the honours schools of our universities. This sound principle, practically interpreted, means that logic should be made an obligatory subject for all candidates in the matriculation examinations of the universities, that, for example, in the "Little-go" logic should replace "Paley," which for the intelligent student is merely a study in one branch of logic, the study of fallacies. For psychology our author does not attempt to claim so urgent and universal importance. It is rather as a complement to the "humanities" that he urges its claims. In the modern world "the panorama of spiritual presentation through which we move" grows overwhelmingly rich and varied, and the mind can hope to cope with it profitably only when its knowledge of spiritual fact is systematised by analysis of psychical processes and by clear conceptions of the elements so revealed and of the laws of their conjunction. Prof. Brough is known as an enthusiast for the modern experimental treatment of psychology, and has the merit of having introduced these methods in the University of Wales; it is therefore regrettable that he has not dwelt upon the value of psychology, so treated, as a training in accurate observation. For no other experimental science exercises so constantly, or makes so exacting demands of, the faculty of close observation and the power of voluntary control of the attention, the development of which two powers is, or should be, a prime object of all educational efforts.

W. McD.

Photography. Edited by Paul N. Hasluck. Pp. 160. (London, Paris, New York, and Melbourne: Cassell and Co., Ltd., 1903.) Price 1s.

Hand Camera Photography. By Walter Kilbey. Pp. 124. (London: Dawbarn and Ward, Ltd., 1903.) Price 1s. net; cloth, 2s. net.

THESE little books are both intended for beginners in photography. The comprehensive title of the first is reflected in the claim made in the preface that the "Handbook contains, in a form convenient for everyday use, a comprehensive digest of the knowledge of photography, scattered over more than twenty thousand columns of *Work.*" Doubtless the volume will be of value to readers of *Work* in saving many a reference to its thousands of columns, and as it is written chiefly by a professional photographer, others will probably be interested in such chapters as that on retouching. Much of the matter is too concise. It is impossible, for example, to give useful directions for the making of a 20 × 15 wet collodion negative in less than one small page, including instructions as to what to buy for the purpose.

The second volume is of a different kind. It is written by an amateur for amateurs, and the author has proved by his published photographs that his experiences are valuable. Of course, everyone will not corroborate all the opinions expressed, for the book has individuality and does not pretend to be a comprehensive treatise. It is essentially popular in style, and meets several difficulties that trouble beginners, and that many authors do not think of referring to. But Mr. Kilbey has surely forgotten himself when he suggests the use of a swing back in order to get such a view as an abbey with a foreground of rushes more easily into focus. Some ten pages further on an example of distortion due to tilting the camera is illustrated. We fear that some will infer from these illustrations that tilting the camera gives distortion, while swinging the plate does not. The book will be found to be a very useful guide by those who use hand cameras, and whose knowledge of photography is but slight, while others who may rank with the author in experience can hardly fail to find useful suggestions.

Mise en Valeur des Gîtes Minéraux. By F. Colomer. Pp. 184. (Paris: Gauthier-Villars, 1903.) Price 3 francs.

MOST of the French treatises on mining hitherto published deal chiefly with the extraction of coal, and this unpretentious and inexpensive volume will therefore undoubtedly prove useful to managers of metalliferous mines. It gives a clear summary of modern practice in metal mining. It is up-to-date and compact with facts. The matter is divided into ten chapters, dealing respectively with the definition of an ore-deposit, access to the deposit, method of working, breaking ground, rock-drills, explosives, transport, raising ore, drainage and ventilation. The work concludes with a brief glossary of technical terms. The absence of illustrations renders some of the descriptions somewhat obscure. The author has, however, carried out his task with care and accuracy, and has produced a volume valuable to the student desirous of becoming familiar with French mining terms.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Psychophysical Interaction.

MY authority for attributing to Descartes the distinction between "creation" and "direction" is Leibniz's "Theodicée" (Erd. 519). I ought to have stated more clearly than I did that he, of course, conceived of the problem in the form in which it presented itself to his age as one of "motion" rather than of energy and momentum. In referring to the history of the discussion at all, I merely meant to indicate its antiquity. This, of course, is no reason why it should not be reopened now. Every generation of thinkers has to adjust old solutions to new forms of a problem. It is, however, a reason why we should inquire whether a controversy of so long a standing may not be founded on a radical misunderstanding.

The object of my letter, if I may repeat it, was not to advocate the removal of the discussion from the field of fact to the *nirvana* of monistic idealism, as Sir Oliver Lodge suggests, but the preparation of the way for a better understanding between the combatants by inviting them, experimentally, at least, to consider the facts from a different point of view, or rather from the point of view of the most fundamental of all facts, our own will and personality. In making this suggestion, I expressly disavowed the introduction of anything transcendental that might dazzle the eyes or divert attention from the "landscape" or the "wayside." The suggestion, on the contrary, was that wayside facts might be better understood and unsatisfying controversy avoided, while, at the same time, the end which I understand Sir Oliver Lodge desires in the vindication of the reality of mind might be more legitimately achieved if we reminded ourselves at times that the road is a part of the landscape, and that both of them (to recall an old simile), both as they are and as they are known, are the work of the sun. So far from being put forward in the name of any one philosophy, this point of view, I maintained, is one which psychologists, pluralists and monists, realists and idealists alike, show a growing tendency to adopt.

The point at which the difference of attitude I advocate is most likely to come home to the physicist is that which Sir Oliver Lodge himself rightly emphasises in the donkey and carrots illustration. The psychologist only asks him to carry this far enough, following the facts as they take him from animal reaction to conscious volition and determination by ideas, on the chance that, when this point has been reached, a new view of the relation of the terms he has been accustomed to oppose to each other as matter and mind may be seen to be possible, and questions such as that raised by Mr. Culverwell in the letter following Sir Oliver's own in your issue of June 18 as to whether one state of motion in the molecules of the brain could in theory be deduced from the preceding state, of whatever interest to the physicist, to be irrelevant to the more ultimate question of the reality and efficiency of mind. If the conception of a physical world as opposed to a mental can be shown (as psychologists are agreed it can) to be one which has grown up within the conscious subject as a mode of organising and utilising his experience, what reason can there be for representing matter as an independent reality reacting upon another which we call mind?

In conclusion, may I say that it seems to me one of the misfortunes of present day specialism that physicists and psychologists, like mind and matter themselves, on the common view (though unfortunately without their pre-established harmony), move in different spheres, writing in different journals, and exchanging words, if at all, from a distance? I am grateful to NATURE for its hospitality on the present occasion, and to Sir Oliver for his note of welcome. May I express the hope that he will return the visit and continue the discussion in the pages of *Mind*? I think I may promise him an equally hearty welcome, and if I am right as to present-day tendencies in psychological science, a congenial atmosphere.

J. H. MUIRHEAD.

Birmingham, June 21.

Tables of Four-figure Logarithms.

FOR many scientific computations it is sufficiently accurate to work to four figures, but there have been complaints that the usual tables of four-figure logarithms are not accurate in the fourth figure. Thus, log 1·019 is given as 0·0080, whereas it ought to be 0·0082. The errors are met with only in numbers from 1000 to 2000. In consequence of this, some such tables are accompanied by a table specially intended for numbers between 1000 and 2000. Many physicists and chemists refuse to use four-figure tables for this reason, and advocate the use of five-figure tables, in spite of their greater size and the waste of time.

I beg to point out that Mr. J. Harrison has got over the difficulty in a very simple manner in the four-figure table published by him recently in his book, "Practical Plane and Solid Geometry." Even he, however, cannot avoid a possible error of 1 in the last figure. The first ten rows of differences have been replaced by twenty. The rest of the table is unaltered. I give a specimen of an old row of figures and how it is replaced. The cause of inaccuracy in the old system is apparent at once.

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
11	0414	0453	0492	0531	0569	0607	0645	0682	0719	0755	4	8	11	15	19	23	26	30	34
						This is replaced by													
11	0414	0453	0492	0531	0569						4	8	12	15	19	23	27	31	35
						0607	0645	0682	0719	0755	4	7	11	15	19	22	26	30	33

It is to be hoped that all four-figure logarithm tables will in future be printed in this way. The Board of Education is now printing tables of this kind for use in evening science classes.

JOHN PERRY.

Ship's Magnetism.

IN a review of my book on the subject of the "Deviations of the Compass in Iron Ships" which appeared in NATURE of June 18 and in the last paragraph, there are statements to which I would take exception. In this paragraph the reviewer finds "food for reflection" in that, after defining C.G.S. units in the introduction of my book, I stick to inches and to other units in the text and charts.

In view of the fact that every measurement in a ship is recorded in feet and inches, whether by constructors, engineers, gunners, or navigators, to have introduced the centimetre as a common unit of measurement in the text and tables would have been a serious drawback to the utility of the book.

Again, the values on the charts of horizontal and vertical force are given in terms which have been found most convenient in the several computations, whilst not detracting from their value as exponents of the changes of terrestrial magnetism which a ship may encounter during a voyage.

Whilst introducing the student to the modern C.G.S. units, the use of the British units is too recent for neglecting to mention them, hence their retention on the map at p. 16, accompanied by the necessary multiplier for converting them to C.G.S. units if required.

A table of errata has been published for some weeks, and sent to all known recipients of the book.

June 20. E. W. CREAK.

Mercury Bubbles.

RECENTLY during the course of an experiment I had occasion to boil water in presence of mercury. After ebullition had been going on for some time, I noticed that occasionally steam forming below the surface of the mercury carried with it a pellicle of mercury as it rose through the water in the form of a bubble. When it reached the surface of the water the pellicle usually burst, and the mercury fell back as a drop. By adjusting the intensity of ebullition, it was possible to bring the two liquids into such a state that, comparatively frequently—say ten times per minute—steam bubbles covered with mercury rose through the water and floated on its surface, and, hovering there for an instant, they cooled and contracted, and sank slowly down through the water. When the bubbles are formed in rapid succession, the phenomenon is one of great beauty, as their surfaces are extremely brilliant, being formed of mercury freshly drawn out before rising into the water. The mercury used in this experiment was the ordinary commercial article, and not freshly distilled. Grease had, however, been removed from it by boiling with a solution of caustic potash. Tap water was used.

I have since found that these mercury bubbles are easily produced in a variety of ways. The most striking form of the experiment is perhaps as follows:—About 30c.c. of mercury are poured into an evaporating dish and covered by a depth of about 1·7cm. of water. Bubbles are now formed in the mercury by forcing air under its surface through a bent glass tube drawn to a fine nozzle. When the bubbles reach a certain size they become pyriform and draw out from the surface of the mercury, and, rising through the water, float on its surface. The bubbles so formed have considerable stability, and usually last for 15–30 seconds before bursting. One having a diameter of about 1·9cm. was timed to have lasted for 75·6 seconds, floating on the water. When the break does occur, it has explosive violence, and drops of mercury are thrown through a considerable distance. The bubbles which reach the surface of the water intact do not vary, as a rule, much in size, the maximum diameter observed being 2·0cm. and the minimum 1·8cm. The weight of mercury in the bubbles may be determined by floating them into a watch glass, and weighing the mercury which falls down from them on bursting. There is always more than 0·150 gram in the pellicle, and rarely more than 0·200 gram. The mean of ten weighings gave 0·177 gram as the weight of mercury in these bubbles. From these data it appears that the mean thickness of the mercurial pellicle is 0·001cm. At the thinnest part, however, it must be much thinner, for, as the profile view shows, each bubble carries a drop of varying dimensions hanging from its lower pole. The bubbles float immersed nearly to their equator. In the majority of cases they remain covered with a skin of water, so that the meniscus of the water is not depressed round the floating bubble, but is raised round it. The skin of water may be made to retreat from the upper pole, or to aggregate itself into droplets on the surface of the bubble, without causing the rupture of the bubble, by the addition of a small amount of spirit to the water. The complete absence of the water skin from the mercury pellicle may be demonstrated by the dulling of the surface of the latter when breathed upon.

The high surface tension of the water does not seem necessary to the phenomenon. Mercury bubbles in every way similar to those just described may be formed under methylated spirit, and will float upon its surface; also the addition of a slight contamination to the water, such as oil or soap or spirit, does not make the mercury film of the bubble completely unstable. But when large quantities of these impurities are added, the bubbles seldom last more than a moment on the surface of the water, although even in the presence of these impurities they may last as long as 25 seconds.

The depth of the overlying water is of importance in the ease of producing stable bubbles by this method. If it is deeper than 2cm. the bubbles usually break before getting to the surface; this is probably due to the change of pressure during the rise of the bubble through the water, and consequent excessive expansion causing rupture. If the water is less than 1·5cm. deep the bubble formed swells up to a great size (2–3cm. in diameter) before it leaves the mercurial surface, and generally bursts in doing so.

Considerable impurities in the mercury do not render the production of these bubbles impossible. Very stable bubbles may be formed of mercury contaminated with sodium. But the most stable have been formed from mercury recently cleaned with dilute nitric acid followed by a solution of caustic potash.

Another striking and beautiful experiment with the production of these bubbles may be made by directing a strong jet of water into a shallow vessel containing some mercury. The stream of water, carrying air bubbles with it, penetrates the supernatant water and impinges on the mercury below. There it forms numerous bubbles of various sizes contained in mercury pellicles, many of which detach themselves from the mercury below, and are carried about in the water. The stability of these bubbles is amazing. They are often whirled round and round in the turbulent motion of the water for several seconds without bursting.

HENRY H. DIXON.

Botanical Laboratory, Trinity College, Dublin.

Radium Fluorescence.

IF a tube containing radium bromide is wrapped in black paper and brought within three or four inches of the eye, in a dark room, a curious sensation of general illumination of the eye is experienced; this occurs whether the eyelid is closed or not. It is difficult accurately to describe the sensation produced; the eye seems filled with light. This effect can readily be detected when six florins are placed between the closed eye and the sample of radium.

Probably the effect is due to general fluorescence of every part of the eye, for fluorescence seems to be a commoner property of matter than hitherto suspected.

The following substances are distinctly fluorescent under radium radiation :—

Opal Glass.	Quartz.	Human Skin.
Soda Glass.	Sulphur.	Human Nails.
Lead Glass.	Sugar.	Camphor.
Uranium Glass.	Starch.	Cetaceum.
Didymium Glass.	Fluor Spar.	Solid Paraffin.
Celluloid.	Yellow Resin.	Liquid Paraffin.
Mother of Pearl.	Cotton Wool.	Turpentine.
Mica.	White Paper.	Chloroform.
Borax.	Cupri Sulph.	Water.
Alum.	Quinine Sulph.	Glycerin.

I have been unable to detect decided fluorescence in the following substances, however, with a more powerful source of radiation, or a more sensitive receiver than the eye; possibly some of these might be placed in the first list :—

Potass Bichrom.	Selenium.
Ruby Glass (flashed).	Plaster of Paris.
Prepared Chalk.	Iodosulphate of Quinine.
Ebonite.	Woods (various).
Silk.	Camphor Monobromate.

In the case of translucent substances, the effects are best observed by looking through the substance, placing the tube of radium nearly in contact with the far side. If the experiments are carried on too near the eye, the direct fluorescence of the eye itself interferes with accurate observations.

Little cups made of thick tinfoil are very convenient for the examination of liquids; the open vessel is viewed from above, the radium being placed below the cup.

It is important to well prepare the eye by excluding every trace of light from the room for at least a quarter of an hour before the experiments are made.

F. HARRISON GLEW.

156 Clapham Road, S.W., June 1.

A New Series in the Magnesium Spectrum.

IN your issue of April 16 there is an abstract of a paper communicated by Prof. Fowler on the above subject to the Royal Society. He shows that his new series is of the same type as the special series for magnesium discovered by Rydberg, and represents it by a similar formula to that used by Rydberg. But in "The Cause of the Structure of Spectra" (*Phil. Mag.*, September, 1901) I have shown that the Rydberg series for magnesium can be represented by a formula which brings out the existence of harmonics in atomic vibrations. These can be demonstrated in the hydrogen spectrum also, but it seemed to be of interest to inquire whether the new series gives a further example of the existence of optical harmonics. It does, for the vibration numbers of its four lines can be given by the formula

$$n = 39730 - \frac{107250}{(2{\cdot}977 - 2{\cdot}021/s)^2}$$

where s has the values 4, 5, 6 and 7.

This may be written approximately as

$$n = 39730 - \frac{107250}{\{3 - 0{\cdot}023 - (2 + 0{\cdot}023)/s\}^2}$$

while Rydberg's special series is represented by

$$n = 39730 - \frac{107250}{(3 - 2{\cdot}343/s)^2}.$$

I have not thought it worth while to test whether the harmonic formula for the new series is as successful as Rydberg's in giving the wave-lengths accurately, as the evidence for the existence of optical harmonics is what I wish to draw attention to. In Rydberg's series s has all the integral values from 3 to 8. In the new series Prof. Fowler gives wave-lengths for which s has integral values from 4 to 7. We might expect the lines for $s=3$ and $s=8$ to be yet found. Their wave-lengths by the harmonic formula would be 5125·8 and 3956·3.

Melbourne, May 27. WILLIAM SUTHERLAND.

THE KITE COMPETITION OF THE AËRONAUTICAL SOCIETY.

THE kite competition for the silver medal of the Aëronautical Society of Great Britain took place on Thursday, June 25, on the Sussex Downs, at Findon, near Worthing, by permission of Lord Henry Thynne. The conditions specified that a weight of two pounds as representing the weight of recording meteorological instruments should be carried, and that the medal should be given for the highest flight attained by a single kite above 3000 feet. The altitude of the kites was to be determined by trigonometrical observations.

The locality proved to be admirably adapted for the competition under the conditions of weather prevailing at the time. A light wind from the south-west blew up the slope of the Downs in the morning, and increased to a steady breeze in the afternoon, backing somewhat to the southward as the day, which was beautifully fine, went on.

It was understood that observations of the altitude of the kites should be commenced after the lapse of an hour from the signal for starting. By 2.45 p.m. stations for the kite reels had been arranged, 200 yards apart, along the slope of the Downs, and two stations for the theodolites, 700 yards apart, were selected, from which the kite stations were visible, and which were likely to command an uninterrupted view of the kites during the flight. The responsible duty of carrying out the measurements with the theodolites and the auxiliary chaining was most kindly undertaken by Mr. J. E. Dallas and Mr. W. F. Mackenzie, of the Royal Indian Engineering College, Coopers Hill, and the success of the arrangements was due in no small degree to the assistance afforded by these gentlemen.

At 2.45 the signal was given to start, and at 3.45 observations of height commenced. The synchronism of the observations of any particular kite from the two stations was secured at first by a prearranged code of signals from one theodolite station to the other, and subsequently by telephone between the two stations. Eight kites were entered for the competition, but only six appeared on the ground, and only four reached a height sufficient to require trigonometrical determination. These were a Hargrave kite, of rhomboidal cross section, with four bands of linen, by Mr. S. H. R. Salmon; a kite of special design, by Mr. S. F. Cody, having the appearance in the air of a very large bird; a similar kite by Mr. L. Cody, and a Burmese kite by Mr. Charles Brogden.

In the course of an hour, four sets of observations were obtained for each kite, and were subsequently computed by Mr. Mason, of King's College, London, in accordance with a systematic programme drawn up by Prof. C. Vernon Boys.

As the result of the calculations, it appears that the greatest height measured for Mr. Salmon's kite was 1250 feet, for Mr. L. Cody's 1476 feet, for Mr. Brogden's 1816 feet, and for Mr. S. F. Cody's 1407 feet, and, therefore, none reached the minimum height required for the award of the medal. This unfortunate result was probably due to the fact that the wind, which had gradually increased from a light air as the sunshine continued, was a surface wind, and fell off in strength at some little height above the surface. The average heights of the several kites from the four observations of each were 1189 feet, 1271 feet, 1554 feet, and 1326 feet respectively.

At 4.45 the signal was given to haul in the kites, and all but one were safely brought back. The wire of this one had become entangled in the trees, and the kite was still in the air when the majority of the visitors had left the ground. The winding gear was in each case hand gear.

The supervision of arrangements for the competition was entrusted to a jury consisting of Dr. W. N. Shaw, F.R.S. (chairman), Prof. C. V. Boys, F.R.S., Mr. E. P. Frost, J.P., D.L., Sir Hiram Maxim, Dr. Hugh Robert Mill, Mr. E. A. Reeves, and Mr. Eric Stuart Bruce, secretary of the Aëronautical Society.

The society and its energetic secretary are to be congratulated upon having carried out successfully a series of arrangements that were necessarily elaborate, and not free from difficulties of many kinds.

THE CELTIC GOLD ORNAMENTS.

THE decision in the Court of Chancery that the gold ornaments from the north of Ireland, and bought as long ago as 1897 by the British Museum, are treasure trove, and, therefore, are to be taken from the Museum and handed over to the King, will produce a curious effect on the mind of the intelligent foreigner. But when he is told that the action at law is due to the persistent claims of the irreconcilable Irish party, he will probably begin to understand the position, from analogous conditions in his own country. The whole affair is to be regretted, but it must in fairness be stated that the entire blame lies at the door of the Irish executive, and that but for their incomprehensible apathy in making no effort to secure the ornaments before the British Museum ever entered the field, there would have been no need for a costly lawsuit. There is, however, a wider application of this particular example, arising from the contention of the Irish archæologists that all antiquities found in Ireland must remain there. Foreign students coming to an institution like the British Museum will expect to find there, primarily, an adequate representation of the archæology of the British Islands—surely not an unreasonable expectation in the central museum of the Empire. But if the Irish contention is to prevail, Scotland will claim equal rights, and Wales also when it decides on a capital for the Principality, so that the earnest student, not generally a wealthy individual, will be compelled to seek out what he wants in widely separated cities. There are, of course, arguments in favour of such a course; but, as a practical matter, there are, in fact, ancient remains enough in these islands to admit of the central museum having a fair comparative series, without in any way damaging the local museum. A little mutual understanding is all that is wanted, and it is to be hoped that the parochial idea that seems to prevail in Dublin will not be thought worthy of Edinburgh. London, after all, is the capital of these islands, and, for one foreign or English student in Dublin or Edinburgh, there are fifty, or, may be, a hundred, who work in London. The greater the number of workers, the greater will be the benefit to science.

THE UNIVERSITY OF LONDON.

THE presentation of degrees at the University of London, which took place as we went to press last week, was noteworthy in several respects. Honorary degrees were conferred for the first time in the history of the university, the recipients being the Prince and Princess of Wales, Lord Kelvin and Lord Lister; and representatives of the many and various institutions and organisations which are connected with the university, or are promoting its development, were also assembled together for the first time.

In his report on the work of the university during the year 1902–03, the principal, Sir Arthur Rücker, gave a short description of the educational scheme of the reconstituted university, beginning with arrangements which are primarily intended to be of benefit to those who are not aiming at degrees, and proceeding through the various stages of a university course to post-graduate study and research.

The following are some of the points of general interest mentioned in the report:—

Relation of the University to Schools.—The matriculation examination of the University of London has for many years served some of the purposes of a school-leaving examination. Persons who had passed it were excused by various professional bodies from their own entrance examinations; and for this or other reasons the examination was taken by many candidates who did not intend to pursue a university career. On the other hand, the Senate has for long included the examination of schools among its duties, and of late it has been felt that the time has come for performing this work on more modern lines and on an extended scale. A scheme has therefore been approved by the Senate for the inspection of schools, and the university has been recognised by the Board of Education as an authority under the Board for that purpose. This inspection will include an inquiry into the aims of the school, a consideration of its curriculum and arrangements as adapted to those aims, an inspection of the school buildings and fittings, and of the teaching work of the staff as tested by an inspection of the classes at work.

Entrance to the University.—The first matriculation examination under the new scheme took place in September last. It is a real matriculation examination in the sense that no candidate can begin his university career until he has passed it. It represents the minimum standard of admission to the university, and is intended to be such that it can be passed without special preparation or cramming by a well-educated boy or girl of about seventeen years of age.

The Senate has agreed to waive the matriculation examination altogether in the case of graduates of a large number of approved universities, and of persons who have passed the Scotch leaving examination or hold the *Zeugniss der Reife* from a Gymnasium or Real-Gymnasium within either the German or the Austrian Empire. A large number of persons have availed themselves of this privilege, which will be particularly valuable to those who may intend to supplement a degree taken at another university by study in London.

Courses of Study for Internal Students.—The distinction between an internal and an external student is that, while the latter can obtain a degree on passing certain prescribed examinations, the internal student must not only pass examinations but also produce certificates that he has attended courses of instruction approved by the university and controlled by recognised teachers.

The case of evening students has received special consideration. The hours of compulsory attendance are reduced in the case of those who submit certificates that they are engaged in some business occupation for twenty-five hours a week. The time required for the complete course varies with the subjects chosen, but in general the reduction allowed makes it possible for a student giving some three evenings a week to attendance on lectures and laboratories to complete a degree course in four years. It is satisfactory to be able to state that the regulations under this head are working smoothly at the polytechnics.

Organisation of Teaching.—It is not, however, only by curricula and arrangements as to examinations that the work of a teaching university must be carried on. It is also necessary to extend, organise, and coordinate the work of the teachers. This task requires funds, and also the cooperation of the various schools and other institutions connected with the university.

The Senate has approved a scheme for the establishment in the neighbourhood of the university of an institute of preliminary and intermediate medical studies, which has the support of the Faculty of Medicine, and has authorised the issue of an appeal for its building and endowment. When this is carried out, some, at all events, of the medical schools will be relieved of the necessity of maintaining independent courses of instruction on subjects which are only ancillary to medicine, and need not be studied in the immediate vicinity of a hospital. For the realisation of this project a large sum of money is required, but there can be no doubt that it will be an addition of the first importance to the equipment of London as a centre of medical study.

The attention of those interested in the teaching of engineering has been drawn to the proposals made by Mr. Yarrow in support of the system by which students of that subject spend alternate periods of six months in a college and the workshops. It is satisfactory to be able to state that in all probability some of the schools of the university will cooperate with employers in introducing into the metropolis a system of technical education which has worked well elsewhere.

Lastly, it may be added that the negotiations between the university and University College for the incorporation of the college in the university have been brought to a successful conclusion, and a joint committee has been appointed to draft a Bill for giving effect to the agreement. University College has purchased a plot of land in the neighbourhood of the hospital, to which the medical school will be transferred on an independent footing. This step is a necessary preliminary to incorporation, as it is not considered to be desirable that the university should itself control one, and one only, of the numerous medical schools which exist in London.

Post-graduate Work and Research.—The physiological department of the university, which is established in the university buildings, has been at work throughout the year under the direction of Dr. Waller, F.R.S., who has devoted the whole of his time to the interests of the laboratory. It will be remembered that all the principal teachers of physiology in London have banded themselves together to give, in turn, lectures to post-graduate students.

The research work carried on in the laboratory has resulted in the production of eight or ten original papers, which have appeared in English, American, and German periodicals.

The excellent example given by the physiologists has been followed by the botanists, who have in like manner agreed to give courses of post-graduate lectures at the Chelsea Physic Garden, a scheme which has only been made possible by the cordial cooperation of the trustees of the City Parochial Charities.

Gifts to the University.—The first year's payments on account of the grant of 10,000*l.* a year from the Technical Education Board of the County Council have been made, and the various professors and lecturers have been appointed and are now at work.

The Worshipful Company of Goldsmiths has presented to the university the very valuable library of pamphlets and other works relating to economics, collected by Prof. Foxwell, and recently purchased by the Company at a cost of 10,000*l.* To this munificent gift the Company has added considerable sums to aid the university in installing and maintaining the library.

During the year, Mr. G. W. Palmer, M.P., has contributed the sum of 1000*l.* towards the endowment of the physiological laboratory, and Mr. Alfred Palmer has made a contingent promise of a like amount for the same object.

In addition to their former munificent promise of 30,000*l.* in aid of the incorporation of University College in the university, the Worshipful Company of Drapers has presented 1000*l.* to the university, and a scheme is being drafted for the application of this grant to University College.

Apart from the grant of the Technical Education Board of the County Council, about 25,000*l.* has been given to the university by the above-mentioned donors in the course of last year.

Summary.—The foregoing report will, it is hoped, prove that the university is anxious to leave no part of its duties unfulfilled.

New avenues of work have been opened in connection with schools, with university extension, with the colleges, medical schools, and polytechnics; students are entering both for the ordinary matriculation examination and for post-graduate study and research in unexpected numbers. The authorities of the institutions connected with the university have in all cases shown the most anxious desire to work in harmony with it, and to arrange their classes to meet the conditions which the Senate has laid down.

But, while there are many grounds for hope, and while the university is doing its best to make itself worthy of public support, it must be frankly admitted that it can never adequately fulfil its duties without the supply of funds from public or private sources on a very large scale. The incorporation of University College cannot be carried out until another 100,000*l.* has been raised; the complete endowment of the Institute of Medical Sciences would need much more than that amount; the fuller organisation of teaching on lines which have been already adopted in the case of German, and towards which a small beginning has been made in the case of chemistry, would require very large sums. On the one hand, technical instruction is sorely in need of development; on the other, if funds were available, a scheme could be worked out by which students of literature and archæology might make full use of the magnificent libraries and collections which London possesses.

Lastly, the payment of the professors, which is in many cases very inadequate, and of the cost of their departments, depends so much upon fees and so little upon endowments that the expense of education in London is comparatively high. Those who are engaged in the work are convinced that the one thing needful is endowment adequate to make good the apathy of the past, and to secure the promise of the future. It is for London to say whence and when that endowment will be forthcoming, and to determine whether a university which is providing for all learners, from the evening student to the candidate who has already graduated elsewhere, shall control means and appliances worthy of the highest educational institution in the capital of the Empire.

After the Prince of Wales had been presented for the honorary degree of doctor of laws and the Princess for that of doctor of music, Prof. Tilden, Dean of the Faculty of Science, presented Lord Kelvin for the degree of doctor of science, and in doing so he said:—

My Lord the Chancellor, I present to you William Thomson, Baron Kelvin of Largs, for the degree of doctor of science, *honoris causa.* The illustrious son of a family famous for mathematical talent, for more than half a century Lord Kelvin filled the office of professor of natural philosophy in the ancient University of Glasgow. Two generations have passed since he entered on his professorship, and the advances in physical science which have distinguished the nineteenth century from all preceding epochs have been largely due to the influence of Lord Kelvin in promoting true ideas concerning the conservation of energy, the laws of thermodynamics, and their application to the mechanics and physics of the universe. His untiring intellectual activity has led him also to inquire into problems interesting to the chemist and geologist, as well as those which are important to the physicist and engineer. He has calculated the probable size of atoms; he has studied the structure of crystals; he has estimated the age of the earth. But the world knows him best as the man who has shown how practically to measure electrical and magnetic quantities, and has made it possible to link together distant continents by the electric telegraph. It is he who has shown how to neutralise the effects of iron on the compasses of ships and how to predict the tides, and who has thus taught the mariner to steer safely over the surface of the ocean and to sound, as he goes, its depths and shallows. A greater philosopher than Democritus, in him are united the qualities of Archimedes and Aristotle. Regarded with affectionate reverence by his contemporaries, it cannot be doubted that his name will shine brightly through long future generations. In offering a place of honour to such a man the university confers lustre on itself.

Mr. Butlin, Dean of the Faculty of Medicine, then presented Lord Lister for the honorary degree of doctor of science in the following terms:—

My Lord the Chancellor, since the reconstitution of the university, the Faculty of Medicine has been almost continuously engaged in arduous and not always pleasant work, and to-night, as if in compensation, there falls to its lot—for I am but the mouthpiece of the faculty—the agreeable task of presenting my Lord Lister for one of the four first honorary degrees of the University of London. While every person in my profession is familiar with the work which he has done, and his name has become a household word in every part of the civilised world, comparatively few persons are acquainted with the obstacles which he has overcome. It is not only that, sitting down many years ago in front of a difficult problem of pathology, Lord Lister solved the mystery which had puzzled the brains of the greatest surgeons of all time, or that he then invented a means of meeting and overcoming surgical infection, but that he stood by his theory, and fought manfully for it, until at length, in spite of opposition, of envy, of lack of faith, and even of ridicule, he succeeded in carrying conviction to the minds of his own profession and of the world at large. And all this was done, and these things were borne, not for the sake of gain—care for which has never been a part of Lord Lister's character—but for the sake of science and for the relief of human suffering. It is well-nigh impossible for those among whom a great man lives to form a just estimate of the value of his work, whether in art or in science, but I venture to predict that the name of Lord Lister will be handed down from generation to generation, from century to century, until, more than 2000 years hence, he will be acknowledged by our descendants as the father of surgery, in like manner as Hippocrates is regarded by this present generation as the father of medicine. I, therefore, sir, beg to present the Right Hon. Lord Lister, and ask you to confer on him the honorary degree of doctor of science, and I do so with the happy confidence that the addition of his name will confer lustre now and in the future on the University of London.

The students who had gained degrees in various faculties of the university were then presented in groups by the Dean of each faculty.

A CHARLOTTENBURG INSTITUTE FOR LONDON.

THE magnificent proposals which Lord Rosebery laid before the County Council in his letter to its chairman, Lord Monkswell, on June 27 have roused feelings of keen interest and high hopes in many who, for years past, have been crying, as it seemed in the wilderness, to the nation, to the Government, to public bodies, and to private individuals to do something to improve our higher technical educational methods. Generally speaking, the cry has been ignored or else met with the reply that our fathers obtained the command of the sea, extended our commerce and made the country the greatest commercial centre of the world, so surely methods which were good enough for them are good enough for us. Passing strange, but were they content with the methods of *their* fathers? did the eighteenth century show no advancement upon the seventeenth century? At the beginning of the nineteenth century we were ahead of all nations in the use of gas as an illuminant; later on, our railway systems and our steamships became the envy of the world; other nations could not approach us in engineering. In the middle of the century we were pioneers in many chemical discoveries; but then, apparently, so much prosperity and success seems to have been too rich a diet, and we waxed fat and kicked.

Of late years the country has felt more and more the competition of other nations. The colour industry has forsaken our shores, the finest electrical machinery is made abroad, we go to America for labour-saving appliances. Thinking men have cast about and tried to find a reason why other nations should take our markets; but when it was first suggested that our deficiency in scientific and technical education was at the root of the matter, those who dared to make the suggestion were, if not mocked at, at any rate treated with scant courtesy.

Now, however, it is generally admitted that, unless we improve our educational methods, we shall fall behind in the modern race for advancement to such an extent that it will require almost a miracle for us to be able to pull up again.

Our secondary education is not what it should be, but it is gradually improving. Technical education, generally speaking, has been tinkered at. The polytechnics are doing good work, but they are largely engaged in turning out better workmen and foremen workmen, or taking the place of the old apprenticeship system. Lord Rosebery now comes forward, and, through the generosity of Messrs. Wernher, Beit, and Co. (who offer 100,000*l*.) and other large business houses, is able to offer to London the means for providing higher technical education. Briefly stated, the idea put forward is to supply London with a technical college after the lines of the world-renowned polytechnic at Charlottenburg, which represents the acme of technical education. It is not for teaching the elements of this or that science; but when the foundation of a thorough education has been laid, students can go there for the building up of the superstructure. It is not an easy matter for a student to gain entrance into the Charlottenburg Institute. A very thorough examination must first be passed, in order to show that he is capable to take advantage of the instruction offered.

The Charlottenburg Institute cost more than 500,000*l*. to build and equip, and entails an annual outlay of 55,000*l*. The offer made by Lord Rosebery to the County Council is one of 300,000*l*. to build the institute, and he has reason to think that the Commissioners of the 1851 Exhibition will grant the site (some four acres of ground). The County Council is asked to contribute 20,000*l*. a year for the maintenance of the institute. This sum may be sufficient at the commencement, but will probably be inadequate as the place becomes known and its value appreciated.

Is it right that the County Council should be asked to find the money? The institute is meant to be imperial. Londoners may and will attend it; but it is hoped by the donors of the funds that students from all parts of the British Empire will flock there, and thus make London, "at any rate, so far as advanced scientific technology is concerned, the educational centre of the Empire." Lord Rosebery considers it "little short of a scandal that our own able and ambitious young men, eager to equip themselves with the most perfect technical training, should be compelled to resort to the universities of Germany or the United States." Why, then, should London, which is already overtaxed, and has much more yet to contribute to primary and secondary education, be called upon to pay for the upkeep of this great Imperial undertaking? Are our legislators so dead to the interests of the nation that they will refuse—if asked—to support such a scheme? or to find the much larger sum which will be required for the development of London University.

Lord Rosebery has agreed to act as the first chairman of the trustees. Presumably they will appoint a committee to advise and help them in drawing up and settling the scheme. It is to be hoped that they will use every endeavour to choose the right men, men who are thoroughly conversant with the needs of the nation, and who understand what technical education is.

The institute, if properly organised and equipped, will be a national gain, a national asset; if run on wrong lines a national loss. But with the magnificent institutes in Germany to adapt from, there is really no reason why it should not be a grand success. One thing, however, should not be forgotten, a splendid equipment without an equally good curriculum and organisation is almost valueless. It must also be remembered that the scheme does not touch the question of the provision for development required by the University of London.

The scheme outlined in Lord Rosebery's letter may, we hope, be taken as a sign that our great manufacturers are becoming aware of the national advantages to be derived from an alliance between science and industry. The meeting held at the Mansion House on Monday to inaugurate a memorial to the late Sir Henry Bessemer gave additional reason for the belief that an awakening is taking place. It was decided that a memorial should be established which should not only commemorate Bessemer's work, but also provide a means of carrying it on to further achievements. The proposals of the memorial committee, which were read at the meeting on Monday, include the provision of well-equipped mining and metallurgical laboratories, and scholarships for post-graduate study in London. In the words of the committee :—

The establishment of completely equipped metallurgical teaching and research works in London will form the first object of the memorial, for which the practical cooperation and financial aid of the industrial world is asked. The primary aim will be the thorough technical instruction of mining and metallurgical students. Metallurgical tests and research of all kinds, for which facilities are not available in Birmingham or Sheffield, will be carried out at these works, on a practical scale, by engineers and others. In this way advanced students will be afforded opportunities for the acquirement of practical knowledge and for original research which it would be difficult to obtain in any other way. The second object of the memorial will be a system of grants, in the form of scholarships, for post-graduate courses in specialised practical work in London and the great metallurgical centres.

In proposing the adoption of this form of memorial, Mr. Haldane said the work which was to be done in teaching by the Bessemer Foundation should form a part—an integral part—of the larger scheme for raising the nation's efficiency. He had reason to know that the King was fully cognisant of the details of the great scheme which was laid before the public in Lord Rosebery's letter, and that His Majesty had also been informed of the proposal to launch the Bessemer memorial scheme in connection with and as an integral part of it.

The committee's proposals were adopted, and there is little doubt that the support which will be given to them will enable provision to be made for study and research in mining and metallurgy on a scale appropriate to Bessemer's great name, and to our responsibilities as a State. To maintain a leading position among the nations of the world, industrial methods must be developed in directions indicated by scientific research, and the recognition of this fact in the scheme for the proposed Charlottenburg Institute for London, and in that of the Bessemer Memorial Committee, will give satisfaction to all who are familiar with the developments due to the application of science to industry.

THE BRITISH ACADEMY.

THE first anniversary meeting of the British Academy was held last week. We have received no report, but we learn from the *Times* that the objects of the Academy, and the studies to be fostered by it, were described in the presidential address. In the course of this address, Lord Reay remarked :—

The Academy might be regarded as embodying the recognition on the part of England that she, too, at last recognised that history, philosophy, philology, and kindred studies call for the exercise of scientific acumen, and must take their place by the side of the sister sciences, the priestesses of nature's mysteries.

We are all anxious to extend the boundaries of knowledge by scientific study, and Lord Reay appears to have overlooked the fact that the Royal Society was founded for the purpose of promoting the progress of the subjects he mentions, among others. The first charter granted to the Royal Society in 1662 contains the following words :—

We have long and fully resolved with Ourself to extend not only the boundaries of the Empire, but also the very arts and sciences. Therefore we look with favour upon all forms of learning, but with particular Grace we encourage philosophical studies, especially those which by actual experiments attempt either to shape out a new philosophy or to perfect the old.

The recognition of the value of the application of scientific principles to all inquiries is therefore as old as Charles II., and has not recently been discovered as Lord Reay seems to suggest.

Lord Reay remarked that it would be one of the first important duties of the Academy with the Royal Society to prepare a fitting welcome for the International Association of Academies when it meets in London next year at Whitsuntide, and to make that meeting a success. The following points from the address show some of the directions in which the Academy is to work :—

In history we have to deal with the mutual interaction of different civilisations, and to compare these civilisations. The task of the historian is very similar to that of the explorer of nature's laws. Our colleague, Prof. Bury, in his interesting inaugural lecture, has eloquently emphasised the application of strict scientific methods to the study of history, as the study of "all the manifestations of human activity." In the department of archæological exploration an understanding might be obtained through the International Association with regard to the spheres of scientific exploration which should be allotted to various nations, so as to arrive at a systematic distribution of archæological research in the vast domain open to the explorers of different nationalities. Many questions belonging to economic science have to be studied. The scientific treatment of law has been neglected in England, and it will be our privilege to give encouragement to those who are striving to place the scientific study of law on a footing worthy of the great traditions of English jurisprudence. We shall approach the problems connected with education in a philosophical and historical spirit. Our charter imposes on us the duty of dealing with questions which embrace the whole range of the moral sciences. We have to deal with the problems of the mind. The complex agencies which constitute the motives of our actions are subjects of our investigation. The forces which influence individual energy are open to our analysis. To discover the principles which regulate the progress of human society, which eliminate the causes of friction, which facilitate the attainment of high ideals, all these inquiries come legitimately within the sphere of our operations. The unbiased attitude of the mind towards ethical and metaphysical problems is one of the conditions of our existence as a scientific body. The tendency of all scientific study is to become international and cosmopolitan. We may compare our Academy with a national clearing-house, and the International Association of Academies to an international clearing-house of ideas on these subjects.

NOTES.

THE names of a few men distinguished by their contributions to scientific knowledge are included in the list of birthday honours. Dr. W. D. Niven, F.R.S., has been promoted to the rank of Knight Commander of the Order of the Bath (K.C.B.). Dr. David Morris, F.R.S., and Dr. Patrick Manson, F.R.S., have been promoted to the rank of Knight Commanders of the Order of Saint Michael and Saint George (K.C.M.G.). The honour of knighthood has been conferred upon Dr. P. H. Watson. Mr. F. W. Rudler has been appointed a Companion of the Imperial Service Order.

THE Colombo correspondent of the *Times* reports that on a motion introduced in the Legislative Council on June 24, the Government of Ceylon agreed to invite the British Association to Colombo in 1907 or 1908.

DR. C. J. MARTIN, F.R.S., professor of physiology in the University of Melbourne, has been appointed director of the Jenner Institute of Preventive Medicine.

IN reply to a question asked in the House of Commons on Tuesday, it was announced that, in the first instance, the following six lightships are to be connected with shore stations by wireless telegraphy:—the East Goodwin, the South Goodwin, the Gull, the Tongue, the Sunk, and the Cross-Sand.

MANY friends of the late Sir William Roberts-Austen will be glad to know that it is proposed to erect a memorial in his honour in the Church of St. Martins, Blackheath, Wonersh, where he resided for many years. The erection of the church was mainly due to his generous and devoted efforts, and he often said that the first things done to complete the building should be to line the east wall and the chancel arch with marble or alabaster. It is proposed that the memorial should include the carrying out of this work, and the erection of a memorial tablet or inscription in the church. Contributions for this purpose should be sent to Mr. H. W. Prescott, Brantyngeshay, Chilworth, Guildford.

M. ZYBIKOFF, a Buddhistic Buriat of the Baikal region and a graduate of the University of St. Petersburg, has recently returned to Russia after a year's residence in the city of Lhassa. M. Zybikoff was able to travel in Tibet as a Lama, and approached Central Tibet by way of the Boumza Mountain, where Przewalsky was turned back in 1879. He describes the city as one of not more than ten thousand inhabitants; the Uitchu River passes to the south, canals and dykes protecting the city itself from floods. The residence of the Dalai Lama is on Mount Buddha La, a mile from Lhassa. Near it is the ancient castle of Hodson Buddha La, a structure 1400 feet long and nine storeys high, containing the treasury, the mint, quarters for officials and monks, and a prison. The native traders are all women.

MRS. GARRETT ANDERSON, M.D., in a letter to the *Times*, directs attention to the work of the Imperial Vaccination League, which has now been in existence a year. The League, which has on several occasions been referred to in these columns, was formed to study the administration and working of the "Vaccination Act," 1898, and to promote vaccination, and especially revaccination, among the public. It is now desired to extend its sphere of work by assisting candidates at Parliamentary elections to meet the pressure brought to bear upon them by the opponents of vaccination. For this purpose Mrs. Anderson appeals for subscriptions, and desires to find 100 friends who will each contribute five guineas a year for three years. The League has done good work in the past, and it is to be hoped that this useful extension will receive support.

ATTENTION was directed in the House of Commons last week to the administration of the "Cruelty to Animals ('Vivisection') Act," 1876. The debate was more moderate in tone than some previous ones on the same subject, and had for its main object the imposition of more stringent inspection by the appointment of additional inspectors. Sir M. Foster and Dr. Hutchinson strongly deprecated the attacks on, and abuse of, the medical profession with regard to this question, and obtained a retractation from Mr. MacNeill. The Home Secretary, in his reply, defended the inspections as carried out by Dr. Thane, and pointed out that successive Home Secretaries had been among the severest critics of vivisection, and that his own control was exercised with the greatest care and full appreciation of his responsibility. It would be almost impossible to improve upon the administration of the Act, and he doubted whether the ability of the inspectors was sufficiently recognised or remunerated.

REUTER reports that a violent earthquake occurred at Erlau, Hungary, on the morning of June 26. Four shocks were felt. Several houses in the suburb of the town collapsed, and nearly all the buildings in the town were damaged.

THE arrangements for the International Fire Prevention Congress, convened by the British Fire Prevention Committee, have now been completed. The congress will be conducted in general and sectional meetings; there will be six sections, each of which will have its own honorary chairman and acting vice-president. The sections with their honorary chairmen will be as follows:—(1) Building construction and equipment, Privy Councillor J. Stubben; (2) electrical safeguards and fire alarms, Chevalier Goldoni; (3) storage of oils and spontaneous combustion, M. Louis Bonnier; (4) fire survey and fire patrols, Prince Alexander Lyoff; (5) fire losses and fire insurance, Mr. C. A. Hexamer; (6) fire tests and standardisation, M. Alcide Chaussé. All meetings, except the opening meeting, will be held at the Caxton Hall, Westminster, and the whole of the executive arrangements will be in the hands of Mr. Edwin O.

Sachs, as congress chairman, with Mr. Ellis Marsland as honorary general secretary. The general opening meeting will be at the Empress Theatre, Earl's Court, lent by the executive of the International Fire Exhibition. The subject-matter is limited strictly to fire preventive questions, and all internal fire brigade questions will be excluded, as these will be dealt with at separate meetings.

A PARIS correspondent writes:—M. Santos Dumont's experiments in aërial navigation in Paris during the past fifteen days have attracted public attention. M. Santos Dumont was seen flying over the Longchamps Hippodrôme when a race was actually going on; at another time he went to his private residence in the Champs Elysées, left his balloon to the care of his assistants, who had followed his aërial track in an automobile, took his customary breakfast, and returned to the balloon shed near Puteaux Gate, in the Bois de Boulogne. On another occasion he sailed from the Puteaux Gate to Bagatelle, where he landed during a parade. But the area of his promenades is very limited, and sometimes the balloon has to be carried by hand for a part of the way; so it is not possible to say if M. Santos-Dumont has really improved his speed and stability.

THE fifty-sixth annual meeting of the Palæontographical Society was held at the Geological Society's apartments, Burlington House, on June 27. The report of the council referred to the activity of the contributors to the Society's monographs, which extended over a wider field than usual. Volumes on Pleistocene Mammalia, Carboniferous and Cretaceous fishes, Carboniferous and Cretaceous Mollusca, Trilobites, Graptolites, and Devonian corals were in course of publication. The expenditure for the year exceeded the income, which was nearly 100*l.* less than that of the preceding year. The withdrawal of several small libraries was referred to, and an appeal for new personal subscribers was made. The officers were re-elected, Dr. Henry Woodward as president, Mr. Etheridge as treasurer, and Dr. Smith Woodward as secretary.

TWELVE stations took part in the international scientific balloon ascents on the morning of May 7, including Zürich, for the first time, and Bath. The records for the latter station had not been found at the time of the publication of the preliminary results. The following are the most noteworthy of the unmanned ascents:—Strassburg, 13,400 metres; at 9500 metres the temperature was $-58°·3$ C., above this height an inversion of temperature occurred. The reading at starting was 10°·5. At Berlin the balloon rose to 13,360 metres, temperature at 7560 metres was $-43°$, at starting 11°·9. At Vienna a temperature of $-54°·4$ was recorded at 9020 metres, at starting 14°·8. At the first two places the ascents were made about 4h. a.m., at Vienna about 7h. a.m. Relatively high pressure prevailed over south-east Europe, and a large area of low pressure to the northward, with its centre (29·5 inches) over the North Sea.

THE Meteorological Office pilot chart for July contains, in addition to the usual information, a most useful series of twelve maps exhibiting the direction of flow of the tidal streams round the British Isles at each hour from high water at Dover. They are reduced from the more detailed large Admiralty charts in three volumes of 36 sheets. To seamen the handy form in which the streams are now shown on the pilot chart will be invaluable, as the whole circulation is seen at a glance. Early in April last it is shown, by means of a small map, that there was a remarkable displacement of the Atlantic anticyclone, which was transferred northward beyond the 50th parallel. As a result, the Transatlantic liners, to and fro on the northern routes, experienced easterly winds right across the ocean, instead of the usual westerly and south-westerly winds. There were numerous reports of ice during May and the early part of June.

THE German Government has erected a new lighthouse on the island of Heligoland, which will supplant the old petroleum lamp that has long directed the commerce at the mouth of the Elbe. It is claimed for this light that it is one of the most powerful in operation. The distinguishing feature is the return that has been made to the old form of parabolic reflector, with a powerful illuminant in the focus, in place of the Fresnel lenses and prisms. The mirror in this case is of glass, 75cm. in diameter, and silvered at the back. An arc light with a current of 34 amperes is the illuminant. The positive pole of the carbon is so near the focus that it is estimated that the beam is not more than two degrees in diameter, and its candle-power is quoted as thirty millions. No protection against weather is provided in front of the light, and it is asserted that none is needed. Three similar mirrors and lamps are mounted in one plane round an axis, and the whole revolves four times in a minute, so that a flash is given every five seconds. A fourth mirror and lamp is provided in case of necessity, which will turn three times as rapidly, but it is not proposed to use this except in case of emergency. The duration of the flash is only one-tenth of a second. Herein the German firm of Schuckert and Co., the manufacturers, have followed the lead of the French authorities. It is, however, a question whether these brief durations have not been carried to an extreme. Undoubtedly one-tenth of a second is sufficient to make the maximum impression on the eye, when the light is brilliant. But with a hazy atmosphere, and the light much diminished, it is doubtful whether a longer duration should not be allowed. The experiment will be watched with great interest, both on account of the bold deviation from the ordinary plan which has been so long followed, and also on the ground of economy, which is claimed for the new method. It is stated that on the first night of trial the light was seen at the pier of Büsum, a distance of 64 kilometres, or 40 miles.

"THE Cure of Consumption," a popular account of the open-air treatment of pulmonary tuberculosis, and a description of "An Experiment in Nature-study," carried out among village lads, are two articles of scientific interest that appear in the current issue of the *Pall Mall Magazine*.

SEVERAL cases of fatal illness have occurred in connection with the Mond process for the extraction of nickel from its ores, which is based upon the conversion of the metal into gaseous nickel carbonyl. It is not yet known whether the nickel carbonyl is itself poisonous, or whether some other deleterious gas or substance is generated in the process, but the subject is being investigated by several experts.

THE statistics of the anti-rabic inoculations carried out at the Pasteur Institute, Paris, during 1902 have just been published. The number of persons treated was 1106, of whom three died, but one of these had not completed the treatment, leaving 1105 cases with two deaths, a mortality rate of only 0·18 per cent. This is the lowest mortality rate recorded since the commencement of the treatment in 1886.

THE new method for sewage disposal by bacterial treatment in a septic tank is not altogether free from danger. In this process the sewage is stored in closed tanks for a variable period, during which time it is acted upon and dissolved by the agency of the bacteria present. Probably marsh gas and other gases are generated which become explosive when mixed with oxygen and fired. During the past six months three explosions of septic tanks have occurred, viz. at Exeter, Walton-on-Naze, and Sheringham; in the last named three persons were killed and several injured.

A PARLIAMENTARY paper has been issued by the Colonial Office containing official correspondence and circulars relating to the investigation of malaria and other tropical diseases, and the establishment of schools of tropical medicine. It contains a circular letter to the Governors of all colonies upon the investigation of tropical diseases and the establishment of the London School of Tropical Medicine, a summary of researches upon malaria by Drs. Stephens and Christophers, a despatch from Sir William MacGregor relating to the prevalence and prevention of malaria at Ismailia, and a despatch from Sir F. A. Swettenham upon the work done at the Institute for Medical Research, Federated Malay States. The increasing importance of the study of tropical medicine has been recognised by the Special Board of Medicine of Cambridge University, which has proposed to institute a special examination and to grant a diploma in tropical hygiene and medicine.

A PAPER read before the Royal Dublin Society by Dr. H. H. Dixon offers a reply to some criticisms passed on the cohesion theory of the ascent of sap which was proposed by the author and Dr. Joly. There seems to be a difficulty in the minds of some botanists in accepting this hypothesis if the column of water contains air-bubbles. As Dr. Dixon points out, this merely puts out of gear the particular cell in which the bubble appears. Another opinion which the author combats is that glass tubes containing plaster of Paris through which water passes may be taken as the equivalent of the water columns in trees. Experiments show that plaster continues for a long time to absorb water, and further, the amount varies with the changes of temperature.

THE appearance of a new scientific publication, *Records of the Albany Museum*, emanating from Grahamstown in South Africa is a matter for congratulation, whether it is offered to the director, Dr. Schönland, or in so far as it furnishes an indication of the sign of the times. Dr. R. Broom contributes three palæontological articles, in the first of which he describes the skull of a small lizard taken from the Triassic beds in South Africa. Dr. Schönland is responsible for the remainder of this, the first part. A critical account of a number of species of South African aloes adds considerably to the information collected by Mr. J. G. Baker in his monograph in the "Flora Capensis." In addition to the botanical papers, Dr. Schönland describes some Bushman and Hottentot pottery which is stored in the museum. A pot about 14½ inches high, consisting of a wide neck slightly ornamented by raised lines and a remarkably fine curved base, approximately oval, denotes workmanship of a higher order than that displayed by the civilised potter.

WE have received the second part of the *Sitzungsberichte* and *Abhandlungen* of the Dresden "Isis" for 1902. The former contains an obituary notice of the late Hofrath Dr. H. Nitsche, professor of zoology at the Academy of Tharandt. Among the contents of the latter is an article, by Prof. O. Schneider, on the prevalence of melanism among the beetles of Corsica.

AN interesting case of "commensalism" is recorded by Dr. R. Horst in the May issue of the Leyden Museum *Notes* (vol. xxiii. part ii.). In Sabang Bay, Poeloe Weh, several small fishes (*Amphiprion intermedius*) were observed to issue from the cavity of a large anemone of the genus Discosoma. Several previous instances of a similar association are on record, notably in Australian waters, where other species of Amphiprion have been observed frequenting anemones of the genus above mentioned.

OUR knowledge of the fishes of Africa is progressing by rapid strides, one of the latest contributions to the subject being a paper on a collection from Zanzibar, by Mr. H. W. Fowler, published in the *Proceedings* of the Philadelphia Academy, in the course of which two species are described as new. The same serial also contains a revision of the land and fresh-water molluscs of Western Arkansas and the adjacent States, by Mr. H. A. Pilsbry.

WE have received a copy of the address on "Modern Views on Matter: the Realisation of a Dream," delivered by Sir William Crookes before the recent Congress of Applied Chemistry at Berlin. A general account of the proceedings of the congress appeared in NATURE of June 18 (p. 156), and abstracts of some of the papers brought before the various sections are given in the present number.

THE additions to the Zoological Society's Gardens during the past week include a Patas Monkey (*Cercopithecus patas*) from West Africa, presented by Mr. H. Padgett; two Two-spotted Paradoxures (*Nandinia binotata*) from West Africa, presented by Mr. Charles R. Palmer; a Burrowing Owl (*Speotyto cunicularia*) from South America, presented by Mr. L. M. Seth-Smith; a Diademed Sand Snake (*Lytorhynchus diadema*), five Egyptian Eryx (*Eryx jaculus*) from Egypt, two Bull Frogs (*Rana cotesbiana*) from North America, deposited; six American Flying Squirrels (*Sciuropterus volucella*) from North America, purchased; an Ogilby's Rat Kangaroo (*Bettongia penicillata*) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

REPORTED CHANGE ON SATURN.—The following telegram, announcing the discovery of a new phenomenon on Saturn by Prof. Barnard, has been received from the Kiel Centralstelle:—

"Conspicuous white spot, Saturn, three seconds north, transit June 23, 15h. 47·8m., Williams Bay time.—Barnard."

SEARCH EPHEMERIS FOR FAYE'S COMET.—A search ephemeris for Faye's comet, from which the following is an extract, is published in No. 3876 of the *Astronomische Nachrichten* by Prof. E. Strömgren:—

Ephemeris 12*h*. (*Berlin M.T.*).

1903	α (h. m. s.)	δ (° ′)	log *r*	log Δ
July 2	4 59 44	+18 41·8	0·2240	0·4060
,, 6	5 11 28	+18 42·6		
,, 10	5 23 6	+18 40·2	0·2281	0·4044
,, 14	5 34 37	+18 34·7		
,, 18	5 46 0	+18 26·1	0·2330	0·4028
,, 22	5 57 14	+18 14·5		
,, 26	6 8 19	+18 0·0	0·2386	0·4012
,, 30	6 19 13	+17 42·8		

This ephemeris is calculated from the elements previously published, in the *Astronomische Nachrichten*, by the same worker, and takes June 3·64 (Berlin M.T.), 1903, as the time of perihelion passage. The comet will rise about two hours before sunrise towards the middle of the month.

OBSERVATIONS OF NOVA GEMINORUM.—Prof. Barnard publishes in No. 5, vol. xvii., of the *Astrophysical Journal* the results of his observations of Nova Geminorum; most of these observations were made with the finders of the 40-inch and 12-inch refractors of the Yerkes Observatory.

During the first set of observations the Nova had a strong reddish colour, but this has since disappeared.

Observations made in order to determine whether the light of this Nova exhibited the change of focus observed in the light of Nova Persei gave at first, negative results, but careful observations made on April 27 indicated that the light of the Nova, when compared with that of an ordinary star, showed a difference of +0·08 inch (2·00mm.) in focus.

The crimson image observed on March 30 had disappeared on April 27, the out-of-focus image of the Nova then resembling that of an ordinary star. Cloudy weather at Yerkes from April 7–27 prevented Prof. Barnard from determining the exact date at which this change took place. The magnitude of the Nova is exhibiting the same periodical fluctuations as were observed in the case of Nova Persei.

The Red Spot on Jupiter.—In No. 3875 of the *Astronomische Nachrichten*, Mr. Stanley J. Williams describes, and gives the detailed results of, his observations of the "great red spot" during the opposition of 1902.

Transit observations of the middle of the spot gave a rotational period of 9h. 55m. 39·55s., and of the "following" end of the spot 9h. 55m. 39·88s.; taking the weighted mean of these observations, Mr. Williams obtains, from 275 rotations, 9h. 55m. 39·66s. as the result. This shows a further considerable acceleration of the rotational period of the red spot, amounting to 1·26s., as compared with the result obtained during the opposition of 1901.

The Study of very Faint Spectra.—In a dissertation published in No. 35 of the Lick Observatory *Bulletins*, Mr. Harold K. Palmer describes an arrangement whereby the Crossley reflector has been adapted to the study of very faint stellar and nebular spectra.

The work was first suggested, but not completed, by the late Prof. Keeler for the purpose of obtaining, amongst other spectra, the spectrum of the faint central star of the ring nebula in Lyra.

A modified form of Prof. Keeler's proposed spectroscope has now been adopted, and the results obtained with it are very satisfactory; its essential features are as follows:—A concave quartz lens intercepts the converging beam of light from the large mirror, and renders the rays parallel; these parallel rays are then refracted by a 50° quartz prism and are focused on to the photographic plate by a convex quartz lens placed between the prism and the plate. The two lenses and the prism each have an aperture of 25 mm. An arrangement attached to the prism cell allows the prism to be moved to one side, so that the spectroscope may be focused for the incident light by means of an eye-piece which carries a finely divided scale, and another eye-piece, placed at the side of the movable slipping plate, allows the "following" during exposure to be performed in the usual manner.

Spectrograms of such faint objects as the stellar nebula NGC 6807 (magnitude 13), the Novæ in Perseus (1901), Auriga and Cygnus (1876), and the Wolf-Rayet star No. 43 have been obtained with exposures varying from one to four hours, and show a fair amount of detail.

Three spectrograms of the ring nebula were obtained, two with thirty minutes' and one with two hours' exposure, but the only trace of the central star is a faint line which appears on all three plates, and, in the longer exposure, shows a faint dot in a position a little to the more refrangible side of the condensation λ 373 in the nebula ring. A detailed description of each of the spectra obtained is given in Mr. Palmer's paper.

INSTITUTION OF NAVAL ARCHITECTS.

The Institution of Naval Architects held its summer meeting this year in Ireland, commencing Tuesday, June 23, when the opening meeting was held in Queen's College, Glasgow, the president of the Institution occupying the chair.

After the usual formal proceedings, in which the members were welcomed to the city by Sir Daniel Dixon, the Lord Mayor of Belfast, and the Rev. Dr. Hamilton, president of Queen's College, three papers were read. The first was by Mr. C. F. L. Giles, the engineer to the Belfast Harbour Commissioners, and gave a brief description of the harbour and its development. Mr. E. H. Tennyson D'Eyncourt followed with a paper "On Fast Coaling Ships for our Navy." The author proposed that certain vessels should be built specially to wait on the fleet and supply it with coal in time of war, and they should be fitted with appliances for transferring the fuel to the warships at sea. These vessels should be able to steam 17 knots easily and continuously, and 18 knots in case of emergency. They would have to be of considerable size, therefore, and would be loaded with 10,000 tons of coal, besides that needed for their own use. The author estimated that the requirements could be met on a length of 550 feet, a beam of 66 feet, and a draught of 27 feet with 10,000 tons of coal on board; that would enable the vessels to get through the Suez Canal. The horse-power necessary for 17 knots would be about 12,000. With quadruple engines the consumption of coal would be 1½lb. per I.H.P. per hour, so that at full speed the collier could go 1000 miles from the coaling station and back on 800 tons of coal, carrying 10,000 tons of coal for the use of the fleet. That would be sufficient to coal completely five of our largest battleships or cruisers, or, if needed, ten such battleships could have their bunkers half full.

Comparing this with the present conditions, it would take one of our large cruisers or ironclads four or five days to make the 2000 miles, and she would lose at least 1000 tons of coal, and have to be steaming hard all the time. The vessel would arrive with dirty boilers, a tired complement of stokers, and the greater part of her coal already burnt. In ordinary peace time the colliers could be used for taking coal to the coaling stations. The cost of these vessels, fully equipped, with Temperley transporters and all the necessaries for quick coaling, would be about 270,000*l*. each, so that four or five could be built for the cost of one first-class armour-clad or cruiser, whilst four could be kept in commission for about the cost of keeping up an armour-clad. In time of war, the author claimed, each collier would be equal to several additional warships, as it would enable so many of the latter to remain at sea, saving them the time of going to and fro for coal, and giving them an opportunity to clean their boilers and do minor repairs to the engines, besides resting the whole crew, officers and men. In the discussion which followed the reading of this paper, it was pointed out that it was more reasonable to transform a mercantile vessel into a collier in time of war than to build such vessels purposely for an occasion that might never arise.

Mr. James Hamilton, of Glasgow, next read a paper in which he described an ingenious means which he had devised for converting a moderate speed steamer into one of very high speed for war-like purposes. He pointed out that the extreme speed now demanded by the Admiralty for the new mercantile cruisers to which it was proposed to give subsidies was higher than could be used, with profit to the owners, during peace time for ordinary Transatlantic service. The Admiralty asked 25 knots; Mr. Hamilton put the limit for mercantile use at 22 knots. If engines are not worked up to the power for which they are designed, they are uneconomical in themselves, whilst for excessive speeds very great engine power is needed. In order to solve this difficulty, Mr. Hamilton proposes triple-screw steamers, with one central screw and two wing screws. For the 25-knot speed all three screws would be used, and their respective engines would therefore be at work at their full power, and so be operating economically; for the 22-knot speed the two wing screws only would be used, and in order to prevent the drag of the central, idle propeller, the latter is drawn forward, with its shaft, until the blades of the screw touch the stern-post of the ship. This stern-post is so formed that the blades lie snugly against it, and in this way the resistance of the water flowing past the idle propeller is got rid of. For a four-bladed screw the stern-post is made of cruciform shape by the addition of two horizontal wings. In the discussion on the paper, it was pointed out that the shape of the stern-post was not favourable to speed on account of the eddy-making resistance. Mr. Hamilton, in reply to the discussion, said, however, that the objection was not of so serious a nature as was supposed, supporting his contention by diagrams illustrating the stream-line theory.

On the second day of the meeting, Wednesday, June 24, Prof. J. H. Biles read a paper "On Cross-Channel Steamers," in the course of which he gave particulars of certain vessels, and discussed the different qualities needed for success in this particular kind of craft. The paper was illustrated by a large number of drawings of various vessels.

A paper "On Registered Tonnages, and their Relation to Fiscal Charges and Design" was read by Mr. James Maxton. In this the author pointed out some of the absurdities and anomalies incidental to the present stage of the law in regard to the tonnage of ships. A long discussion followed, in the course of which many speakers gave expression to the opinion that a change in the law was absolutely necessary in the interests of shipowners, harbour authorities, and, also, passengers. Several shipowners who spoke laid it down as a principle that in cross-channel steamers every passenger should have a separate berth, and it was only the way in which tonnage was measured that prevented such a desirable feature being introduced.

Prof. W. H. Watkinson read a paper in which he described some new features of superheaters. He pointed out that, even with a separate condenser, and all the other improvements that have been made since the time of Watt, from 12 per cent. to 30 per cent. of the steam supplied to an engine is condensed during its admission to the cylinder. The steam turbine is the only engine in which this condensation of the steam by previously cooled surfaces does not take place, but the steam in turbines is wet from expansion while doing work. Liquefaction of steam may be reduced by steam jacketing; by compounding the cylinders; by steam separators; by a special arrangement for sweeping the condensed steam out of the cylinder at each stroke; by reduction of clearance surface; and by superheating. The last, the author said, was by far the most effective. During superheating, although the pressure of the steam remains constant, its volume is greatly increased. The amount of heat required to superheat 1lb. of steam by 150° F. is 72 British heat units; this is only about 6 per cent. of the heat required to generate 1lb. of dry saturated steam. The increase in volume due to this additional 6 per cent. of heat averages about 30 per cent. In some cases where superheated steam is used, the superheating is only carried so far as to reduce, or at most to annihilate, initial condensation. In these cases the steam, after it has been admitted to the cylinder of an engine, becomes ordinary saturated steam before or at cut-off, so that during expansion some condensation of steam takes place, due to work being done at the expense of the internal heat of the steam. There is, then, no advantage due to the increase of volume of the steam during superheating, but there is great saving in steam and in coal, due to the reduction of initial condensation and leakage of steam past the valves and pistons. In the case of large engines of the usual type, it is not possible to superheat the steam by more than 200° F., and in some cases there is trouble with the valves if the degree of superheat exceeds 150° F. With piston valves the limit can be considerably exceeded. The author next discussed the question of independently-fired superheaters, and those in which the apparatus is placed in the uptake of the boiler or is heated by gases from the furnace. A superheater to which a gas-producer was attached was also illustrated and described by the author.

In the discussion on this paper, Mr. A. F. Yarrow said that superheating was the direction in which engineers must look for improvement in the economy of the steam engine. The difficulty in lubricating the cylinders of steam engines had been spoken of, but it was well known amongst engineers that for years the torpedo boat builders had never used internal lubrication for the engines of the craft they built. It was interesting to note that water would ooze through places where steam would not pass, and for this reason piston valves might be worked with superheated steam without metal being in rubbing contact with metal. Mr. A. Morcom gave some particulars of a vertical engine in which superheated steam had been used. It was a 500kw. engine, and the steam was at 600° F. With saturated steam the consumption of water per kilowatt-hour was 21lb.; with superheated steam it was 16lb.

During the stay in Belfast, the shipyard and engine works of Messrs. Harland and Wolff, and those of Messrs. Workman and Clark, were visited. There was a steamer trip down Belfast Lough, a reception at the harbour offices, and a dinner given by the Right Hon. W. J. Pirrie at his residence at Ormiston.

On Thursday, June 25, members proceeded to Dublin, where they attended a garden party given by the Lord Lieutenant at the Vice-regal Lodge; rain entirely spoilt the pleasure of the reception. In the evening there was a ball at the Mansion House.

On the following day the members met in the lecture theatre of the Royal Dublin Society, when Mr. A. F. Yarrow, vice-president of the Institution, occupied the chair. A paper by the Hon. C. A. Parsons was first taken, the subject being "Modern Steam Turbines, and their Application to the Propulsion of Vessels." The paper was largely of an historical nature, and gave particulars of the various vessels in which the steam turbine had been fitted, such as the two unfortunate torpedo-boat destroyers, *Viper* and *Cobra*, which were both lost at sea. The *King Edward* and *Queen Alexandra* were two passenger steamers that had been running successfully on the Clyde. The *Queen* is a cross-channel steamer, built for the Dover-Calais route, and has been put on her station since the paper was read. She has machinery of 8000 I.H.P. On her trial on the Skelmorlie mile she made a mean speed of 21·73 knots. Another boat of the same type, to be fitted with turbine engines, has been built for the L.B. and S.C.R., and will be put on the Newhaven-Dieppe route. She is 280 feet long and of 34 feet beam, and will shortly be launched. Three large yachts have lately been fitted with steam turbines, the largest being the *Lorena*, built by Messrs. Ramage and Fergusson, of Leith. She is 253 feet in length and of 33 feet 3 inches beam. The steam turbines in this vessel are similar to those of the *King Edward* and *Queen Alexandra*, but somewhat larger. The trial of the *Lorena* took place in the Firth of Forth in May, the speed attained being 18 knots. The turbine yacht, the *Tarantula*, built for the late Colonel McCalmont by Messrs. Yarrow and Co., was of the torpedo-boat type, but with somewhat heavier scantlings. She made 25·36 knots on her trial trip, her displacement being 150 tons. The *Velox* is a torpedo-boat destroyer recently purchased by the British Admiralty. She has machinery similar to that which was in the *Viper*, and will be capable of developing upwards of 10,000 H.P. Two small triple-expansion reciprocating engines, each of 150 H.P., are fitted for cruising speeds up to 13 knots. The steam from these exhausts into the turbines, where its expansion is completed before it passes to the condensers. Another torpedo-boat destroyer, the *Eden*, will have machinery of 7000 H.P., and her speed will be 25½ knots; whilst a third-class cruiser, *Amethyst*, built for the British Government, will have turbines of 9800 I.H.P., her speed being 21¾ knots. The author looked forward to the time when steam turbines would be fitted to vessels of the largest size, such as Atlantic liners. The experience with the marine turbine up to 10,000 H.P. in ships of fast as well as of moderate speed had tended, he claimed, to justify the anticipation—guided by theory—that the larger the engines the more favourable would be the results as compared with the reciprocating engines. The saving in weight, space, attendance and power would be still more marked with turbine engines of above 10,000 H.P., and up to 60,000 H.P., for which designs had been prepared.

The remaining paper read at the meeting was on the Dublin Harbour works, the author being Mr. J. P. Griffith. During their stay in Dublin the visitors took a steamer trip down the Dublin Bay, and on the evening of Friday the Institution dinner brought the meeting to a close.

THE INTERNATIONAL CONGRESS FOR APPLIED CHEMISTRY.[1]

SO many papers on analytical methods were presented that it is impossible even to enumerate them. The International Commissions on Analysis and on the Analysis of Fodders and Manures had not received all the reports yet which the Paris meeting had called for; the two Commissions over which G. Lunge presided—Maercker (Halle), chairman of the second Commission, having died—held some of their meetings jointly with sections i. (analysis) and vii. (agricultural chemistry). The proposals for a uniform method of drawing up analytical reports were made by W. Fresenius (Wiesbaden); Ch. Guillaume (Sèvres) reported

[1] Continued from p. 158.

on the mass of the c.c. of water and on thermometer scales.

Section ii. received some important communications on the auto-purification of waters. G. Weigelt (Berlin) has experimented on the rates of diffusion of refuse waters into river courses when introduced in different circumstances; tests based upon average contamination are quite misleading when injury to the fish is concerned. River water can, owing to its contents in carbonates, bind enormous quantities of sulphuric acid and also of alkalis, by decomposition of the bicarbonates, and iron salts are quickly deposited. F. Fischer (Göttingen) spoke on technically pure water, and regretted that biological tests seemed to supplant chemical analysis; the methods of sample taking were faulty. In section viii. Vandevelde (Gand) remarked that rest, absence of antiseptic and chemical compounds, presence of living organisms, and aëration favoured the auto-purification of water courses. Hygiene and navigation were in opposition; in flat country districts rivers should be doubled, a canal to serve for navigation, and the old bed for purification. Ch. Dreyfuss spoke on the septic tanks of Manchester, Proskauer and Erlwein on the ozone-sterilisation plants of Siemens and Halske at Wiesbaden and Paderborn. On the suggestion of Klaudy (Vienna) it was resolved to bring the water question before the next congress.

G. Lunge reviewed the state of the sulphuric acid manufacture in a very able paper, recommending water-sprays (not vapour) for the lead chambers, and reaction plate towers with artificial draught, and pointing to the great improvements lately effected in concentration apparatus. Kestner (Lille) described his lead ventilators for artificial draught. E. Hart (Easton, Pa.) reported on sulphuric acid in the United States since 1900, and D. Pennock (Syracuse, N.Y.) on the progress in the soda industry in the United States. G. Beilby (Glasgow) reviewed the position of the cyanide industry, pointing out that the actual plants could supply more than twice as much cyanide as is wanted. Synthetic cyanide processes were further discussed, in different sections, by F. Rössler, G. Erlwein, and A. Frank. The latter two spoke particularly on the Caro-Frank process taken up by Siemens and Halske. The carbides of barium and calcium bind nitrogen when powdered and heated, forming $CaCN_2$, which, on extraction with water, yields $(CN.NH_2)_2$, and on fusion with salt (soda was used for the barium compound which was first prepared) sodium cyanide. The calcium cyanamide can also directly be prepared in the electric furnace from lime, coal, and atmospheric nitrogen. Decomposed with water vapour under pressure ammonia results; the calcium cyanamide also gives off ammonia in the soil, and is used as manure under the name of Kalkstickstoff. J. Bueb (Dessau) explained the recovery of the cyanogen from illuminating gas.

F. Mylius (Reichsanstalt) showed that the loss of weight which glass undergoes when treated with water would afford a basis for the classification of chemical glasses; an electric conductivity test practically gives the necessary data. R. Dralle described glass blowing machines; Heinecke, recent improvements in keramics effected at the Royal Porcelain Manufactory of Berlin; Vogt (Sèvres) and Heintze (Meissen) also contributed communications on their porcelains. H. Heraeus, of Hanau, showed his new resistance furnaces, in which platinum foil 0·007mm. in thickness is used instead of wire. The new iridium furnace, also shown, is an iridium tube 0·3mm. in thickness, which was directly heated by continuous currents up to 2000° C. With the aid of these furnaces and the experienced glass-blowers of Siebert and Kühn, of Cassel, quartz vessels are now made in Hanau. Ordinary quartz crucibles cost about half as much as platinum crucibles; they are attacked by metallic oxides and are permeable to hydrogen above 1300° C. (1100° C. according to Hahn), but do not crack on sudden cooling; water gas converts the quartz into tridymite. Siebert and Kühn had quartz thermometers on view. W. Hempel (Dresden) constructs simple high temperature furnaces by cementing small carbon rods to a zig-zag surrounding the crucible; the shell is iron lined with kieselguhr and carbon. Using an arc furnace and placing the substance in the cup of a hollow carbon rod, he has determined the following melting points:—magnesia, 2250°; lime, 1900°; alumina, 2068°; magnesite, 2000°; porcelain (Berlin) softens at 1550°; Meissen porcelain at 1850°. In these experiments a rod rests loosely on the substance, and breaks a contact when sinking. The temperature is determined with a Holborn-Kurlbaum optical pyrometer, or a Bunsen photometer of Hempel's, in which the rays are several times reflected; for this reason Hempel himself regards all these preliminary values as probably too low. H. Bunte (Karlsruhe) demonstrated with the aid of laboratory mantles that neither pure thoria nor pure ceria yield the high luminescence which we obtain by mixtures, and that very small percentages of uranium, platinum, &c., in thoria also produce brilliant lamps, but that none of these are durable. The luminosity is probably simply physical, but there may be catalysis.

Section iii*a*., metallurgy, discussed papers by H. Wedding and Th. Fischer on metallic hydrides, by C. Schiffner (Freiberg) and A. Lodin (Paris) on pyritic smelting, by Ch. E. Munroe (Washington) on mining, metallurgy, and explosives in the United States, Gin (Paris), on extraction of copper pyrites with SO_2, &c. In section iii*b*. Brunswig, Bichel, Blochmann, Mettegang, Eschweiler, Watteyne, O. Guttmann (London), Knight (Krümel), Lenze, Bergmann and others had long discussions on the Trauzl lead block test, determination of explosive velocities, transport of compressed gases and liquids, protection of explosive works against lightning, danger from perchlorates in powder, &c. O. Guttmann's proposal for an international committee on explosion tests in experimental mine galleries did not find sufficient support.

Section iv*a*. had many good papers by C. Engler, Bergner (Baku), Aisinmann (Campina), E. O'Neill (California), Harperath (Argentina) on petroleum; Charitchkow (Grossny) proposed to fractionate technically naphtha in the cold by means of alcohol mixtures. Connstein (Berlin) described the successful splitting-up of fats by the enzymes contained in Rhicinus seeds, &c.; Lewkowitch (London) referred to the same subject. Other papers were on cyanogen, illuminating and water gas (Bunte and F. Fischer), saccharin (Fahlberg), &c.

Sections iv*b*., dyes; v., sugar; vi., fermentation and starch; vii., agricultural chemistry; viii., hygiene, pharmaceutical and medicinal chemistry, and foods; xi., legal and economical questions, were all very busy.

Section ix., photochemistry, discussed papers by J. M. Eder (Vienna) and Ollendorf (Berlin) on sensitometers; on latent images, by J. Waterhouse (Eltham) and Schaum (Marburg); on colour photography by additive synthesis, by A. Miethe and R. Neuhaus (Berlin); on photochemistry in the United States, the centrifugal bromide of silver, and other points, by L. Baekeland, Yonkers, N.Y.; on the resolution of the finest spectrum lines on Doppler's principle, by O. Lummer; and an exhaustive study of the dichroic fog, by A. Seyewitz (Lyon).

In section x., electrochemistry and physical chemistry, J. Traube and G. Teichner (Berlin) performed an experiment apparently disproving Andrews's views on the critical state of gases. A glass tube is partly filled with carbon tetrachloride; it contains also little spherical floats of glass of different densities. The tube is jacketed with paraffin and diphenylamine. When heated to and above the critical point, the meniscus disappears, and the floats do not all collect in the middle portion of the tube. This is to prove that there is no uniform density in the vapour. Repeating experiments of de Heen and Dwelshauvers-Dery, Traube considers that van der Waals's molecular gas volume constant b is not constant, but increases when the liquid passes into the gaseous state, and that the vapour contains liquidogenous and gasogenous molecules the proportions of which depend upon the temperature. At the critical temperature both molecules are soluble in one another in any proportions.

W. Nernst (Göttingen) showed an apparatus with the aid of which he has determined the vapour densities of CO_2 with 0·3017mg., of NaCl with 0·16mg., of S with 0·57mg. of substance. The substance is brought in an iridium vessel, which is lowered into a tubular iridium furnace of Heraeus and heated up to 1950° C. The weighing is done on a balance, consisting of a capillary glass tube as beam, bent down at the end to serve as pointer, and resting on a quartz thread; this balance weighs to 0·001mg., and can be loaded with 2mg. maximum. The values found are, *e.g.* H_2O 17·1 (instead of 18), CO_2 42·9 (44), S 36 and 37·7 (32), so that the sulphur would appear to be monatomic at that high temperature.

E. Wedekind (Tübingen) produces colloid zirconium by reducing the oxide with magnesium and extracting with hydrochloric acid; O. Burns (Boston) colloids of paper, oxides, sulphides, &c., by shaking them for many hours. Monti (Turin) spoke on the concentration of solutions, perfumes, wines, and ordinary salts by freezing; the acids and salts collect in the microscopical interstices between the small ice crystals, and when frozen blocks are left to themselves, the substances diffuse downward; concentration by cold is more economical than by heat. Bredig (Heidelberg) and Count Schwerin (Höchst) spoke on electric osmosis, E. Solvay (Brussels) on a gravitation formula applicable to diffusion phenomena, Zengelis (Athens) on the production of very high temperatures by burning aluminium in oxygen and other gases. The kinetics of the catalytic sulphuric acid process were discussed by Knietsch (who has worked the process out in Ludwigshafen) in section ii., and by Bodenstein and Bodländer in x. Similar papers were read by Schenck (Marburg) on the splitting of CO, by H. Goldschmidt (Christiania) on the kinetics of reductions, by Bodländer on technical catalysis. H. Goldschmidt (Essen) reported on the manufacture of steel in the electric furnaces of Stassano, Gin-Leleux, Héroult, Keller, Kjellin, and others; Bancroft and A. A. Noyes on electrochemical research in the United States; Fr. Foerster (Dresden) and Brandeis (Aussig) on electrolytic preparation of inorganic compounds; M. Le Blanc (Karlsruhe) spoke on electrolysis with alternating currents and the possibility of determining the velocity of ionic reactions; Coehn (Göttingen) on electrode influence in electrolytic oxidations and reductions, H. Moissan on metallic carbides, Héroult on the efficiency of electrolytic soda processes, Danneel and Nissenson on the electrolytic deposition of metals, Küster (Clausthal) on dissociation pressure of soda solutions, W. Marckwald on his radioactive tellurium, and Precht (Hanover) on the spectrum and atomic weight of radium (in ix.). W. von Bolton demonstrated what he briefly calls luminosity of the ions. When a carbon rod is lowered as anode into sulphuric acid, containing a copper spiral as kathode, the rough surface of the carbon becomes at once bright under the influence of currents of 110 volts. When rods of metals (or of carbon) are dipped into solutions of their salts, the rod being the kathode, a platinum spiral the anode, the rod begins to glow in brilliant colours, and beautiful band spectra of the ions (?) are obtained, differing from the spark spectra which result when the anode is glowing. The discussions were very good.

H. BORNS.

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES.

THE eighth annual congress of the South-Eastern Union of Scientific Societies was held at Dover on June 11–13. A lively address by the president, Sir Henry Howorth, F.R.S., put pin pricks into all the infallibilities, begging the student to accept no predominant hypothesis without demur, to resist the fascination of great names, to challenge the exactness even of the exact sciences. Fallacies might often lurk in phrases, as when "the survival of the fittest" was glibly used to mean nothing more than the survival of the survivors. The address impressed its hearers with the advantage which every branch of science might derive from the touch of a keen and active critical faculty, working outside the ranks of the specialists.

The papers contributed to the congress fall into three classes, the purely local, the general, and those of divided interest. In the last of these Mr. A. T. Walmisley's essay discussed the methods by which a traveller between Kent and the Pas de Calais might cross the intervening strip of shallow water, on, in, under, or over it, without the incidents which now so often befall him when the "silver streak" is converted into a tumultuous concourse of atoms. The new turbine steamer was indicated as the best chance for humanity—at least until something better is invented. Mr. W. Whitaker, F.R.S., observed that clearly nature had expressly designed the Straits of Dover for a submarine tunnel, though politicians might think otherwise. Mr. A. O. Walker, dealing with the effects of climate on distribution, compared his long experience of the fauna and flora of Cheshire and North Wales with his later observations while residing near Maidstone.

Of local papers the most important was that by Mr. Sydney Webb and Captain McDakin on the disappearing fauna and flora of the district. There were many lamentable and in part unavoidable losses. The dwindling of the colony of seals at Beachy Head was deplored, but no tears were seen to fall at the news that vipers were becoming scarce and polecats scarcer. The congress museum was instructively adorned by Mr. Webb's fine collection of Lepidoptera with their caterpillars, and by the display of plants with their seedlings from the Catford Society.

Prof. Boulger opened a discussion on the best means of checking the extermination of British plants and animals. Dr. Rowe, in a paper on the importance of zonal distribution, alluded to the doctrine that the souls of good geologists go hereafter to their favourite "sections," and hoped he might be allowed to stake out his claim to a particular slice of Dover Chalk, from which he had already abstracted about 5000 fossils.

The non-local discourses included an interesting account by the Rev. R. A. Bullen of "a late Celtic cemetery at Harlyn Bay," and a valuable investigation by Miss Ethel Sargent, who unfolded the story of Geophilous plants, explaining how these "lovers of the soil," to suit seasons and climates, for periods of varying duration, keep themselves close within the protecting bosom of their mother earth, the seeds and bulbs in the meantime, with a kind of vegetable instinct, ever using their foodstore to the best advantage. The concluding address was by Dr. Jonathan Hutchinson, F.R.S., the retiring president, who at two successive congresses has delighted his audience by a finely-argued discussion of a subject not at the first blush very attractive. His theme was leprosy. His theory is now well known, that this disease is caused by the consumption of badly cured fish, or occasionally by the eating of food which has been handled by lepers. During the last two years he has visited Africa and India, everywhere seeking out lepers and leprous communities, especially in places where he had been told that a fish diet was out of the question. Everywhere he found that in that particular his informants had been misinformed. A quotation from Erasmus sent to Dr. Hutchinson by a classical friend represented the Pope himself as proposing to proscribe the use of salt fish on account of its supposed tendency to spread leprosy, though it is not salt fish in itself that lies under any evil imputation. Erasmus often makes ironical statements, but on the foul effects produced in his day by the consumption of putrid fish his dialogue "Ichthyophagia" speaks with no ambiguity.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The following is the text of the speeches delivered by Prof. Love in presenting M. Poincaré and Prof. Story-Maskelyne for the honorary degree of D.Sc. at the Encænia on June 24:—

Nescio an maximus inter mathematicos qui nunc vivunt sit Henricus Poincaré: vir iure mirandus non solum quod novis viis quærendi usus novos fructus adeptus est, sed quod tot et tam diversa doctrinæ genera unus complecti potuit, cum commentariis innumerabilibus fere omnes geometrices et analyseos partes illustraret. Cum in hæc recondita doctrinæ arcana altius penetrasset, rite eum Regalis Societas ornavit numismate aureo in memoriam Professoris nostri Sylvester instituto quod ei primo datum est. Non solum subtilissimis illis quæstionibus quæ de mathematicæ veritatis natura inter philosophos oriuntur hunc auctorem plerique sequuntur, sed ingenii maximi viribus nisus de luce, de vi electrica, de difficillimo quoque doctrinæ genere præclarissime disseruit. In Astronomia certe ea de motu et de figura planetarum est commentatus ut omnibus de hac re quærentibus nova quadam et meliore via insistendum sit. Hunc talem virum in omni genere doctrinæ insignissimum, rerum naturam animo peragrantem, geometren, physicum, astronomum præstantissimum, Academia nostra inter suos doctores libentissime adscribit.

Septem et quadraginta abhinc annos Willelmo Buckland successit Mervin Herbertus Nevil Story-Maskelyne, Mineralogiæ primo Prælector mox Professor factus, quem honorem, nulli antea apud nos concessum, novem et triginta annos nullo intervallo retinuit, nec nisi octo abhinc annos deposuit. Primus etiam eodem fere tempore minerarum in Musæo Britannico custos creatus trium et viginti annorum labore effecit ut maxima vis minerarum omnium, nusquam alias in omni orbe terræ invenienda, intra parietes Musæi Britannici congereretur. Quod ad scientiam exquisitiorem pertinet, natura lapidum de cælo iactorum investiganda summam laudem adeptus est: idem minerarum et crystallorum formas et species accuratissime descripsit. Sed magistri boni præcipua laus in discipulis constat, neque silendum arbitror multos ex iis, qui hodie in hac scientia principes et signiferi sunt, hoc auctore et Professore doctissimo usos esse. Idem rude iam donatus a Musæo Britannico ita recessit ut rei publicæ se daret et Crickladensium suffragiis ornatus in publico totius civitatis consilio indivisi imperii vindex et defensor acerrimus sederet. Addo quod Regalis Societatis Sodalis et Collegii Wadhamensis socius honoris causa creatus cum multis virorum doctorum societatibus et in Europa et in America litterarum commercio coniunctus est.

PROF. J. LARMOR, F.R.S., has had the honorary degree of doctor of science conferred upon him by the University of Dublin.

A COMMITTEE has been formed with the object of raising a memorial in honour of the late Mr. T. G. Rooper, who died on May 20. Mr. Rooper held the office of H.M. Inspector of Schools in the Isle of Wight, Southampton and the neighbourhood during the last seven years, and both in his district and elsewhere he promoted the development of rational teaching of geography, natural history and other science studies. Information concerning the proposed memorial will be gladly supplied by Profs. F. J. C. Hearnshaw and J. F. Hudson, Hartley University College, Southampton.

THE appeal for funds for extending and modernising the scientific departments of the University of Dublin, to which reference was made last week (p. 188), should receive liberal support not only from graduates of the university, but also from all who sympathise with the cause of higher education in Ireland. Each science department of the university is in need of funds for laboratories, instruments, and other means of study and research. The university has already made considerable outlay in order to increase the efficiency of the scientific departments, but the new demands created by modern developments are too many and extensive to be met by existing resources, and it is necessary to ask for additional endowments if the university is to maintain its high position among the educational forces of the British Isles. In making the appeal for funds, it is pointed out that the important position assumed by modern science as a subject of collegiate education, and the great expansion of the scientific professions, render it incumbent on the older universities to make a costly provision for the adequate teaching of the experimental sciences. Not only must the universities of to-day be able to extend to their students—whether professional or in arts—sound theoretical and practical instruction in the established principles of science, but if these corporations are to continue to fulfil their duties efficiently, they must, in addition, provide facilities for research available both to student and teacher. In short, the demands on the resources of universities are not only for the endowment of chairs of science and the salaries of assistants and demonstrators, but also for the provision, equipment, and maintenance of lecture-rooms for teaching, and laboratories for both class-work and research. Moreover, the provision for laboratory equipment must be adequate to meet the ever-fresh demands of scientific advance. In the past the University of Dublin has discharged her duties towards the newer studies in a manner which has, in many particulars, set example to wealthier bodies. But a time has arrived when expenses must be incurred beyond her existing resources, and the University of Dublin must either obtain external aid to build and equip laboratories and lecture-rooms for physical science, electrical and mechanical engineering, botany and zoology, or conduct under grave disadvantages the instruction of those students who require to include these subjects in their professional training, or in their courses in arts.

A REPORT drawn up by a committee appointed by the Board of Trinity College, to consider the present scientific requirements of the college, shows that a sum of at least 100,000*l.* is needed by the scientific schools of the university. The appeal from which this statement of position and needs of the university has been taken is signed by Lord Rosse (Chancellor of the university), Mr. D. H. Madden (Vice-Chancellor of the university), Prof. Geo. Salmon (Provost of Trinity College), Lord Ashbourne, Lord Lansdowne, Lord Pembroke, Lord Ardilaun, Lord Iveagh, Lord Rathmore, Mr. E. H. Carson, Mr. W. E. H. Lecky, and Mr. J. H. M. Campbell. To carry the recommendations of the committee into effect, a considerable expenditure (for which no provision can be made out of college funds) must be incurred, including a capital outlay (for building and fitting laboratories and the like purposes) of 34,000*l.*, in addition to an annual charge for increased salaries and other expenses, estimated at 2730*l.* per annum. Lord Iveagh has generously offered to provide the capital sum of 34,000*l.* so soon as a sufficient amount has been collected and invested to produce the annual outlay contemplated by the committee (viz. 2730*l.* per annum), and this offer will hold good for three years from May 1 next; or if a sufficient annual income is assured by investments for carrying out the recommendations of the committee for any one department, he is prepared to contribute the capital expenditure necessary for the equipment of that particular department. A very large sum has to be collected during the next three years, but Lord Iveagh's offer ought to inspire others to contribute as generously as they are able to the subscription list. The Chancellor of the university, Mr. Benjamin Williamson, and Prof. W. E. Thrift are acting as honorary treasurers of the science fund.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 14.—"On the Radiation of Helium and Mercury in a Magnetic Field." By Prof. Andrew **Gray,** F.R.S., and Walter **Stewart,** D.Sc., with Robert A. **Houstoun,** M.A., and D. B. **McQuistan,** M.A., Research Students in the University of Glasgow.

The experiments had for their object primarily to test for lines of different substances, the proportionality of the change $d\lambda$ of wave-length, for each of the components into which a single spectral line is resolved by the application of a magnetic field, to the field intensity H, and to deduce the corresponding values of the ratio e/m of charge to mass of the electron. The apparatus consisted of a set composed of a large electromagnet (built to Prof. Gray's specification), and an echelon spectroscope of twenty-six plates with auxiliary (by Hilger, London). The readings were obtained by means of a micrometer eye-piece fitted to the observing telescope. The first observations were made at right angles to the magnetic field on several of the helium lines, and on the green line of mercury. The results were used to calculate the values of $d\lambda/H\lambda^2$, and of e/m by the formula $e/m = 2\pi v . d\lambda/H\lambda^2$, where v is the velocity of light, 3×10^{10} cm. per second. In every case the normal triplet was obtained, and the separation between the extreme components found to be proportional to H up to fields of 10,000 C.G.S.; at fields above this the light becomes so faint, in all the tubes with which the authors worked, that it is impossible to obtain readings. The following table shows the results:—

Substance.	Wave-length, 10^{-8} cm.	$d\lambda/H$.	$d\lambda/H\lambda^2$.	e/m.
Helium ...	5016 (green)	$1{\cdot}61 \times 10^{-5}$	$6{\cdot}41 \times 10^{-5}$	$12{\cdot}1 \times 10^6$
,,	5876 (yellow)	$2{\cdot}07 \times 10^{-5}$	$6{\cdot}00 \times 10^{-5}$	$11{\cdot}3 \times 10^6$
,,	6678 (red)	$2{\cdot}90 \times 10^{-5}$	$6{\cdot}49 \times 10^{-5}$	$12{\cdot}2 \times 10^6$
Mercury...	5461 (green)	$2{\cdot}12 \times 10^{-5}$	$7{\cdot}12 \times 10^{-5}$	$13{\cdot}4 \times 10^6$

At a field intensity of 13,000 C.G.S. the centre component of the normal triplet was doubled, while each of the outer components was itself tripled. The polarisation of the two triplets and of the central doublet was the same as that of the lines from which they originated, namely, that of the lines of the normal triplet. At all fields up to 13,000 the faint companion to the yellow helium line D_3 was not tripled, but only doubled.

For the above lines observations were made also along the lines of force, one of the magnet cores being replaced by a core drilled from end to end with a hole about a centimetre in diameter. The following table gives the numbers obtained :—

Substance.	Wave-length, 10^{-8} cm.	$d\lambda$/H.	$d\lambda/H\lambda^2$.	e/m.
Helium .	5016	$1·75 \times 10^{-5}$	$6·95 \times 10^{-5}$	$13·1 \times 10^6$
,,	5876	$2·24 \times 10^{-5}$	$6·50 \times 10^{-5}$	$12·3 \times 10^6$
,,	6678	$3·13 \times 10^{-5}$	$7·01 \times 10^{-5}$	$13·2 \times 10^6$
Mercury...	5461	$1·88 \times 10^{-5}$	$6·31 \times 10^{-5}$	$12·0 \times 10^6$

With respect to the green mercury line of wave-length 5461 tenth-metres, the authors incidentally observed fully a year ago, as they found afterwards had also been done a little earlier by Zeeman, that the line appeared to have three faint companions on the violet side, and two (they seemed at times to see three) on the red side. The companions are visible only under special conditions of the discharge tube. The values of $d\lambda$ for the first three are −0·208, −0·096, −0·059, and for the other two +0·032, +0·067. Though those values do not in every case agree with those given by Perot and Fabry, it is possible that, on account of hitherto unexpected complexity of the line, both sets of observations are correct.

It ought to be noticed here that Runge and Paschen have obtained a resolution of the green mercury line into three triplets in the magnetic field. This observation is entirely confirmed as to the side triplets by those of the authors (which were made before Messrs. Runge and Paschen's paper came to hand), but they have not been able to verify Runge and Paschen's result for the middle group, which appears to the authors to be a doublet. But the instrument of Runge and Paschen was a large Rowland grating of 6·5 metres diameter of circle, and the spectrum was photographed, so that their observations were, no doubt, more certain than the authors'.

May 28.—"Note on the Effect of Extreme Cold on the Emanations of Radium." By Sir William **Crookes**, F.R.S., and Prof. James **Dewar**, F.R.S.

The first endeavour was to ascertain whether the scintillations produced by radium on a sensitive blende screen were affected by cold.

A small screen of blende with a morsel of radium salt close in front was sealed in a glass tube, and a lens was adjusted in front so that the scintillations could be seen. On dipping the whole into liquid air they grew fainter and soon stopped altogether. Some doubt was felt whether this might not have been caused (1) by the presence of liquid, (2) by the screen losing sensitiveness, or (3) by the radium ceasing to emit the heavy positive ions. To test this two tubes were made, in one of which the radium salt could be cooled without the screen, and in the other the screen could be cooled while the radium salt was at the ordinary temperature.

The results were as follows :—(1) Radium salt cooled by liquid air. Screen at ordinary temperature. Scintillations quite as vigorous as with radium at the ordinary temperature, the screen and radium being *in vacuo*. (2) Radium at the ordinary temperature and screen cooled in liquid air. As the screen cooled the scintillations became fainter and at last could not be seen. On allowing the temperature to rise the scintillations recommenced. (3) A screen with a speck of radium salt in front of it was sealed in a tube. The tube was sealed off when a few fine drops of water were still remaining in the tube. The scintillations were well seen in this saturated aqueous vapour. The lower end of the tube was dipped in liquid air, which instantly condensed the aqueous vapour and left a very good vacuum. On now examining the scintillations they were if anything brighter and more vigorous than at first. When liquid hydrogen cooling was used instead of liquid air, the action was equally marked, showing that the highest vacuum that can be obtained by the action of cold does not diminish the scintillations.

In order to test the activity of radium in rendering air electrically conductive some radium bromide was sealed up in a glass tube and heated to the highest temperature the glass would stand, during the production of as high a vacuum as the mercurial pump would give. The whole tube was then immersed in liquid hydrogen contained in a vacuum vessel. On bringing the radium in such a vessel into a room in which a charged electroscope was placed it began to leak when the tube of radium surrounded with liquid hydrogen was some three feet away, and was very rapid in its action when a foot away from the electrometer. On immersing the tube containing the liquid hydrogen with submerged radium in another large vessel of liquid air and bringing the combination near the electroscope, the action was the same.

Prof. Rutherford and Mr. Soddy have made the important discovery that a condensable emanation is diffused into gases from solutions of radium salts, which is capable of condensation from the gas mixture at the temperature of liquid air. As it was important to ascertain what was taking place in this respect with the anhydrous radium bromide when isolated in the highest vacuum, the following experiment was arranged :—A glass apparatus was constructed consisting of a ∩-shaped tube having a bulb at one end, and being drawn out to a capillary tube at the other. Above the bulb was a plug of hard-pressed purified asbestos. The radium salt was located at the bottom of the bulb, and the whole was most carefully heated, exhausted to the limit of the mercurial pump, and sealed off. In the dark no trace of phosphorescence could be seen in any part of the apparatus unless from the pieces of the radium bromide. The capillary tube was now immersed in liquid air in a large flask, so that distillation might proceed undisturbed for days. After twenty-four hours of this operation, on looking at the capillary tube while covered with the liquid air, a marked phosphorescence was recognisable owing to some condensed emanation. The luminosity became naturally more marked the longer the time the action was allowed to proceed, and it is the authors' intention to continue the experiments for a lengthened period of time, and then seal off the fine capillary part so that the condensed product may be thoroughly examined.

Entomological Society, June 3.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Mr. G. C. **Champion** exhibited numerous specimens of *Coccinella distincta*, taken in the pine woods of Woking. They were found, as usual, running about the ground in company with *Formica rufa*, and were perhaps wanderers from some other locality. Mr. Donisthorpe said the species was still common at Weybridge in the nests of *Formica rufa*, and that he had observed it also at Bexhill, while Mr. Chitty noted its former occurrence in Blean Woods in great numbers.—Mr. H. St. J. **Donisthorpe** exhibited a very remarkable melanic form of *Halyzia 18-guttata*, L., black with white spots, the type, which was also exhibited, being light brown with white spots. The former was taken at Oxshott on May 22. He also exhibited *Stilicus fragilis*, Gr., a melanic form with a black thorax instead of red as in the type, taken at Shirley on May 15; and *Staphylinus fulvipes*, Scop., taken by himself at Bamber Forest on June 1, a new locality for this rare beetle.—Dr. T. A. **Chapman** exhibited two full-grown larvæ of *Thestor ballus*, sent by Mr. H. Powell, from Hyeres, and read a description of them in their various stages. He also exhibited a larva of *Heterogyna paradoxa*, full fed, reared from the egg at Reigate, and a cocoon of *Orgyia auro-limbata*, with parasite microgaster. The microgaster and the moth both came from the same larva, and the moth, though containing a few eggs, laid none. An imago and a parasite from the same larva have not infrequently been recorded, but there has been some doubt on the occurrence.—The **President** exhibited the dry form of *Precis actia* bred by Mr. Guy A. K. Marshall from an egg laid by a female of the wet form. The parent was captured by Mr. Marshall at Salisbury, Mashonaland (5000 feet), on February 14; the egg was laid on the following day. It hatched February 20, the larva pupated March 16, the perfect insect, a male, emerged March 28. The differences between these two forms are as astonishing as those between the two phases of *Precis antilope* bred, the dry from the wet, by Mr. Marshall last year. The president said this was the third South African species of the genus Precis in which Mr. Marshall had produced incontrovertible evidence of the specific identity of forms widely separated in colours, patterns, shape, relation of upper- to under-side, &c., and even instinct, including the selection of a particular type of country. The president also showed a small series of ants, part of a much larger collection made by the late W. J. Burchell in Brazil between the years 1825 and 1830. Considering their great age, the specimens were wonderfully well preserved, and were accompanied by remarkably exact and detailed data, and, in many cases, interesting notes on habits, instincts, &c.—Mr. O. E. **Janson** communicated a paper on the genus Theodosia and other Eastern Goliathides, with descriptions of some new species.—Colonel C. **Swinhoe** communicated a paper on new genera and species of the family Lymantriidæ in the National Collection.—Mr. G. W. **Kirkaldy** communicated a memoir on the Rhynchota collected by Dr. Arthur Willey chiefly in Berara and Lifu.—Prof. E. B. **Poulton** gave an account of experiments in 1893, 1894, and 1896 on the colour relation between certain lepidopterous larvæ and their surroundings, and especially the effect of lichen-covered bark upon *Odontopera bidentata* and *Gastropacha quercifolia*.

Mineralogical Society, June 9.—Dr. Hugo Müller, president, in the chair.—Mr. H. F. **Collins** gave an account of a remarkable mass of wollastonite with associated minerals which occurs at Santa Fé, State of Chiapas, Mexico. This mass of nearly pure wollastonite covers an area of 400 yards by 160 yards, and reaches to a depth of more than 300 feet; it is surrounded on all sides by granite, felsite, and other igneous rocks, and is separated by a mile from the nearest limestone. Near the outskirts of the mass occur extremely large crystals of wollastonite, most of which have been partially or entirely converted into quartz or semi-opal. Here are also found masses of garnet and of workable copper ores containing gold and silver. The author exhibited and described specimens of wollastonite, bornite in wollastonite, bornite in calcedony, gold-bearing linnæite, idocrase rock, and a remarkable intergrowth of bornite and galena resembling graphic granite.—Prof. H. A. **Miers** described the results he has obtained from the observation of the growth of crystals by a new method. The method consists in tracing the changes of angle upon a crystal during its growth by measuring it at intervals by means of a specially devised inverted goniometer, without moving it from the solution in which it is growing. It was found that an octahedron of alum yielded invariably three images for each face, so that the crystal had really the form of a very flat triakis-octahedron. Similar observations on other crystals lead to the conclusion that the faces of a crystal are in general not faces with simple indices, but vicinal planes slightly inclined to them, which change their inclination during the growth of the crystal. By determinations of the refractive index of the solution by means of total reflection within the crystal, it was found that in each case the liquid in contact with the growing crystal is slightly supersaturated.

Mathematical Society, June 11.—Prof. H. Lamb, president, in the chair.—The president announced that, after the conclusion of the current volume, some changes would be made in the form of publication of the *Proceedings*, the chief being an increase in the size of page and type.—The following papers were communicated:—Major P. A. **MacMahon,** The application of quaternions to the algebra of invariants.—Mr. G. B. **Mathews,** Jacobi's construction for quadric surfaces.—Mr. H. W. **Richmond,** Automorphic functions in relation to the general theory of algebraic curves. The object of the paper is to extend to curves in space of three or more dimensions the methods which have been developed by Poincaré and Humbert for the parametric representation of plane curves by means of automorphic functions. Curves are classified by their genus (or deficiency), their order and the number of dimensions of the space in which they lie, and the properties of all the curves in a class can be inferred from those of particular members of the class. The genera 1, 2, 3, 4, 5 are discussed in detail.—Prof. L. E. **Dickson,** Addition to the paper on four known simple groups of order 25920.—Prof. A. C. **Dixon** made an informal communication On a method of introducing the logarithmic function by means of geometrical properties of conics.

EDINBURGH.

Royal Society, June 1.—Dr. Munro in the chair.—Mr. George **Muirhead**, commissioner for the Duke of Richmond and Gordon, read a paper on the effect of temperature on the taking of salmon by rod and fly on the River Spey at Gordon Castle. From a careful examination of the full statistics which had been kept for a number of years, and a discussion of them in the light of various possible meteorological and climatic causes, the conclusion come to was that the number of salmon caught on a day was determined, to a large extent, by the variation of temperature during that day, the greater the variation of temperature the smaller the catch.—Dr. W. **Peddie** read a paper on the theory of colour vision. The theories which give the best account of the facts of colour vision and colour blindness are the Young-Helmholtz theory and Hering's theory. Both are trichromatic theories, and, apart from physiological or anatomical questions, both can, by proper choice of fundamentals, be made to give a good account of the main facts. The facts of one-eyed colour blindness show that, on the Young-Helmholtz theory, colour blindness must be regarded as due to fusion of at least two fundamental sensations. But the curves of one sensation, determined by observations on different eyes, differ considerably among themselves. This indicates that a broader basis for the theory may be desirable. This may be sought for in a tetrachromatic theory. But any such theory must explain the possibility of trichromatic representation of all colours. The theory proposed assumes two pairs of complementary stimulations, say, R, G_1 and G_2, V. In this respect it has a resemblance to Hering's theory. But whereas, in Hering's theory, stimulation of one member of a complementary pair means no stimulation of the other member, in the proposed theory equal stimulations of two such members gives white. It is shown that four sets of equivalent trichromatic fundamentals must exist. Assuming Helmholtz's fundamentals as such a set, the four mathematically possible sets of tetrachromatic equivalents, of which only one can exist physically, are deduced; and it is found that one of these does suit the known facts of colour vision and colour blindness. Choosing this set, the other three trichromatic equivalent sets (Helmholtz's being the fourth) can be deduced. The perceptibility curves (ordinates being differences of wave-length just appreciable to the eye in the spectrum) found for one of these sets is compared with that given by Helmholtz's set. The comparison is found to be very satisfactory. The nature of the tetrachromatic set shows that colour blindness must be regarded as due to suppression of one complementary pair of sensations, while variations in normal eyes are due to partial suppression. In this way the sensation curves for different eyes may have greater fixity as regards form, depending on wave-length, than in the trichromatic set. This result is desirable if the sensation curves are to be regarded as really corresponding to physiological stimulation produced photochemically or photoelectrically. A simple theory of such stimulation is given and shown to lead to the required form of relation between the four fundamentals.

June 15.—The Hon. Lord M'Laren in the chair.—Dr. **Horne** and Dr. **Peach** read a paper on the Canonbie Coalfield: its geological structure, &c. Though of limited extent, this coalfield has aroused considerable interest owing to the important series of plants obtained from the beds and to the questions bearing on the correlation of the Carboniferous rocks of the Scottish border with those of the north of England and centre of Scotland. About twenty years ago it was assigned by the Geological Survey to the Calciferous Sandstone series. At that time, however, great difficulty was felt in correlating the subdivisions of the Carboniferous rocks as there developed with those in the midland valley of Scotland, owing to the marked variation in some of the groups from the normal Scottish types. The palæontological evidence then obtained was not in accord with these conclusions, for the plants seemed to show that the coalfield really belonged to the true Coal-measures. Last year the Canonbie area was reexamined by the Geological Survey and Mr. Kidston. Deep bores have been sunk in recent years by His Grace the Duke of Buccleuch, and these also have furnished important geological evidence. By means of horizontal sections it was shown that the following order of succession prevailed in the Lower Carboniferous rocks of that region:—(1) at the base, the Whita Sandstone resting on the Birrenswark volcanic platform; (2) the cement stone group; (3) the Fell Sandstones; (4) the Glencartholm volcanic group with Scorpion Bed; (5) a group of marine limestones, sandstones, and shales, with coal seams on two horizons—a lower, the Lawston Linn and Muirburn coals (Scremerston position), and an upper, the Kilnholm coals (Lickar position). The Upper Carboniferous Rocks of that region, embracing the Canonbie Coalfield, have been referred by Mr. Kidston to the Lower, Middle, and Upper Coal-measures, in virtue of the evidence obtained from the plants. The bores sunk in recent years near Rowanburn prove that the Rowanburn coals (Lower Coal-measures) overlie the marine limestone group with the Kilnholm (Lickar) coals; and that, further, the Red Sandstones and shales referred by Mr. Kidston to the Upper Coal-measures pass downwards into a series of thin coals which may be the upper part of the Byreburn series. An important economic question arises as to the extension of this coalfield, for it appears that there is good ground for the belief that the sandstones and shales of the Upper Coal-measure age overlie the Middle and Lower Coal-measures. In conclusion, it was shown by means of vertical sections that the Carboniferous succession in Eskdale and Liddesdale resembles more closely that of Northumberland than that of central Scotland.—As an important supplement to the foregoing, Mr. Kidston communicated lists of the fossil plants of the Calciferous Sandstone series of Dunfermline, of the Carboniferous Limestone of Eskdale, of the Lower Coal-measures of Canonbie, of the Middle Coal-measures of Byreburn, and of the Upper Coal-measures of Jockie's Syke, Cumberland, which borders on Dumfriesshire. Tables showing the horizontal distribution of the species were given, and some new and interesting species described, among these a new species of Pinakodendron (*P. Macconochiei*) being the first record of the genus in Britain.—A paper by Prof. **Ewart** on the wild horse will be printed in full in these columns.

DUBLIN.

Royal Dublin Society, May 19.—Prof. W. F. Barrett, F.R.S., in the chair.—Prof. T. **Johnson** gave an illustrated account of a tylose which he had found in a tracheide in the xylem of the rhizome of a bracken fern (*Pteris aquilina*, L.). He suggested that the disturbance in the transpiration current resulting from cutting the bracken might produce tyloses in the underground stem.—Mr. Richard J. **Moss** read a paper on an Irish specimen of dopplerite. This interesting substance does not seem to have been previously recorded as occurring in the United Kingdom, though it would appear from a reference to a peculiar form of peat in a report issued by the Commission on Bogs in Ireland in 1811 that the substance named dopplerite by Haidinger in 1849 had previously been observed in Ireland. The dopplerite recently found in a peat bog in the county of Antrim was in the form of an elastic jelly, velvety-black in colour, and drying to a solid of jet-like appearance, with a bright conchoidal fracture. In chemical composition it differs little from the peat in which it was found. It is shown that mineral matter, chiefly iron oxide and lime, which constitutes 5 per cent. of the dry substance, may be removed by steeping the jelly in hydrochloric acid without altering the consistence or appearance of the substance. The original jelly is acid to litmus, and liberates carbon dioxide from calcium carbonate. Assuming that it consists chiefly of monobasic humic acid with a molecular weight of 350, the gas liberated corresponds to 73 per cent. of humic acid in the dry substance. The peat in which the dopplerite was found liberates carbon dioxide corresponding to 60 per cent. of the dry substance.—Prof. W. F. **Barrett** exhibited and described Hilger's direct-reading wave-length spectroscope. —Prof. E. J. **McWeeney** gave a description of *Streptothrix nigra*, an organism occurring in soil, and producing a bright brown pigmentation of the nutrient medium.

Royal Irish Academy, May 25.—Prof. R. Atkinson, president, in the chair.—Reports were presented by Dr. R. F. **Scharff,** R. L. **Praeger,** Prof. G. A. J. **Cole,** Prof. D. J. **Cunningham,** F.R.S., G. **Coffey** and others on the results obtained during their exploration of the Kesh Caves, Co. Sligo. The reports detailed the results obtained from an exploration of the deposits of clay, rock-fragments, and stalagmite found in the caves situated on the slopes of Keishcorran Mountain in Co. Sligo. Several weeks were spent by the committee in excavating these caves in 1901. The zoological results possess many points of interest. The brown bear was found to have inhabited these caves in great numbers in former times; in Ireland remains of this animal have hitherto been found only very locally. The other animals found in the caves which are now extinct in the country in either a wild or domesticated state were the reindeer, wolf, and Arctic lemming, the last of which is an addition to the Irish fossil fauna. Man was chiefly a late inhabitant of the caves, a single polished axe being the only Neolithic object found. Several implements of crannog type were found, and abundance of charcoal.

June 8.—Prof. R. Atkinson, president, in the chair.—The intrusive gneiss of Tirerrill and Drumahair, by Prof. Grenville A. J. **Cole.** The northern end of the gneissic axis of the Ox Mountains consists of an intrusive granite, which contains blocks of amphibolite, derived from an earlier series. The banded phenomena presented by it are connected with its flow, and the contrasts of mineral constitution in the bands are connected with the abundance of basic inclusions, which have become streaked out in the fluidal mass. Though brought into their present prominence by Caledonian and Hercynian movements, the crystalline rocks of the chain may still be of Archæan age, as originally suggested by Prof. Hull.

PARIS.

Academy of Sciences, June 22.—M. Albert Gaudry in the chair.—Two fluid batteries; electromotive force, condensations, transformations of energy at the electrodes, by M. **Berthelot.**—On the structure and history of the lunar crust. Observations suggested by the seventh number of the photographic atlas of the moon, by MM. **Lœwy** and P. **Puiseux.** This volume contains photographs which show clearly the frequent distribution of the eruptive orifices along the lines of cleavage. From the mode of diffusion of the scoriæ there would appear to have been, at a remote period, an atmosphere, and from the state of these deposits it is clear that there can be no running water on the surface.—On the loss, in time of drought, of a spring fed by infiltration of a sheet of water, by M. J. **Boussinesq.** —On a property of the α-rays of radium, by M. Henri **Becquerel.** If the α-rays, placed in a field of magnetic intensity H, have a real or fictitious mass m, carrying an electric charge e, they ought to describe a circular trajectory of radius R, with a velocity v, and the relation $RH = vm/c$ ought to hold between these quantities. From this RH ought to be a fixed quantity for the α-rays, but this is not the case, since Prof. Rutherford has given $RH = 3{\cdot}9 \times 10^5$, and in the experiments now described values of RH, varying continuously between $2{\cdot}91 \times 10^5$ and $3{\cdot}41 \times 10^5$, have been obtained. From this it follows that in a uniform magnetic field the radius of curvature of the trajectory of the α-rays deviated by the field increases with the length of the trajectory, and this may be attributed to the presence of air.—The preparation of carbides and acetylene acetylides by the action of acetylene gas upon the hydrides of the alkalis and the alkaline earths, by M. Henri **Moissan.** At a temperature of 100° C. the hydrides of the alkalis and the alkaline earths react with acetylene, liberating hydrogen and giving compounds of the type $C_2K_2.C_2H_2$ and $C_2Ca.C_2H_2$. These compounds, heated in a vacuum, dissociate readily into acetylene and the corresponding carbide, and hence form a new method for the preparation of the carbides at a low temperature. Neither methane nor ethylene react at 100° C. with these hydrides.—The influence of the solvent on the rotatory power of certain molecules, by MM. A. **Haller** and J. **Minguin.** Details are given of experiments on several camphor derivatives. In solution in benzene and its homologues, which are non-ionising liquids, the rotatory power of cyano-camphor was found to be nearly zero, whilst in other solvents, especially in alkaline liquids, which are strongly ionising, the rotatory power was very high. Other camphor derivatives showed similar results, although the differences were less marked.—The differences between the diseases known as nagana, surra, and caderas, by MM. A. **Laveran** and F. **Mesnil.** It has been previously shown that the nagana or disease of the tsetse fly and caderas, prevalent in South America, are distinct diseases, and a comparison of the Trypanosoma from the disease known as the surra with the two preceding shows that this is quite different from either. The three diseases are hence quite distinct.—The international congress of savants at the Universal Exhibition of St. Louis, 1904, by M. **Newcomb.** This congress will be held on September 19, 1904, and the five following days. A short account is given of its objects and the arrangements that have been made.—The drawings on the walls of the cave of Altamira (Spain), by MM. Emile **Cartailhac** and the Abbé H. **Breuil.** A comparison is made between these drawings and those recently described in the French caves. The style of work and colouring is similar in both, but in the Spanish cave the colouring is much superior to that in the French caves; it is noticeable that in the former drawings of the mammoth and reindeer are absent.—Remarks by M. Salomon **Reinach** on the preceding memoir. It is noteworthy that only animals which could be used for food are depicted in these caves, there being no representations of carnivora. The Aborigines of Central Australia also draw figures of animals on the rocks and soil, with the object of increasing their multiplication, and here, also, carnivora are naturally absent.—The propagation of waves in elastic media, according as the media are conductors or non-conductors of heat, by M. P. **Duhem.**—The perpetual secretary announced to the Academy the death of M. L. Cremona, correspondant for the section of geometry.—On surfaces which may, in several movements, give rise to a family of Lamé, by M. A. **Demoulin.**—On the simultaneous employment of the laws of distinct survival, by M. Albert **Quiquet.**—On a method of measuring the variation of the current in the armature in short circuit during the time of commutation in a continuous current dynamo, by M. **Iliovici.**—On the physical constitution of the atmosphere, by M. Louis **Maillard.** The usual formula for the density $\rho=273/760\ p/T$ does not appear to hold when p and T are both very small. From the author's calculations, which are partly based on results from captive balloons and partly on laboratory experiments, the density of the air diminishes up to a height of 30 to 50 kilometres, and then increases up to 75 kilometres ($\rho=0{\cdot}21$). If these results are correct, the theories of astronomical refraction will require some modifications.—On the estimation of vanadium in alloys, by M. Paul **Nicolardot.** The method of Sefström (the solution of the alloy in sulphuric or hydrochloric acid) for the qualitative detection of vanadium in Swedish iron, when slightly modified, can be made quantitative. Comparative analyses of the same sample by three methods are given.—On the esterification of the hydracids, by M. A. **Villiers.**—On the benzoyl derivatives of hydrazobenzene, by M. P. **Freundler.**—On the action of abietic acid on ferments, by M. Jean **Effront.**—On some combinations of chloride of gold and pyridine, by M. Maurice **François.**—The phenyl substitution in the phenylmethanes, their carbinols and chlorides, by M. Jules **Schmidlin.** A thermochemical paper.—The preparation of alkyl nitrates and nitrites, by MM. L. **Bouveault** and A. **Wahl.** Excellent yield of nitric esters can be obtained by the use of anhydrous nitric acid in the case of the primary alcohols; with secondary alcohols the action is quite different, the corresponding ketone being the main product of the reaction; with tertiary alcohols the action is destructive. The action of pure HNO_3 is suggested as a reagent for differentiating between the three classes of alcohols. Excellent yields of nitrous esters were obtained by the action of nitrosyl chloride upon a mixture of the alcohol and pyridine at 0° C.—Chlorine derivatives of methylene chloroacetate and diacetate, by M. Marcel **Descudé.**—On some new members of the pyranic series, by MM. R. **Fosse** and A. **Robyn.**—On stachyose, by M. C. **Tanret.** It is shown that manneotetrose and stachyose are identical, the composition being $C_{24}H_{42}O_{21}$.—Comparisons between the phenomena of nutrition in seedlings with or without their cotyledons, by M. G. **André.**—On some conditions of oxidation of salicylic aldehyde by organs and extracts of organs, by MM. J.-E. **Abelous** and J. **Aloy.** The oxidation of salicylic aldehyde in extracts from the liver of the horse or calf goes on better in a vacuum than in air, the presence of free oxygen diminishing, or even suppressing, the oxidation.—On the glycerol in the blood, by M. Maurice **Nicloux.**—On mixtures of iodine and sulphur, by M. R. **Boulouch.** From a dilatometric study it would appear that sulphur and iodine when fused together give rise to neither definite compounds nor solid solutions.—The action of the magnetic field on the infusoria, by MM. C. **Chéneveau** and G. **Bohn.** Contrary to the results obtained by M. H. du Bois, it is found that an intense magnetic field modifies the ciliary movements, the growth, and the multiplication of the infusoria.—The law of the action of trypsin on gelatin, by MM. Victor **Henri** and Larguier **des Bancels.**—The family of the Clostridiaceæ, by M. Paul **Vuillemin.**—On the structure of the seed of *Nymphaea flava*, by M. J. **Chifflot.**—The disease of the plane tree, by M. J. **Beauverie.**—On the exotic plant species in the immediate neighbourhood of Béziers (Hérault), by M. P. **Carles.**—On the geology of the Oubangui district at Tchad, by M. **Lacoin.**—The poisons of the organism and gestation, by MM. **Charrin** and **Roché.**—The results of phototherapy and the technique of its application in lupus, by M. **Finsen.** Statistics of the results obtained in the treatment of lupus at the Finsen Institute, Copenhagen, with some details of the mode of treatment.

DIARY OF SOCIETIES.

FRIDAY, JULY 3.

INSTITUTION OF MINING ENGINEERS, at 11.30 a.m.—Further Remarks on the Portuguese Manica Gold-field: A. R. Sawyer.—Coal fields of the Faröe Islands: E. A. Greener.—Miners' Anæmia or Ankylostomiasis: Dr. J. S. Haldane.—Water-softening Plant: Vincent Corbett.—The Redevelopment of the Slate-trade in Ireland: O. H. Kinahan.—The Smelters of British Columbia: W. Denham Verschoyle.—The Common-sense Doctrine of Furnace-draught: H. W. Halbaum.—The Ventilation of Deep Mines: Arthur C. Murray.

GEOLOGISTS' ASSOCIATION, at 8.—Some Flint Implements from Reading and Maidenhead: Ll. Treacher.

CONTENTS.