Nature

A WEEKLY

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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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REVIEWS AND OUR BOOKSHELF.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, MAY 7, 1908.

LA HOUILLE BLANCHE.

Service d'Études des grandes Forces hydrauliques (Région des Alpes), Annales de la Direction de l'Hydraulique. In two volumes. Vol. i., pp. 181; vol. ii., pp. 451; with maps and diagrams. (Paris: Imprimerie nationale.)

MOUNTAINOUS countries are ill adapted for convenience in travel and transport, but as some compensation for this drawback, Nature has endowed them with a signal benefit of another and equally important kind. She has placed at the disposal of the inhabitants a form of energy which is not only readily utilisable, but in the majority of instances is cheap and plentiful, and, it may be added, is also picturesque. The numerous streams of water which streak the mountain sides like veins of silver ore, or which

"like a downward smoke,
Slow dropping veils of thinnest lawn,"

spread themselves over the ledges of precipitous cliffs, possess a wonderful commercial value. They are, indeed, to be reckoned among the most utilitarian assets and resources of a country, side by side with coal, iron, and other such serviceable minerals, while they possess the additional advantage that their application to industrial purposes is readily effected, and is almost as unlimited in scope as the supply is, apparently, inexhaustible. The French have poetically referred to the latent wealth of these mountain streams as *la houille blanche* (white coal), and coal they surely are, to all intents and purposes, for when diverted into proper channels, do they not serve to actuate wheels and vanes, motors and turbines, setting in useful motion a wide range of plant and machinery as effectively as coal itself, without the complicated series of transformations required before the latter is converted into horse-power units?

The study, then, of so valuable a source of industrial energy is almost an obvious duty on the part of the countries thus enriched. Not until within the last fifteen or twenty years, however, has this duty become definitely recognised as a national obligation deserving of governmental support. At the present time in France, Switzerland, and Italy, three countries enclosing or bordered by lofty mountain ranges, there are organised commissions, subsidised by their respective Governments, for the purpose of collecting data and establishing records of the various changes in flow and level of mountain streams.

In Italy the initiation of systematic hydrographical research dates from 1890, when Zoppi was commissioned to study successively the Aniene, the Nera, the Velino, and their principal affluents. The Swiss hydrographical service was inaugurated by a federal decree of 1895. France did not recognise her obligation until eight years later, and the first of the two volumes under consideration opens with an account of how an instruction of the Minister of Agriculture, dated March 25, 1903, set upon a proper footing the study of questions affecting the assessment of hydraulic power in mountainous regions and the utilisation of the energy therein contained by the regulation of channels or of the water itself.

The hydrological service thus established was first allocated to the Alps, to be extended later to the Pyrenees, and ultimately, if it be considered desirable, to the whole country. Its programme comprises, first, the purely physical investigation of watercourses and their basins from a geographical, meteorological, and hydrographical point of view; and, secondly, the economical study of questions involved in the utilisation of the energy produced.

The first part of vol. i. is devoted to an account of the steps taken and the results achieved during the first year, or rather during the whole period prior to 1904. There is some reference to early attempts at gauging the Isère and the Durance, and a deduction, from these and similar experiences, of methods advisable to be pursued in the future.

Then follows a detailed account of the observations made and recorded during the years 1904 and 1905. Both this and the preceding section are arranged on common lines, and the subject is treated under several heads, comprising:—

(1) General organisation and programme of work.

(2) Gauging stations; methods adopted for measuring the discharge of streams.
(3) Pluviometry, nivometry, and glacial studies.
(4) Planimetry; surface measurement of basins.
(5) Levelling; determination of slope and fall.
(6) Publication of results.

The records are very full and complete. They abound in instances of local difficulties and the manner in which these were overcome. The work was carried out under the joint direction of M. de la Brosse and M. Tavernier. The former gentleman concerned himself more particularly with the basins of the Arve and the Isère, and the latter with the basins of the Durance and the Var.

There are a large number of appendices dealing with various matters of special interest, including some practical directions in the matter of gauge measurement, a note on the theory of screw calibration, a provisional estimate of the value of the hydraulic forces, a typical hydrological study of a mountain basin, and other cognate matters of importance.

The theoretical and mathematical investigations are of an extended and detailed character, and the volume forms a thoroughly complete and valuable guide for those who are engaged in hydrographical studies and experiments. A number of interesting photographs are reproduced, showing the actual operation of gauging as carried out at several places, and illustrating in a most effective manner the expedients described in the text for dealing with particularly difficult and almost inaccessible stations.

It is recorded that a good deal of very useful assistance was derived from voluntary workers, including those at power stations and industrial depôts. Help was also forthcoming from officers at military posts and from the staff of the conservators of waters and forests. Aid was rendered, too, by meteorological and geological departments, municipal and vicinal administrations, and by railway companies, notably the Paris-Lyon-Mediterranée. The coordination and instruction of all these various agencies, spread over an extended area, involved much care and attention.

The second volume is devoted almost entirely to a numerical record of the results of the work. It abounds in figures and data systematically collated and arranged, so as to be of immense value for reference purposes. It also includes a series of excellent maps of the various basins printed in colours, showing the subsidiary watersheds, and indicating the positions of the stations of observation. Altogether, the volumes are replete with information, and form a striking testimonial to the value and national utility of the Service d'Études des grandes Forces hydrauliques.

SUBTERRANEAN STUDIES.

L'Évolution souterraine. By E. A. Martel. Pp. 388; with 80 figures. (Paris: Ernest Flammarion, 1908.) Price 3.50 francs.

IN France, the fascinating study of caverns—or, as it is now the fashion to call it, spelæology—has risen greatly in popular favour during the last twenty years, mainly through the energy and enthusiasm of M. Martel, one of the editors of *La Nature*. The scope of spelæology, in the course of its recent development, has become gradually enlarged until it now touches at one point or another almost the entire circle of the sciences. The work before us, which forms a volume of Dr. Gustave Le Bon's "Bibliothèque de Philosophie scientifique," extends, however, beyond the mere study of caves, though this forms its main theme. From caverns the author passes to the general phenomena of the underground world, and seeks to show how their study has a bearing on nearly all branches of knowledge, especially on the doctrine of evolution. The range of the work consequently comes to be extremely wide. Where the programme set before the writer is so ambitious, no reasonable reader can expect to find it worked out with thoroughness. Brevity often becomes imperative. The wonder is not that many of the subjects are touched with only a light hand; the wonder is rather that it has been found possible to crowd so much into a volume of such limited size.

Scattered through M. Martel's pages are many suggestions which seem to call for remark. Thus, with regard to the planes of rupture in the earth's crust, he suggests that the term "joint" should be limited to planes of stratification, whilst those fissures which run vertically or obliquely, and in stratified rocks across the bedding, should be called "diaclases"—one of the terms introduced by Daubrée in his system of nomenclature for divisional planes. No doubt it would be convenient to have some short word for a plane of bedding, but it will certainly require much persuasion to induce an English geologist to call it a joint, for this happens to be just the term that he is in the habit of applying to any plane other than that of stratification.

Our author does well to insist on the fact that the process of cave-making, so far from being due to a single agent, depends in most cases partly on mechanical erosion and partly on chemical corrosion. Which of the two processes is the more important is determined to a large extent by the character of the rock to be hollowed out. Moreover, the formation of these subterranean hollows has not been limited, as some Continental writers have supposed, to any particular geological epoch.

On the question of the supposed desiccation of the earth—a subject on which so much has been written—M. Martel holds very pronounced views. Whilst some writers who admit the progressive diminution of the earth's superficial waters believe that it proceeds too slowly to be recognised in historic time, our author holds that abundant evidence of the change may be cited within the range of human history. On the other hand, a compensating action may come into play if it be true, according to an opinion that has recently been gaining ground in certain quarters, that much of the water emitted as vapour by volcanoes is derived from the deep-seated magma of which it is an original constituent, so that its emission is a direct contribution to the surface-waters of the globe.

It was only to be expected that M. Martel would have much of interest to say on his favourite subject

of the hygiene of potable waters. Those who are acquainted with his former writings will not be surprised at his warning that springs of apparently pure water are in many cases merely the outflow of surface-waters which have disappeared through fissures, carrying with them pollution from the soil and not undergoing purification during their passage through the rocks. Even chalk, according to the writer, is generally far from being a thoroughly effectual filter.

In glancing through M. Martel's work the reader will find, probably to his surprise, that the spelæologist is unquestionably a being of large discourse, looking before and after. In one part he discusses the origin of man and the cradle of his civilisation; in another he speculates on the probable future of humanity; in an early chapter he discourses on the hypotheses concerning the beginning of the earth; in the last chapter he carries the reader forward to the catastrophes likely to bring the history of our planet to a close. Notwithstanding the fact that the range of subjects is thus so wide and diverse, the book remains readable and informing throughout. M. Martel is always vivacious, sometimes impressive, and occasionally original—but never obscure. In fine, he has written a little book which may be described in the best sense of the word as popular.

CHEMISTRY OF PHARMACOLOGY.

The Chemical Basis of Pharmacology. By Francis Francis and J. M. Fortescue-Brickdale. Pp. xii+372. (London: E. Arnold, 1908.) Price 14*s.* net.

THE general scope of this work is indicated by the above title and the subtitle, reading "An Introduction to Pharmacodynamics based on the Study of the Carbon Compounds." Short general introductions to chemistry and physiology are first given, dealing with such subjects as valency, structural formulæ, isomerism, correlation of chemical and physiological properties, and the relationships between structure and action. Then follow chapters on the main groups of carbon compounds, for example, hydrocarbons, alcohols, purine bodies, and the alkaloids, their methods of preparation and properties, both chemical and physiological. The book contains a fund of information, from which many suggestions as to lines of research may be gathered, and is a genuine attempt to systematise our present knowledge of the chemistry of pharmacology. As such it should prove of great use, more particularly to physiological and pharmaceutical chemists rather than "to the practitioner who is daily brought in contact with the claims of new drugs," and whose chemical knowledge could hardly be expected to reach the standard required for the assimilation of the information given, however desirable such a state of things might be.

We agree with the authors that the student of organic chemistry will find in the work an introduction to a fascinating branch of applied chemistry, but think that the usefulness of the book, alike to the student of chemistry and manufacturer of synthetic drugs, would have been largely increased had more references to original papers been given. It is also to be regretted that more care has not been bestowed on the book during its passage through the press. The orthography is sometimes unusual in such words as "etherial," "radical," "Kekule," and the work contains innumerable press errors, and many which cannot be attributed to this cause. For example, the expression (p. 90)

$$C_2H_5.OH + HNO_2 = H_2O + C_2H_5ONO2 \text{ (Ethyl nitrite)}$$

is not an equation, nor is the formula for ethyl nitrite correct. Butyl chloral (pp. 79, 109) has not the formula $CCl_3.CH_2.CHO$, and trichloroethyl alcohol is not accurately represented as $CCl_3.COH$. Such faults are inexcusable.

A very deplorable aspect of modern chemistry in its application to pharmacy or physiology would appear to be the lack of system in nomenclature, and a consequent flood of synonyms. This point does not seem to have appealed to the authors, for we find them either ignorant of, or not in agreement with, the systems of nomenclature adopted by the Physiological and Chemical Societies, and in consequence confusion is rendered worse confounded by the adoption of any and every style of naming. We quote as examples "proteid or protein"; "methyl or methylic alcohol"; "sodic or sodium acetate"; "silver hydrate, aqueous potash, ammonium hydroxide"; "glycerol or glycerin"; "mannite or mannitol"; "oxybenzoic or hydroxybenzoic acid"; and "1-oxy-2-iodo-4-chlorquinoline."

It could reasonably have been expected that the authors would have made a serious attempt to introduce order and method where chaos prevails by adhering strictly to those generally accepted principles of nomenclature which, though imperfect, materially help to build up an intelligible chemical literature.

A. C.

TWO RECENT BOOKS ON EVOLUTION.

(1) *A Picture Book of Evolution.* By Dennis Hird. Part ii. Pp. vi+214. (London: Watts and Co., 1907.) Price 2*s.* 6*d.* net.

(2) *Darwinism To-day.* By Prof. V. L. Kellogg. Pp. xiv+403. (London: George Bell and Sons; New York: Henry Holt and Co., 1907.) Price 7*s.* 6*d.* net.

WE cannot recommend anyone wishing to make himself acquainted with the present aspect of the problem of evolution to put himself under Mr. Hird's guidance. His treatment of the subject is crude and uncritical, nor does he give any evidence of familiarity with the evolutionary questions that are now chiefly engaging the attention of biologists. Putting minor inaccuracies aside, the book might have been of some service if published, say, forty years ago; at the present time it is to a large extent either misleading or superfluous. Opposition to the doctrine of species-formation by natural selection comes to-day, not, as the author seems to think (p. 25), from the "House of Lords or the pulpit," but from scientific men, both in this country and abroad; more particularly in Germany and America. While no educated person now disputes the fact of evolution, the Dar-

winian theory is being attacked more vigorously than ever; the assailants, however, belong to a very different class from Darwin's impetuous critics of the early 'sixties. Mr. Hird takes little or no notice of present-day problems, but writes as if the whole question of evolution still occupied the same position as in the mid-Victorian era. Within these limits he is fairly interesting; it is, however, unfortunate that he has admitted to his pages several inaccuracies that might with a little more care have been avoided. "Oasperm," "octoderm," are ugly misprints; "hermaphrodite" does not mean the same as "dicœcious"; it is new to us that hæmatococcus "like the amœba, requires to be magnified some 900 times in order to be seen." Huxley can scarcely be ranked as a "discoverer of evolution"; he would certainly never have made such a claim for himself. The illustrations in Mr. Hird's volume have mostly been seen before. Many of them are good, but the connection of some with the text is remote.

(2) Prof. Kellogg's book is of a very different stamp. So far from ignoring the questions that have in recent years grown up around the central doctrine of evolution, he has devoted an immense amount of labour to collecting, arranging, and expounding the views of nearly all the recent writers on evolutionary subjects. His treatise thus contains a vast quantity of material, in large part consisting of copious quotations from English, French, and German authors, put together somewhat promiscuously, and discussed without much exercise of the critical faculty, but useful to the student as a storehouse of various and conflicting opinions. The author's own standpoint is not very easily discovered. He passes in review the tenets of Darwinians, Lamarckians, Mutationists, Nägelians, with much appearance of giving a fair hearing to all sides. But as he seldom seems to know his own mind for long together, the general result is unsatisfying, not to say irritating; his impartiality is the impartiality of the pendulum rather than that of the judge. The author rightly appreciates the constructive weakness of anti-Darwinian arguments, but greatly overestimates their destructive efficiency. He allows, for example, far too much weight to frivolous objections such as those raised by Wolff in his "Beiträge zur Kritik der darwin'schen Lehre."

In examining the assaults delivered from various quarters on the Darwinian position, one cannot help being struck with the fact that the efforts of objectors tend much more effectively, on the whole, to refute each other than to weaken the defence. It is also quite obvious that to many of these critics Darwin's own writings are practically a sealed book. One cannot suspect Prof. Kellogg of talking about Darwin without having read him; nevertheless he shows, like other writers, a strange confusion of mind with respect to the Darwinian view of the function of natural selection in evolutionary process. Why should it be considered a "weakness" of the Darwinian theory of natural selection that this principle has "no influence whatever on the origin and control of variations"? Darwinism never professed to be an "all-sufficient explanation of adaptation and species-forming" apart from the existence of variation, which fact it takes for granted. It is irrational to blame a theory because it does not explain one of the fundamental data from which it starts.

In at least one passage of his book, the author shows a distinct leaning towards the "orthogenesis" advocated by the school of Eimer. Theories, he thinks, of this general type "are directly in line with the spirit of modern biological methods and investigations." On this point, opinions will differ; we should be inclined to maintain the opposite. On a later page he advances what he considers to be "a logical proof for the introduction into phylogeny of adaptive ontogenetic changes," *i.e.* a proof of Lamarckism, for it is hard to see any distinction between this view and that of the French evolutionist.

"When species-differences and adaptations are identical with differences and modifications readily directly producible in the individual by varying environment, are we not justified," he asks, "on the basis of logical deduction, to assume the transmutation of ontogenetic acquirements into phyletic acquirements, even though we are as yet ignorant of the physicochemical or vital mechanism capable of effecting the carrying over?"

This question we should unhesitatingly answer in the negative. When rhetoric of the above description is dignified with the name of "proof," we are not surprised to find that the author's estimate of the true bearing of ascertained facts is feeble. It appears to cause him some astonishment that there still exist, "especially in England," thorough-going Darwinians who remain unmoved by the storm of criticism levelled against the theory of natural selection. That there are such stalwarts is undoubtedly the case, and the situation as maintained by them could not be better expressed than in the words, quoted without approval by Prof. Kellogg, of Sir E. Ray Lankester, at York, in August, 1906:—

"In looking back over twenty-five years it seems to me that we must say that the conclusions of Darwin as to the origin of species by the survival of selected races in the struggle for existence are more firmly established than ever."

F. A. D.

OUR BOOK SHELF.

Graphics, applied to Arithmetic, Mensuration, and Statics. By G. C. Turner. Pp. ix+388. (London: Macmillan and Co., Ltd., 1908.) Price 6*s*.

THIS work forms a valuable addition to the text-books on an important branch of mathematics, and, coming from a past student of Prof. Henrici, is especially welcome. Within the limits imposed by the author, the subject of graphics is very fully and ably treated. The first chapter, on graphical arithmetic, gives, at perhaps undue length, the geometrical constructions corresponding to the ordinary arithmetical processes, with the employment of scales and squared paper, and is followed by a very useful chapter on the graphical mensuration of plane figures. Vectors are then introduced, with examples of displacement, velocity, and acceleration vectors, and problems on mass centres—altogether a very interesting section. Experimental work is done in connection with concurrent forces in

chapter iv., and in verification of the properties of the link polygon and the equilibrium of a general system of coplanar forces in chapter v.

The principles of graphic statics, having thus been well laid and amply illustrated, are further developed in the succeeding chapters by practical applications, such as to stress diagrams for bridge and roof trusses, loaded at the joints, at intermediate points, and under wind pressures; to bending moments and shearing forces in beams, and the action of travelling loads; and to problems involving friction and work done by constant and variable forces.

While the deductive reasoning is well sustained throughout and satisfying to the logician, the subject is everywhere exemplified by concrete examples, fully worked out, and at short stages the student is provided with exercises in abundance, with answers, the author having drawn freely from the examination papers of the University of London, the Board of Education, the Civil Service Commission, and similar sources.

The very fulness with which graphic statics is discussed and illustrated in this volume makes one regret that some space could not have been found (by omissions, if necessary) for the equally important subject of graphic dynamics, founded on the vector conception of Newton's second law, with the application of the hodograph, and illustrations drawn from the motions of machines, the leading idea being to develop the fundamental law that force is vector rate of change of momentum. The author rightly emphasises the need for good-sized figures, and uses fairly large set-squares, in conjunction with straight-edge, scale and compasses, but he seems content with this comparatively meagre equipment, the incompleteness of which must surely handicap a student who does much quantitative graphical work.

With these reservations the book is admirable, and should do much to encourage the teaching of a subject that ought to form an integral part of the mathematical training given in our secondary and technical schools.

Man and his Future: A Glimpse from the Fields of Science. By Lt.-Col. William Sedgwick. Pp. 256. (London: T. Werner Laurie, 1907.) Price 7*s.* 6*d.* net.

THIS book is a curiously naïve attempt to justify and interpret in the light of modern scientific discoveries a somewhat old-fashioned form of orthodoxy. "The whole universe is the scene of a conflict between two powers over the possession of atoms of matter." This conflict is waged by means of the α- and β-rays of the physicist, which have respectively the power of "doing building work" with the atoms and of destroying the systems thus set up. Man is "a transgressing anthropoid ape" who, having wandered out of the regions where alone he could live in a state of nature, has purchased relief from his conditions by taking service with the Power of Repulsion—destroying the forests of the earth for fuel, and analysing compounds (such as ores) for their useful elements. But the growth of his needs has led him from mere destruction to synthesis, and so into the service of the Power of Attraction. Nevertheless, his original transgression condemns him still to destroy on earth, so that his synthetic activities—shown, for example, in chemistry, physics, and engineering—must be regarded as really "a training in the art of Universe-building," to be applied seriously only when the present cosmic order makes way for the New Evolution. Thus death is "a recruiting agency for the staff" to be engaged upon this gigantic re-constructive operation, when they have re-clothed their "resting forms" in the protoplasmic garments for which the coal seams and the nitrate beds are perhaps intended to provide materials.

This work is so sincerely and modestly written that one regrets the necessity of saying that it can have but little value except to the student of the psychological history of discovery, who will note with interest and curiosity that, in connection with his "building-up" theory, Col. Sedgwick, in 1902, predicted the existence of non-valent elements having the atomic weights now actually assigned to the members of the helium group.

Développement et Progrès de la Fabrication du Malt pendant les quarante dernières Années. By Ed. Eckenstein. Pp. 212. (Paris: A. Hermann, 1908.) Price 5 francs.

THIS work gives an account of the development of methods of malting on the Continent from the time when the employment of mechanical appliances to supplement hand labour was first suggested to the present day, when, in some maltings, hand labour has practically disappeared. The author makes no attempt to discuss the progress of scientific knowledge in relation to malting, but confines himself almost entirely to a description of the manner in which the engineer has overcome many of the practical difficulties met with when attempting to deal with large bulks of germinating grain other than by hand labour. Problems such as the controlling of the heat generated by respiration of germinating grain in mass, and establishing an equal distribution of moisture throughout the individual corns of the mass, together with equal conditions of aëration, have to be solved. The solution of such problems by mechanical means is not easy, and there are still many competent critics, both in this country and abroad, who consider that the claim for success made by advocates of mechanical malting is not at present thoroughly well justified. However this may be—and the question is essentially a technical one—everyone interested in the progress of mechanical malting should read M. Eckenstein's book, the value of which is much enhanced by the numerous very excellent drawings and diagrams which it contains.

The Romance of the Sky; the Story of Star-gazing and Star-tracing, being an Introduction to the Study of Astronomy. By C. J. Griffith. Pp. viii + 166. (London: George Routledge and Sons, Ltd.; New York: E. G. Dutton and Co.)

MR. GRIFFITH has undertaken to tell his story through the mouth of a mythical amateur astronomer, condemned to live through all the phases of astronomical science from pre-Ptolemaic days to the present. The method naturally introduces a great deal of reading matter that is not astronomy, but for non-astronomical readers the result, thus diluted, should prove of interest. A talk with Ptolemy, the enunciation of his great theory by Copernicus himself, the unfortunate reaction which delayed astronomical progress for centuries, and the final clearing of the mists by Kepler's results, occupy the first twenty pages. Then in rapid sequence Galileo, Newton, Halley, Herschel, and other notable workers in astronomy are interviewed, the volume concluding with discourses on the making of present-day observations and the deductions arising therefrom. The book is good, in parts, and the glossary of astronomical terms (chapter xxiv.), together with the excellent index, should not prove the least interesting or instructive to the beginner.

W. E. R.

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.]*

Life on Mars.

IF the canals of Mars are structures made by intelligent beings, it is difficult to believe that these beings have not at their disposal appliances both for construction and survey. It is difficult to believe that some of these appliances are not made of metal. If made of metal, it is difficult to believe that the Martians do not use fire. There is strong evidence that friction was the source of the discovery of fire on the earth. But is it likely that fire would be discovered by friction on a planet the barometrical pressure of which is less than 4 inches of mercury, and the still atmosphere of which is believed to be free from thunderstorms and lightning flashes?

The obvious, and I think adequate, criticism of such an argument is that it is anthropomorphic. It interprets the conditions of life on Mars too much in terms of human experience. In the present state of our knowledge, may not the same criticism be made of the assertion that life on Mars is accompanied by an intelligence similar to our own? On the earth, life without any high degree of intelligence has been the rule. Life with a high degree of intelligence has been the exception, an exception confined to an insignificant fraction of the time during which mundane life has existed. Is it safe, without very cogent evidence, to assert that a similarly exceptional state of things exists on Mars? Can no other possibilities be suggested?

To be told that life exists on Mars tells us but little of its nature. It does not even tell us that living beings exist. Perhaps on Mars there is only one living being, a gigantic vegetable the branches or pseudopodia of which embrace the planet like the arms of an octopus, suck water from the melting polar snows, carry it to other parts of the planet, and are visible to us as the Martian canals. Lowell adduces the straightness of the canals as a proof that they are artificial products of intelligent beings. But they are certainly no straighter than the somewhat similarly interlaced pseudopodia seen in certain Heliozoa, Foraminifera, and Radiolaria.

That this idea is not excluded by anything necessarily inherent in the nature of living matter may be shown by considering the conditions that must have accompanied the origin of life, whether on the earth or on Mars. Parenthetically, it may be remarked that the existence of life on Mars is not without bearing on the problem of the origin of life on the earth, and Lowell's discovery may be regarded as adding reason to the hope that has been expressed that some day life may be artificially produced in our laboratories.

It is impossible to believe that life originated directly by a fortuitous concourse of atoms of the elements of which living matter consists. Organic compounds must first have come into existence as links between the living and the not living. Some clues as to the nature of these links possibly may be afforded by current researches on the fixation of atmospheric nitrogen. We may surmise that some stages in the evolution of living matter were amino-acids, polypeptids, and proteids. The fact that nowadays no such substances exist in natural water does not disprove this supposition, for had such compounds existed they must long ago have been destroyed by bacteria and similar organisms. We may surmise that gradually these primeval proteids became aggregated into larger and larger molecular complexes until they existed as a loose jelly of indefinite extent, that these complexes were subjected to a slow oxidation, that, if we may accept Pfluger's doctrine of the nature of respiration, these molecular complexes, under the influence of oxidation, acquired a certain molecular instability, but showed at first no other vital character than the power of combining with or assimilating other molecules of primeval proteid. However imperfect such a conception may be, there can be no doubt that the process of the origination of life was in the main a process of building up (one is tempted to use the word polymerisation) of small simple aggregates into larger and more complex aggregates. I can see no reason for believing that there was anything in the nature of this primitive living matter that would prevent this process of aggregation from continuing indefinitely. Or, in other words, we have no right to assert that there could have been anything in the nature of the primitive living matter itself to prevent it forming a scum of unlimited extent on the water in which it existed.

The fact that such indefinite growth either did not occur, or, if it did occur, was only a transient stage in evolution, may safely be ascribed to the effect of some external forces or conditions of the environment. An illustration may make this clear. Ice-crystals have the property of aggregating together to form snow-flakes. Owing to conditions and forces external to themselves, the process of aggregation does not continue indefinitely, but the snow-flakes cease to grow when they have reached a certain size. Under another set of conditions, ice-crystals may not form snow-flakes at all, but may cover a large extent of country in the form of hoar-frost. Similarly, the primitive living matter on the earth, owing to the action of some external forces or conditions, developed in the form of separate individuals that we may compare to snow-flakes. The possibility cannot be excluded that on Mars living matter developed in the form of a scum covering the seas of that planet, which scum would correspond to the hoar-frost of our illustration. What external force is there that would be likely to act on primitive living matter on the earth, but not on Mars? Could it be the action of tides and waves?

All I wish to assert is that it is possible and conceivable for a single vegetable organism to come into existence on a planet, and for it not to break up into separate individuals. In such a vegetable, parts unfitted for the environment might perish and be assimilated by other parts that were better adapted to the conditions that existed. Thus it might possess a power of adaptation to a changing environment, such as must have occurred, for example, in the drying up of the seas that once existed on Mars. No one who believes in "the continuity of the germ-plasm" will see any objection in the quasi-immortality of such an organism.

Another possibility may be suggested. Supposing, in the course of many millions of years, the earth was to follow the example of Mars and gradually to lose its water. Should this happen, a stage would be reached in which a few isolated lakes existed in the dried-up beds of the oceans. Let us imagine what then might be seen by an intelligent being on the planet Venus who had "an eye for planetary detail." Might he not see a system of faintly shown lines stretching from lake to lake and to the polar caps? Might they not show evidence of seasonal change? And might he not then conclude that they were canals made by beings of greater intelligence than his own, though in reality they were only fronds of a gigantic seaweed that had developed from the gigantic seaweeds that at present exist in the Sargasso Sea? Is it not likely that in the course of ages the fronds of such vegetables would contract until they formed straight lines from oasis to oasis, and so further the idea that their production was due to intelligence?

These ideas are obviously merely of the nature of suggestions, and I wish expressly to disclaim holding any definite opinion or belief as to the nature of the life on Mars. Prof. Lowell has measured the rate of flow of water in some of the Martian canals. Is this rate the "economical rate" for the flow of water along an open canal, or does it agree better with the economical rate, if the phrase is applicable, for the flow of water along pipes of a vegetable organism, where presumably the loss from percolation and evaporation would be trivial?

My position is that one may admit that Prof. Lowell's brilliant researches prove the existence of life on Mars, and still ask from him further evidence before we are convinced that that life is intelligent.

E. H. HANKIN.

Agra, India.

The Warm Stratum in the Atmosphere.

WHILE not presuming to offer an explanation of the isothermal or relatively warm stratum in the high atmosphere, which the recent letters in NATURE have made known to others than meteorologists, I desire to point out that it is probably a universal phenomenon, existing at some height all around the globe. This inversion of temperature was first discovered by M. Teisserenc de Bort with the *ballons-sondes* sent up from his observatory at Trappes, near Paris, in 1901, and almost simultaneously by Prof. Assmann from similar German observations. Since then almost all the balloons which have risen more than 40,000 feet above Central Europe (that is, near latitude 50°) have penetrated this stratum, without, however, determining its upper limit. Teisserenc de Bort early showed that its height above the earth, to the extent of 8000 feet, varied directly with the barometric pressure at the ground. Mr. Dines (NATURE, p. 390) gives the average height of the isothermal layer above England as 35,000 feet, with extremes of nearly 50 per cent. of the mean. Observations conducted last March by our indefatigable French colleague, Teisserenc de Bort, in Sweden, just within the Arctic circle, showed that the minimum temperature occurred at nearly the same height as at Trappes, namely, 36,000 feet, although Prof. Hergesell, who made use of *ballons-sondes* over the Arctic Ocean, near latitude 75° N., during the summer of 1906, concluded that the isothermal stratum there sank as low as 23,000 feet.

During the past three years the writer has dispatched seventy-seven *ballons-sondes* from St. Louis, U.S.A., latitude 38° N., and most of those which rose higher than 43,000 feet entered the inverted stratum of temperature. This was found to be somewhat lower in summer, but the following marked inversions were noted last autumn:—October 8, the minimum temperature of −90° F. occurred at 47,600 feet, whereas at the maximum altitude of 54,100 feet the temperature had risen to −72°; October 10, the lowest temperature of −80° was found at 39,700 feet, while −69° was recorded at 42,200 feet, showing a descent of nearly 8000 feet in the temperature-inversion within two days. The expedition sent out jointly by M. Teisserenc de Bort and the writer, on the former's steam yacht *Otaria*, to sound the atmosphere over the tropical Atlantic during the summer of 1906, launched *ballons-sondes* both north and south of the equator within the tropics, and although some of these balloons rose to nearly 50,000 feet, they gave no indication of an isothermal stratum. In fact, the paradoxical fact was established that in summer it is colder eight miles above the thermal equator than it is in winter at the same height in north temperate regions. This results from the more rapid decrease of temperature in the tropics and the absence of the numerous temporary inversions which, as Mr. Dines has pointed out, are common in our regions below 10,000 feet. If, therefore, as seems probable, the isothermal or relatively warm stratum does exist in the tropical and equatorial regions, it must lie at a height exceeding 50,000 feet, from which height, as the data quoted show, it gradually descends towards the Pole, at least in the northern hemisphere.

A. LAWRENCE ROTCH.
Blue Hill Meteorological Observatory, Hyde Park, Mass., U.S.A., April 24.

The Nature of X-Rays.

PROF. BRAGG in a recent letter (NATURE, April 16) credits me with the admission that the experiments I made on the intensity of secondary (scattered) X-rays are not so contrary to the neutral pair theory as I at first supposed. Will you permit me to correct this by saying that all the evidence I have obtained has verified the ether pulse theory in a more striking way than I ever anticipated, and I cannot think of a single experimental result obtained in researches on secondary X-rays which gives any support to his theory?

Prof. Bragg refuses, on the plea of want of knowledge of the constitution of the atom, to accept as conclusive the results of experiments I recently made. It appears to me, however, that such absence of knowledge is insufficient to conceal the disproof of his theory, and that the evidence (though by itself not sufficient to establish any theory) is quite sufficient to distinguish between the ether pulse theory and that proposed by Prof. Bragg.

The supposed difficulty in accounting on the ether pulse theory for the change in the ratio of intensities, to which he refers, is not one affecting the theory at all. Sufficient experiments have not yet been made to lead to a final choice between several possible causes as producing the bulk of this effect. The result itself is in harmony with the results of other experiments.

As Prof. Bragg is apparently not convinced, I venture to recommend the consideration of the following evidence obtained in investigating secondary X-rays, for I can only think that the study of this evidence would at least lead him to confine the application of his hypothesis to the explanation of phenomena which at any rate do not furnish so striking a disproof.

The evidence may be briefly summarised as follows:—

(1) The partial polarisation of a primary beam of X-rays.

(2) The identity in penetrating power of secondary (scattered) rays from light atoms, and of the primary producing them, though the scattered constitute only a fraction of the incident rays.

(3) The equality in the proportion of rays of different penetrating power which are scattered.

(4) The fairly complete polarisation of the rays scattered in a direction perpendicular to that of propagation of the primary.

(5) The distribution of the secondary (scattered) rays.

(6) The order of magnitude of the energy of scattered radiation.

(7) The homogeneity of a second type of secondary X-radiation from many substances.

(8) The fact of this homogeneous radiation being characteristic of the element emitting it, and independent of the penetrating power of the primary radiation producing it.

(9) The fact that for large ranges in the penetrating power of the primary these homogeneous secondary rays from some substances are proportional to the ionisation produced by the complex primary in air.

These are points that occur to me while writing; there are probably others.

The first five results (though not explicitly stated) were contained in the theory as given by Prof. J. J. Thomson ("Conduction of Electricity through Gases") shortly after the publication of the second experimental result, and before the others were experimentally observed. The sixth is in harmony with the calculation given by Prof. Thomson if we accept his theory of the number of electrons in the atom. Results (7), (8), and (9), obtained in joint-work with Mr. C. A. Sadler, can be explained on the ether pulse theory.

Prof. Bragg has given an explanation (based on what seem to me doubtful assumptions as to the behaviour of a neutral pair on collision with light atoms) of the fourth result. An explanation on his theory of the other facts necessitates in some cases very improbable assumptions; in others it appears to me to lead to absolute impossibilities. In no case can I find the slightest support for the neutral pair theory.

Regarding the nature of γ rays, or even of very penetrating X-rays, the direct evidence is much less conclusive, the corresponding phenomena being in reality more complex, for reasons which are beginning to be understood. For that reason I do not wish at present to discuss them, preferring to deal with what is to me a certainty, and waiting for the results of further experimental work to throw light on the more complex. Prof. Bragg commences at the other end with a hypothesis which gives an easy explanation of what on the pulse theory is somewhat obscure, but when an attempt is made to apply this to the simpler phenomena it is found inadequate, not only as a complete theory, but even as a supplementary one.

CHARLES G. BARKLA.
Liverpool, April 27.

Echelon Spectroscopes and the Green Mercury Line.

IT is interesting, in reference to Prof. Nagaoka's letter in NATURE of April 23 (p. 581), to note that I exhibited photographs of the green mercury line, showing a number of new components, at the Leicester meeting of the British Association. I did not publish the number or position of the lines in the report, not being quite satisfied that some of the fainter ones might not be produced in the instrument, and I discovered later (NATURE, vol. lxxvii., pp. 198 and 222) that secondary effects, due to light reflected in the echelon, have to be taken into account. Since then Von Baeyer's measurements with a Lummer and Gehrcke spectroscope and Galitzin's echelon measurements have confirmed two of the lines that were new, and added confirmation to my values for the old ones. A doubt still remains, however, about some of the fainter lines, and as a comparison of the values given by different instruments is the most obvious way of confirming the true components and eliminating false ones, I give my results for comparison below.

It is usual in stating results of this kind to give the wave-length intervals between the components and the principal line, but this leads to mistakes in comparing results, because the principal line given by most of the observers has been divided by Von Baeyer and Nagaoka into two components, and by taking the brighter component as the principal line they shift the reference point about 15 milli-Ångström units, and the agreement, which would otherwise be evident, is quite obscured. I have given below the distances of the various components from the component of shortest wave-length, which happens to be a good reference line. The differences shown in Prof. Nagaoka's comparison are in this way much reduced.

Comparison of Recent Echelon Spectroscope Determinations of the Components of the Green Mercury Line, λ 5461.

Janicki	Galitzin	Nagaoka	Stansfield	
0 ...	0 ...	0 ...	0 ...	17 bright
			23 ...	faint
		31		
			41 ...	very faint
			59 ...	,,
		72 ...	75 ...	,,
			93 ...	,,
		105 ...		
133 ...	137 ...	137 ...	135 ...	12 bright
166 ...	168 ...	163 ...	165 ...	12 ,,
	189 ...	189 ...	188 ...	8 medium
232 ...	236 ...	{223 / 247} ...	232 ...	{52 bright / *principal line*
		280 ...	277 ...	5 faint
320 ...	321 ...	315 ...	319 ...	16 bright
			345 ...	8 medium
365 ...	365 ...	356 ...	363 ...	12 bright
		390 ...	386 ...	8 faint
			409 ...	very faint
		448 ...	448 ...	14 faint
		477 ...	473 ...	very faint

The numbers give the distances of the components from the component of shortest wave-length in milli-Ångström units. In the fifth column the widths of the brighter lines, taken from the photographs, are given in the same units

It will be seen that there is generally close agreement as to the position of the five bright companion lines. As to whether the principal line is single or a close double, it is interesting to note that several of my photographs showed it divided, the brighter component being on the longer wave-length side as Nagaoka and Von Baeyer give it, but owing to the secondary effects in the echelon I have not been able to make sure of the division.

Prof. Nagaoka's values agree fairly well with mine for all the faint lines on the list below the principal line, although he does not give the lines on my photographs at 345 and 409, but we do not agree about the positions of those which fill in the long gap between the first and second bright companion lines. The agreement is not sufficiently good to exclude the possibility of some of the faint lines having their origin in the echelons.

H. STANSFIELD.

The University, Manchester, April 25.

Appearance of the Slug Testacella in a Flooded District.

SOME time ago I wrote to you to say that the remarkable slug Testacella occasionally appeared in large numbers on the surface of the ground in my garden. This phenomenon only occurs when the district is heavily flooded. The abnormal weather of the last half of April has brought severe floods out in many parts of the Thames valley, and yesterday, through the kindness of a friend who now occupies the house and garden referred to, I was able to collect about a hundred of these animals. I shall be pleased, therefore, to send specimens alive or preserved to those correspondents who wrote to me on the subject when my previous letter appeared in NATURE, whose addresses I have mislaid, unfortunately, while changing houses. I may add that it is only in this particular garden that I have seen these animals. What the conditions may be that cause the slugs to live there and not elsewhere, so far as I know, in the neighbourhood, I am quite unable to suggest. They live too far down even in wet weather to be found during ordinary gardening operations.

M. D. HILL.

Eton College, Bucks, May 3.

THE TOTAL SOLAR ECLIPSE OF JANUARY 3, 1908.

SINCE the brief announcement made in this journal (vol. lxxvii., January 23, p. 273) in the first month of this year, relative to the success of the eclipse expedition organised by Mr. F. K. McClean, further information has become available.

The communications received give a complete account of the doings of the expedition from the time it left Auckland in the Union S.S. Company's *Taviuni*, which Mr. McClean had chartered specially for the expedition, to its return to that port. A detailed report, containing the scientific results of the expedition, will in due course be presented to a society, but a short sketch will no doubt be of interest to many readers of this journal who have been waiting for further information.

The members who finally formed Mr. McClean's party were as follows:—Joseph Brooks, F.R.A.S., retired surveyor in charge, Trigonometrical Survey, N.S.W.; W. E. Raymond, F.R.A.S., first assistant, Sydney Observatory; J. W. Short, astronomical photographer, Sydney Observatory, and magnetic observer; Rev. F. W. Walker, of Auckland; Henry Winkelmann, of Auckland.

The party left Auckland on the afternoon of December 12, 1907, arriving at Tahiti on December 20; Flint Island was reached on December 23, at 7 a.m. The expedition from the Lick Observatory was already located on the island, and Prof. Campbell came off to meet the ship.

The landing place is described as consisting of a small channel blasted through the reef and extremely dangerous. In spite of the rough surf, everything was safely landed. As it was raining hard all the time, the first piece of work was the erection of the tents and the temporary housing of all the instruments in them.

The camp was located amongst a number of cocoanut trees, some of which were at least 100 feet high, rendering the horizon invisible. Considerable lopping of branches was found necessary, not only to allow sufficient sky field for the efficient working of the large siderostat, but room for the tents themselves. The accompanying illustration (Fig. 1) will give the reader some idea of the tropical and dense nature of the vegetation on the island. The negative from which this illustration has been taken was made by Mr. Winkelmann.

December 24 was even wetter than the previous day, but in spite of that the remaining tents were erected, and the first layer of concrete for the large

22-inch siderostat was laid. On January 1 everything was complete and drills were commenced, and eventually the programme was arranged to be carried through, utilising the signals called by Prof. Campbell's timekeeper.

From the account given of the weather conditions, on the morning of the eclipse the party seems to have met with exactly the same peculiarities as those which were experienced by many of the observers at Palma in 1905. Fortunately, Mr. McClean was present at Palma on that occasion, so the experience was not new to him, and in his letter he writes, "It has been another Palma and four plates in my bag."

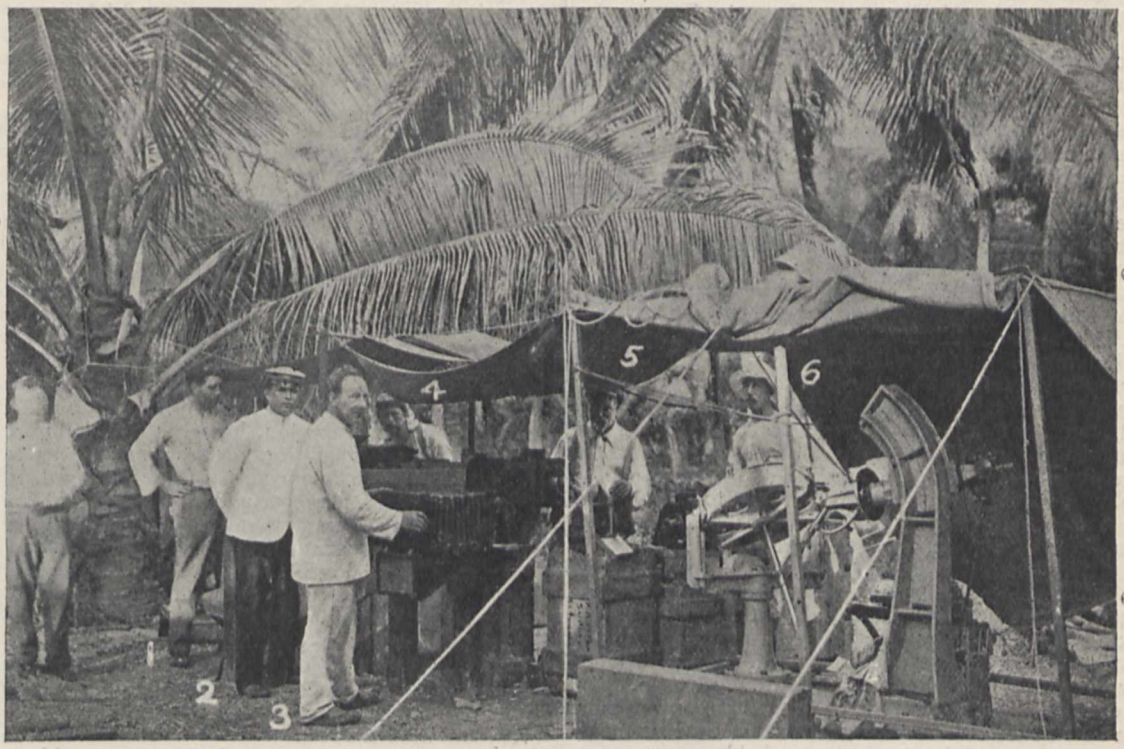
As the wind came in from between the north-east and east, special watch was kept in that quarter. First contact was observed in a perfectly clear sky, and it remained fairly clear to almost within a few minutes of totality. Everyone was prepared to carry out his allotted task when "five minutes before totality" was called out by the American timekeeper.

A heavy bank of cloud then made its appearance in the north-east, and at the signal "48 seconds to go before totality" it began suddenly to rain heavily, and it poured until one second before totality. It had been arranged to determine the instant of totality by observing the cusps, but the clouds prevented their observation. The timekeeper was to have received a signal from the "cusp" observer to commence his counting, but no such signal could be given. At what time the timekeeper started counting is not stated, but it is mentioned that just before totality, probably one or two seconds, because the thin crescent was seen to be just changing into beads, the cloud cleared, and the rain ceased.

The instruments were quickly uncovered, and the exposures made according to the prescribed programme. The clouds continued during the first minute with short intervals of clear sky, after which the eclipse was clearly visible, though light cloud was still present. At the call of 3 minutes 50 seconds, sunlight had broken out, several seconds before it was expected, and was preceded by a brilliant prominence.

Such a sudden and unexpected ending did not, however, spoil the plate which Mr. McClean was exposing at the time, for, as he writes, "then, while expecting another ten seconds, I looked up and saw a red prominence, and shut things up just in time. The others were not so lucky."

The eclipse does not seem to have been a dark one. It is stated that it never became too dark to read large figures, in spite of the instrument being surrounded by trees. Another statement is that a "newspaper could have been read without any difficulty whatever."



Photograph by H. Winkelmann.

FIG. 1.—Mr. McClean and party standing by the instruments they worked during the Eclipse.
(1) Mr. McClean. (2) Mr. Caffyn. (3) Mr. Short. (4) Rev. Walker. (5) Mr. Brooks. (6) Mr. Winkelmann.

Captain G. H. Lacy, who observed the eclipse from the bridge of the *Taviuni*, compared the light during totality to that which would be produced from an arc lamp placed on deck.

Mercury and Venus were seen, the former to the south-west and the latter to the north-east of the sun. Very few stars were observed.

Mr. Raymond, who undertook sketching the corona, using a 4-inch Grubb refractor to project the sun's image on to a sheet of cardboard, likened the form of the corona to "an irregular star of seven points." The corona had a pearly-grey colour, and three of the streamers were shaped like pyramids. These were capable of being faintly traced down to the edge of the moon's limb.

Mr. Flynn, first officer of the *Taviuni*, also made a sketch of the corona.

With regard to the photographs, the following is a brief summary of the successful exposures secured :—

Messrs. McClean, Brooks and Walker, working with the 4⅝-inch De La Rue Coronograph, 8 feet focal length, obtained four pictures.

The same observers secured no results with the Voigtländer 4-inch objective, fitted with a Thorp replica grating.

Mr. Winkelmann, working with a telephoto lens of equivalent focal length of 5 feet 3 inches, obtained five pictures, showing various depths of corona.

Mr. Short (assisted by Mr. Caffin, purser of the *Taviuni*) worked a photoheliograph of about 7 feet focal length and a telephoto lens. Some of his results will also prove very useful.

It will thus be seen that while no spectroscopic results were secured, a very complete record of the form of the corona was obtained, and this was the chief object of the expedition.

With the exception of Raymond's refractor, all the objectives were fed from the 22-inch siderostat mirror taken out by Mr. McClean (see Fig. 1). The De La Rue and photoheliograph received the sunlight directly from the mirror, while the remainder were placed at right angles to the beam from the siderostat, and obtained their light by means of small mirrors placed in the path of the main beam.

Some of the original negatives, and glass positives of others, which have arrived from Auckland indicate at a glance what a magnificent sight the corona must have presented. No wonder the eclipse was not described as a dark one when such an extent of corona encircled the dark moon!

It has been stated, I do not know on what authority, that this eclipse resembled that of 1898. Mr. McClean's beautiful negatives do not in the least remind me of the form it took in that year. Mr. Raymond's description, as quoted above, "an irregular star of seven points," seems to define it very well, and that description could not be given to the form of the corona of 1898, which I observed in India.

In my opinion the photographs of the 1908 eclipse display a form which approaches more to that generally seen when the sun is most active, that is, a "maximum" corona, than to those of the "square" and "wind-vane" variety. Perhaps if it be classed as intermediate between a "maximum" and a "square" form, one cannot be far from wrong. In looking up the records of eclipses, I find that the drawing made by Mr. Weedon of the corona of 1860 July 18 (Memoirs, R.A.S., vol. xli., 1879, p. 543) more closely resembles that of 1908 than any I have been able to find. The year 1860 was a time of maximum sun-spot activity (and also probably a maximum of prominence activity, only no data are available to state this definitely).

Mr. McClean's photographs show several streamers more than one and a half lunar diameters in length. One striking feature of them is their great length and comparatively small breadth, giving them a very spiky appearance. Several prominences are also recorded on some of the negatives. Polar rifts are by no means clearly evident, and this is due possibly to the presence of some streamers in high latitudes.

As was to be expected, Prof. Campbell rendered considerable assistance to Mr. McClean's party, and Mr. McClean writes further in flattering terms of the cooperation of Mr. Mortimer, resident on the island, who rendered him "every assistance during the whole period we were on the island." He also expresses his deep obligations to Mr. A. B. J. Irvine, manager at Auckland of the Union S.S. Company, who did everything in his power to render the expedition a success.

Fortunately only one case of illness is reported. This was Mr. Raymond, who was confined to his bunk on board the *Taviuni* for four days owing to a severe attack of cholera. Although left very weak, he was able to rejoin the party ashore the day before the eclipse, and carry out his programme of sketching the corona as above mentioned.

In conclusion, it may be remarked that the results of the expedition are far more successful than one was led to believe from the previous information received, and the discussion of the photographs will form a valuable contribution to science.

WILLIAM J. S. LOCKYER.

THE MUTATIONS OF ŒNOTHERA.[1]

THE name of an animal or plant may become famous for one of two reasons. Fame may be due either to the intrinsic interest of morphological or developmental characters of "intermediate," "primitive" or rare species, or to the fact that the form in question has been the material by means of which discoveries, which help in the revelation of the fundamental nature of living things, have been made. Examples of plants of the first class are Ginkgo, Ophioglossum, Coleochæte, and Anthoceros. Examples of animals of the first class are Peripatus, Archæopteryx, Acanthobdella, Ceratodus, Okapia, Sphenodon, Anaspides, and Tarsius. Thousands of specimens of an animal which is an example of the second class are daily hurled into the corner of the knacker's stable in the shape of *Ascaris megalocephala*. Thousands of specimens of a vegetable example of the second class could be gathered in a very short time on the sand-dunes along certain tracts of the coast of Lancashire in the shape of *Œnothera Lamarckiana*.

Yet these two classes of forms agree in one respect, that there is a certain magic about their names. Any contribution, however trivial, to a closer knowledge of such forms is regarded as worth publication. The importance of the material is held to compensate for the triviality of the contribution. We are not arguing that this should not be so, but merely pointing out that it is. A new fact, which, if it related to Periplaneta, would not be thought worth publishing will soon find its way into print if it relates to Peripatus.

Every biologist is familiar with, even if he does not take a critical interest in, the wonderful series of observations which have made *Œnothera Lamarckiana* a household word in the mouths of everyone interested in organic evolution. It is not surprising, therefore, to find this form subjected to an investigation which for minuteness and exhaustiveness is without parallel. Those who are familiar with the mutation theory might be excused for thinking that de Vries did not leave much to be done. But the memoir before us shows that, much as de Vries did, this is by no means the case; there is nothing in "Die Mutationstheorie" which for minuteness of detail compares with Dr. Shull's description of the fluctuations of Œnothera.

The memoir is illustrated by a series of beautiful heliotype plates of the various new elementary species to which Œnothera has given rise. Plate 5, which is here reproduced, shows at a glance the striking difference between two of these, *Œnothera lata* and *Œ. albida*—forms with which everyone who knows de Vries's work must be familiar.

The part of this memoir which has interested us most is that which deals with the origin of mutants from strains of Œnotheras different from that which

[1] "Mutations, Variations, and Relationships of the Œnotheras." By D. T. Macdougal, A. M. Vail, and G. H. Shull. Pp. 92. (Washington: Carnegie Institution, 1907.)

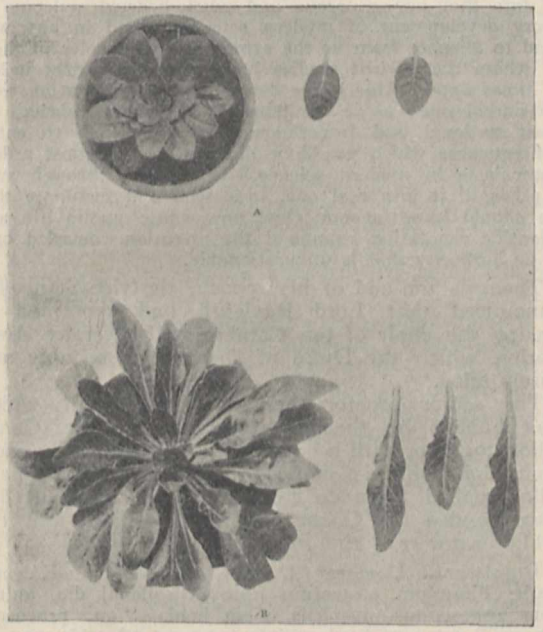
de Vries found at Hilversum and observed his classical series of mutations in.

Three of these strains, from widely different sources, may be referred to.

In September, 1904, Mr. E. P. Bicknell, of Nantucket City, sent two sheets of dried material to the Botanic Garden at New York. The seeds of these specimens were sown in sterilised soil in November of the same year, and amongst the seedlings raised six corresponded exactly to the mutant *Œ. albida* raised by de Vries.

Amongst the seedlings raised from a packet of seed supplied by MM. Vilmorin et Cie., of Paris, there were one *Œ. lata*, one *nanella*, and one *albida*.

Lastly, some plants and seeds of a form provisionally called *Œnothera "biennis"* (Linnæus) were sent over from this country by Mr. H. Stuart Thompson, who had collected the actual seed he sent near Bidston Junction, not far from Liverpool. The plants raised from these seeds proved to be identical with the *Œnothera Lamarckiana* of de Vries, and the strain turned out, like that studied by de



A. Rosette of *Œnothera lata*, four months old, separate leaves of the same age. B. Rosette of *Œnothera albida*, four months old, and separate leaves of the same age.

Vries, to be in a mutable state, for it gave rise to no less than four of the mutants which appeared at Amsterdam—namely, *Œ. lata, oblonga, albida,* and *rubrinervis*.

A. D. D.

THE INDIAN INSTITUTE OF SCIENCE.

IN a recent article on the Jubilee of the Calcutta University it was shown that considerable efforts have been made in Bengal during the last few years to raise the level and tone of university education, and to render it more thorough and practical. Similar efforts are also being made in other parts of India by the Universities of Madras, Bombay, the Punjab and Allahabad, so that it may be hoped that a fairly high standard of university education will be maintained in future in India. Other indications also show that India is becoming alive to the necessity of modelling its educational system on the most modern European lines from the lower forms up to the very highest. The Indian Institute of Science, which is now being started at Bangalore, in Southern India, is an instance in point, and shows how the most advanced of the thinkers in India have grasped the necessity for the prosecution of the very highest forms of post-graduate work. Bangalore, which has been finally chosen for the site of the new institute, has (for India) a most excellent climate; it is situated about 3000 feet above sea-level, and the temperature there is never excessive, so that the conditions for work will be most favourable.

The institute owes its inception to the munificent generosity of the late Mr. J. N. Tata, a Parsee millionaire, who gave (during his lifetime) property which brings in an annual income of about Rs. 1,25,000 (8333*l.*) for the creation of an institute to be devoted to original research. Before the arrangements as to the endowment had been completed Mr. J. N. Tata died, but his two sons, Mr. D. J. Tata and Mr. R. J. Tata, have generously continued the arrangements made by their father.

Considerable discussion ensued as to the best method of utilising this endowment, and a committee was first formed in India to discuss it. Later Sir William Ramsay was asked by Mr. Tata to visit India and advise on the subject, and still later a committee consisting of Prof. Masson and Col. Clibborn made a report as to the best site for the institute and the best scheme of work. The final scheme, however, has been largely worked out by Dr. Morris W. Travers, F.R.S., who was appointed director of the institute about two years ago.

The actual starting of the institute has been much facilitated by two munificent gifts from H.H. the Maharajah of Mysore, who has made a grant of half a square mile of land at Bangalore (in Mysore) for the purpose of the institute, and has also given an annual endowment of half a lakh of rupees (3333*l.*). This has also been supplemented by an annual grant of Rs. 87,500 (about 5833*l.*) from the Government of India, so that the institute will have an annual income of at least Rs. 2,62,500 (nearly 18,000*l.*) for its work.

In addition, too, the Maharajah of Mysore has given five lakhs of rupees, and the Government of India two and a half lakhs, for the erection of buildings, and these sums, together with the accumulations of interest, will give about ten lakhs of rupees (66,666*l.*), and the buildings are to be proceeded with at once.

The constitution of the governing body has been decided on, and the greater part of the detailed initiative has been left to a local committee, consisting largely of the director of the institute and professors of the staff. Practically only post-graduate work and research will be carried on in the institute, and from its nature and position it will be able to attract the cream of the graduates and intellect of India. Provision is to be made for about sixty students to be at work. The subjects which will be taken up are those which are likely to have an important influence in the development of the various arts and industries of India. To begin the work of the institute, for the present five subjects have been decided on: pure and applied chemistry, organic chemistry, bacteriology and the study of fermentation processes, and electrical technology. Probably a sixth (metallurgy) will be added shortly.

India is thus bringing itself into line with the most advanced European countries in the matter of high education, and it may be hoped that every possible success will attend the new institute in its work.

ANTARCTIC ICE.

THE following interesting account of Antarctic experience is from a letter by Prof. Edgeworth David, F.R.S., to Prof. W. J. Sollas, F.R.S. Prof. David is a member of Lieut. Shackleton's expedition :—

GREAT ICE BARRIER, EAST ANTARCTICA.
Lat. 78° 8′ S., Long. 173° 43′ W.
British Antarctic Expedition, 1907.
January 27, 1908.

S.Y. *Nimrod*.

We had some fearfully heavy gales after leaving New Zealand. Our little ship is only 200 tons, and if she had not been an excellent sea-boat and been splendidly handled she might not have survived it. At last we reached the belt of Polar Calms, and were at peace for a day or two: then sighted the heavy brigade of the Ice King, such a sight as I doubt whether any mortal man had seen before. We met, not pack-ice, but countless great tabular icebergs. It was like threading one's way through the streets of Venice with the Doge's Palace and blocks of buildings represented by the purest white alabaster inlaid with liquid sapphire and resting on a foundation of limpid emerald.

The bergs were mostly about 50 to 80 feet high, rarely over a hundred feet; many only about 30 or 40 feet high. Often we had to pass close between them, with a wall of ice on this side and a wall of ice on that. Frequently we seemed to be jammed into a *cul-de-sac*, but always there was some narrow channel into which our ship could be headed. We were about 20 hours steaming through them, the belt being altogether fully 100 miles wide, and probably of much greater dimensions from E. to W.

We knew after this experience that we should get no pack-ice at all between us and the Great Ice Barrier, towards which we were steering almost on the 180° meridian, and our anticipations were fully realised. We arrived at the Great Barrier on January 23. It is a sight that beggars all description. Imagine a continuous wall from Land's End to John o' Groats, 500 miles long and 100 to 200 feet high, the exquisite blue of the crevasses contrasting finely with the dazzling white of the weathered ice on either side of them. We followed it eastwards for about 80 miles, making for an intended base on the Great Barrier, Balloon Inlet. On arriving there the following day we found that Balloon Inlet, fully 10 miles long in 1901, had now completely disappeared, on a piece of ice over 12 miles in width, nothing but more or less high ice-cliffs.

Shackleton, our leader, then tried to force his way along the Great Barrier westwards, so as to get to King Edward VII. Land, but we were blocked by impenetrable pack-ice. Then we followed the pack north for about 100 miles, but it started slowly to envelop us, and we only just escaped in time. Shackleton was very disappointed at not being able to get to King Edward VII. Land, and now we are making for the only base available to us, that of the National Antarctic Expedition of 1901, MacMurdo Sound.

Shackleton is a very capable leader, and I believe that, bar serious accident, he will get to the Pole.

INAUGURATION OF THE NEW CHANCELLOR OF CAMBRIDGE UNIVERSITY.

ACCORDING to custom the inauguration of the new Chancellor of the University of Cambridge took place in London. The Rev. E. S. Roberts, Master of Gonville and Caius College, the present vice-chancellor, accompanied by a certain number of members of the Senate, proceeded on Friday last, May 1, to 4 Carlton Gardens, where the Chancellor-elect received them in the house of his brother-in-law, Mr. Balfour. At noon the vice-chancellor took the chair, and the Senior Esquire Bedell escorted the Chancellor into the room. The train of the black and gold gown of office was carried by Lord David Cecil, the young son of Lord and Lady Salisbury.

In his address to the Chancellor, the vice-chancellor first dwelt upon the loss the University had sustained in the death of the late Duke of Devonshire. In referring to the new Chancellor, Mr. Roberts spoke as follows :—

It is of happy omen, my lord, that you yourself as a student attained to the highest possible academical honours in the oldest and most distinctive of our academical studies. This fact is not without significance for our University in the opening years of a new century. For you afford in your own person a conspicuous example, on the one hand, of reverence for a study which has in former generations made our University famous, and on the other hand of devotion to those newer outgrowths of that study in which Cambridge holds an eminent, if not a preeminent, rank. It is, therefore, with the more ready confidence that we look forward to the period of your Chancellorship as one in which the just balance between the old and the new may be stoutly maintained, and in which the studies of literature and social science may thrive and expand no less exuberantly than that of the natural sciences. One inestimable function of our University has been to quicken the intellectual life of the nation by lessons derived from the history and thought of the ancient world, and to hand on from generation to generation the humanising influence of literary culture. It would be a strange and cruel irony of fate that our generous and whole-hearted welcome of every development of modern science should in any way tend to alienate from us the sympathy and loyalty of those to whom the ancient studies have been dear. Yet it has at times appeared as if the danger of such alienation were no unreal one; as if the honest desire of Cambridge to meet national and Imperial needs were likely to entail consequences which would be deplored by the most ardent enthusiasts in modern science. In passing through such a crisis, if it is a real one, it is well and fortunate that we should have for our chief one whose public life and scientific reputation command the attention conceded only to an authority that is unquestionable.

Towards the end of his speech, the vice-chancellor announced that Lord Rayleigh had consented to occupy the chair of the Cambridge University Association which the Duke of Devonshire so ably and wisely filled.

The senior proctor then read the patent, which was handed by the vice-chancellor to the Chancellor, together with a copy of the statutes. The vice-chancellor read the "affirmation," to which the Chancellor replied "Ita do fidem." The vice-chancellor then handed the Chancellor to the chair, and the public orator read the following Latin speech :—

Dignissime Domine, Domine Cancellarie,—Kalendis Maiis, Floralium nostrorum festo et sollenni die, animo laeto agnoscimus, auspiciis quam bonis, "quo praebente domum," non iam Academi inter umbras sed urbis magnae in luce, Cancellarii novi in honorem purpura nostra vestiti, hic potissimum simus congregati. Tibi vero, vir honoratissime, quod Academiae officium summum a nobis libenter oblatum tam benigne accepisti, senatus totius nomine gratias propterea et agimus et habemus maximas. In honoribus quidem Academicis Duci Devoniae septimo, quondam Cancellario nostro, comparandus, inter nosmet ipsos illam ipsam scientiarum provinciam per quinquennium illustrasti, quae Henricum Cavendish, alumnum nostrum, inter conditores suos numerat, quae Willelmi Cavendish, Cancellarii nostri, munificentiae et officinam splendidam et experimentorum omnium supellectilem amplam iamdudum debuit. Cancellarium alterum, Cancellarii illius filium illustrem, virum de nobis praeclare meritum nuper amisimus, qui qualis in Academiam et in patriam universam quantusque vir fuerit, non est quod longius inter peritos exsequamur. Te vero, muneri illi insigni suffragiis nostris unanimis designate, virum salutamus et Regiae Maiestatis concilio privato et virorum optime meritorum ordini adscriptum, Regiae Societatis praesidem, scientiarum in republica principem, qui lucis sonitusque leges penitus indagasti, qui vis electricae modulos accuratissime determinasti, qui aëris ipsius partem inertem illam prius ignotam detexisti, qui scientiarum physicarum in provincia praemium orbi terrarum toti pro-

positum haud ita pridem adeptus, pecuniae summam magnam non inertem reliquisti, sed Matris almae in manus totam collocasti, et Matris eiusdem filiis omnibus liberalitatis exemplar conspicuum praebuisti. Cancellarii autem ad officium hodie admissus, sine dubio iura et privilegia nostra omnia in tutelam tuam tradita, si quando opus fuerit, fortiter defendes. Tuo, ut speramus, sub patrocinio, non scientiarum modo studia florebunt, sed etiam, praemiis a Cancellario ipso iuventuti Academicae quotannis propositis, et iuris et litterarum Graecarum, Latinarum, Anglicarum, amor, sicut antea, accendetur. Dum gratias tibi hodie omnes ex animo agimus, nihil amplius restat quam ut tibi, vir honoratissime, Cancellarii in munere magno feliciter obeundo, annos prosperos quam plurimos exoptemus.

In his reply the Chancellor expressed his sense of the honour the Senate had done him in electing him to the high office, and mentioned his close connection with Cambridge, "the nursing home of Herschel, Airy, Stokes, Kelvin, and of Adams," both as student and as professor. Lord Rayleigh also recalled the fact that he had served, under the Act of 1877, on the Commission which framed the new statutes for the University and colleges; in fact, he and the Bishop of Bristol, who acted as secretary, are the sole survivors of that Commission. He spoke of the reforms which had been then effected, and referred to the view that they may still need supplementing, and he dwelt for a moment on the fact that the efficiency of the University would be promoted by the command of ample resources. The Chancellor paid a tribute to the late Duke of Devonshire, whose quiet and persistent interest in the University manifested itself in many ways. Indeed, his unremitting efforts to advance its welfare are probably only recognised by those who were brought into contact with him, both as head of the University and as president of the Cambridge Association.

In choosing Lord Rayleigh as its Chancellor, Cambridge has chosen one of the most distinguished men of science of the age, and one whom we feel sure will devote his energies to the promotion of the good of that ancient institution. In these days chancellors of universities have a good deal more to do than even the members of the Senate usually recognise. Apart from occasional appearances at ceremonies there is much and continuous work to be done; the interpretation of the statutes rests with the Chancellor, and in many ways he represents the University in the larger world. The new Chancellor of Oxford has shown what can be done even in a few months of wise activity in re-awakening interest in the older universities, and in defining and formulating a definite policy of expansion.

PIERRE JACQUES ANTOINE BÉCHAMP.

BY the death of Béchamp, on April 15, at the ripe age of ninety-two, France lost the *doyen* of her chemists, and the world of science is the poorer by the disappearance of one more link connecting the new chemistry with the old. The nature of that link will be evident from the circumstance that Béchamp was born in the same year as Gerhardt, and that the period of his greatest scientific activity was contemporaneous with that of Laurent and Gerhardt.

Béchamp was born at Bassing, near Dieuze (Meurthe), on October 16, 1816. He lost his parents when he was eleven years of age, and was taken charge of by an uncle, who had settled in Roumania, and with whom he remained until 1834. In his seventeenth year he was apprenticed to a pharmacist at Strasburg. Pharmacy at that period constituted the main avenue to scientific chemistry, and in traversing it Béchamp simply followed in the footsteps of a dozen of his predecessors, some of whom, like Scheele, Vauquelin, Dumas, are among the most renowned of chemical investigators. At Strasburg, at that period, were Gerhardt and Wurtz, and, as in their case, Béchamp was soon attracted to the study of the rapidly extending branch of organic chemistry, and made ample use of the opportunities which his master's laboratory afforded to prosecute his inquiries. At that time, even in England, pharmacy was a profession, and the pharmacist was a practical chemist, abreast of the science of his time, whose laboratory was of more importance to him than his shop.

In 1851 Béchamp became attached to the School of Pharmacy at Strasburg, and thenceforth devoted himself to an academic career. Pasteur was then a professor of the Faculty of Science of Strasburg, and to him Béchamp presented a thesis on the newly discovered gun-cotton, which gained for him his doctorate of science in 1853. In 1856, at the age of forty, he became a doctor of medicine, and in the following year was appointed to the chair of medical chemistry in the Faculty of Medicine at Montpellier.

Béchamp was a prolific contributor to the literature of chemistry. The Royal Society's Catalogue of Scientific Papers enumerates upwards of 140 papers which proceeded from his pen down to the year 1873. As he continued his activity to the last, the total number cannot fall short of a couple of hundred. In addition he published a number of scientific treatises in book-form, mainly relating to chemical biology.

Béchamp's work ranged over nearly every department of chemistry. Inorganic chemistry appears, however, to have had little attraction for him, and his name is associated with not more than a dozen communications in that branch of inquiry.

It is mainly in connection with the early history of what is called coal-tar chemistry, and more especially in connection with the fields of investigation with which the name of Pasteur is preeminently associated, that Béchamp's services will be recalled. The method of manufacturing aniline ultimately made use of by Perkin in England, and by the brothers Renard in France, was due to Béchamp. It consisted in the action of ferrous acetate on nitrobenzene, and appears to have been first made known in 1854. He also contributed to the French Academy in 1860–61 communications on fuchsine and allied colouring matters.

But it was to the domain of biological chemistry that Béchamp's energies were principally directed, and he took an active part in the inquiries and controversies which ultimately led to the triumph of Pasteur and his immediate followers. Although much of Béchamp's work on fermentation, on the production of moulds, on the silk-worm disease, and on zymases ran parallel with Pasteur's inquiries, his interpretation of the phenomena was generally opposed to that of Pasteur, and the two investigators were frequently in acute controversy on these subjects. Béchamp's fame has probably suffered in consequence. We must, however, do him the justice to admit that his main contention, that unorganised ferments play a larger and more important part in the phenomena of metabolism than the immediate followers of Pasteur were willing to concede, is intrinsically sound. Béchamp developed his views into a general theory, which he published in 1866, whilst at Montpellier, in a work entitled "Microzymas et Microbes. Origine des ferments." This he supplemented some years later by a further work, "Les Microzymas dans leurs rapports avec l'hétérogénie, l'histogénie, la physiologie et la pathologie," Paris, 1883. Whatever may be the ultimate fate of his theoretical conceptions, his experimental work on blood, fibrin, milk, proteins, and his

position in regard to the great and fruitful controversies of half a century ago out of which modern bacteriological doctrine has sprung, will ensure him an honourable place among the founders of biological chemistry.

On the creation of the Faculty of Medicine at Lille, Béchamp accepted the offer of a chair, and he remained there, as Dean, until his resignation in 1887, when he retired to Paris, and, accepting the hospitality of Friedel's laboratory in the rue Michelet, continued his biological inquiries, occupying himself to the end in searching for support for the comprehensive generalisation of organic change on which his fame will ultimately rest.

NOTES.

THE Croonian lecture of the Royal Society will be delivered on Thursday next, May 14, by Prof. G. Retzius, upon the subject of "The Structure of the Central Nervous System of the Higher and Lower Animals."

THE President of the Board of Trade has appointed a committee to prepare a programme for the consideration of the delegates to the International Conference on Electrical Units and Standards to be held in London in the ensuing autumn, and to make arrangements for the reception and assembly of the delegates attending the conference. The members of the committee are Mr. G. R. Askwith, K.C., Sir John Gavey, C.B., Dr. R. T. Glazebrook, F.R.S., Major P. A. MacMahon, F.R.S.,.Major W. A. J. O'Meara, R.E., C.M.G., and Mr. A. P. Trotter. Mr. M. J. Collins, of the Board of Trade, will act as secretary to the committee.

M. BIGOURDAN read a paper at the meeting of the Paris Academy of Sciences on April 27 on the use of wireless telegraphy for weather forecasting. He pointed out that our weather is associated with the passage of atmospheric depressions arriving from the west, and generally from parts of the Atlantic situated north of 35° N. latitude, and it is estimated that about one-half of these depressions come from North America, whilst the others form in the open Atlantic. To forecast the arrival of depressions it is necessary to have observations from the open ocean. Floating observatories have been suggested, coupled with the continents on either side of the Atlantic. M. Bigourdan suggests that steamships should communicate, to the responsible authorities, their position and meteorological observations by wireless telegraphy, and by this means modify and improve our conditions for weather forecasting to the benefit of the general community. For some time past our English Meteorological Office has published in its Daily Weather Report wireless telegrams from ships of His Majesty's Navy.

THE sixteenth Congress of German Electrotechnical Engineers will be held at Erfurt on June 11–14.

THE Entomological Society will hold a conversazione on Friday, May 15, in the rooms of the Civil Service Commission, Burlington Gardens.

THE Rumford medal of the American Academy of Arts and Sciences has been awarded to Dr. E. G. Acheson, of Niagara Falls, for his work with the electric furnace.

THE Chemical Society of Rome, the Chemical Society of Milan, and the Association of Industrial Chemists of Turin will, from January 1, 1909, be united under the name of the Italian Chemical Society.

PROF. W. H. WALKER, professor of technical chemistry at the Massachusetts Institute of Technology, has been awarded the Nichols medal by the New York Section of the American Chemical Society.

MESSAGES from Catania report that dense clouds of vapour issued from the central crater of Mount Etna on April 29. The crater of 1852 in the Valle del Bove was also in eruption. On May 2 the volcano was again in active eruption, and a stream of lava was slowly advancing.

A CONVERSAZIONE will be given by the Medical Society of London on Monday, May 18, in the rooms of the society, Chandos Street, Cavendish Square. After the reception by the president, the Fothergillian medal will be presented to Sir Almroth Wright, F.R.S. An oration will be given by Mr. T. Clinton Dent on the subject of the after results of injuries.

ON Tuesday next, May 12, Prof. F. T. Trouton will begin a course of two lectures at the Royal Institution on (1) "Why Light is believed to be a Vibration"; (2) "What it is which Vibrates." The Friday evening discourse on May 15 will be delivered by Dr. H. T. Bulstrode on "The Past and Future of Tuberculosis," and on May 22 by Prof. J. C. Kapteyn on "Recent Researches in the Structure of the Universe."

AT the Institution of Electrical Engineers on April 30 Prof. Silvanus P. Thompson, F.R.S., gave the first Kelvin memorial lecture, his subject being "The Life and Work of Lord Kelvin." Before the lecture was delivered Mr. H. F. Parshall presented the institution with a bust of Benjamin Franklin on behalf of the American Institute of Electrical Engineers as a souvenir of their visit to England about a year and a half ago. The gift was acknowledged by Lieut.-Colonel R. E. Crompton, the president of the institution.

THE sixteenth International Congress of Americanists will be held under the presidency of Baron Weckbecker at the University of Vienna on September 9–14. The object of the congress is to promote scientific inquiries into the history of both Americas and of their inhabitants. Communications may be oral or written, and may be in one of several languages, English included. For further information application should be made to Herr Franz Heger, Vienna (Austria), I. Burgring 7. A programme will be issued early in the summer.

PROF. ANGELO MOSSO, of Turin, writes to remind us of the fact, to which attention was directed in an article by the late Sir Michael Foster in NATURE of March 9, 1905 (vol. lxxi., p. 445), that the Royal Society has the right to nominate two investigators to occupy tables in the Monte Rosa and Col D'Olen international laboratories. The tables are available for the study of botany, bacteriology, zoology, physiology, terrestrial physics, and meteorology. The two tables at the disposal of the Royal Society are, it will be remembered, due to the generosity of Dr. Ludwig Mond, F.R.S.

AT the annual general meeting of the Institution of Civil Engineers on April 28, Mr. J. C. Inglis was elected president of the institution. The council has made the following awards for papers read and discussed during the past session:—a Telford gold medal to Mr. W. Barclay Parsons (New York); a Watt gold medal to Sir Whately Eliot; George Stephenson gold medals to Sir John Ottley, K.C.I.E., Dr. A. W. Brightmore, and Messrs. J. S. Wilson and W. Gore; Telford premiums to Messrs. F. W. Davis (Darlington), C. R. S. Kirkpatrick (Newcastle-on-Tyne), Hugh T. Ker (Glasgow), G. H. Scott, R. R. Gales (India), and S. H. Ellis.

THE exceptionally cold weather which had prevailed throughout April was temporarily interrupted with the opening days of May, and on the first and second of the present month some remarkably high temperatures were reported from different parts of England. At Greenwich the shade temperature on Saturday, May 2, registered 75°, which is a record reading for that day during the last half century. The thermometer on the previous day registered 73°. The report of the weather issued by the Meteorological Office for the week ending last Saturday states that at Jersey and Bettws-y-Coed the thermometer rose to 78° on May 2, and to 76° at places in the south-east of England and the Midland counties, and to 75° in the east and south-west of England. There was an abrupt change to cool weather again on Sunday, May 3, when in London the highest temperature was 52°.

THE death is announced of M. C. E. Chamberland, the sub-director of the Pasteur Institute, Paris, at the early age of fifty-seven. M. Chamberland is probably best known in connection with the porcelain filter which bears his name together with that of his great master, Pasteur. He did much work on surgical asepsis, showing that the germs in the air may be disregarded provided the skin, the instruments, and the dressings be rendered sterile. He also contributed much to the prevention of animal diseases by the method of vaccination with attenuated viruses.

WE regret to have to announce the death of M. Alfred Riche, one of the last of Dumas's pupils at the Sorbonne. Riche was born at La Roche-sur-Vannon on February 5, 1829. He was originally intended for the law, but becoming attached to science, after a course of study at the École Centrale, he accepted the position of *aide préparateur* under Dumas (1849). He subsequently became *préparateur* at the Institut Agronomique at Versailles, and then at the Sorbonne under Balard and Dumas. In 1874 he succeeded Bussy in the chair of mineral chemistry, which he occupied until 1899, and where he had as assistants Jaques and Pierre Curie, and as a pupil Moissan, who eventually succeeded and predeceased him. In 1862 Riche became an assayer at the Monnaie, and ultimately, in 1887, director of assays, a post which he continued to fill until last year, and he had charge of the revenue laboratories under the Minister of Commerce. He published a considerable number of papers on organic and mineral chemistry, chiefly on the organo-metallic derivatives of tin and arsenic, on copper-tin alloys, on the electrolytic estimations of metals, on sugar-analysis, &c. For many years he was the principal editor of the *Journal de Pharmacie et de Chimie*, and was the author of a number of text-books and manuals.

MR. F. HOWARD COLLINS has sent us a copy of a paper by him, reprinted from the *Nautical Magazine*, in which he describes a method of representing by diagrams the characters of the lights of lighthouses, and of fog signals, so that they may be identified at a glance. He suggests that the system should be applied to Admiralty Charts and to the Admiralty List of Lights. A leading authority upon the subject has favoured us with the following remarks upon the proposed method and application:—"The writer proceeds on the assumption that each lighthouse completes its cycle in a minute. This is not the case, and this system of diagrams could not apply to lights the periods of which are (*a*) more than a minute; (*b*) not an integral fraction of a minute. That is to say that only lights with periods of 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, or 60 seconds can be represented. This would exclude the Nab, Hanois, Royal Sovereign, Dover Pier, South Foreland, Sunk, Galloper, Orfordness, Flamborough, and many other of our most important lights. Apart from this, it is considered that the diagrams are no improvement on the clearly composed description of each light as given at present in the light lists (such as Flash, 5 seconds, Eclipse, 10 seconds); indeed, it is very doubtful if they would convey any meaning at all to the less educated members of the seafaring community. This applies with additional emphasis to the diagrams representing fog signals. The extra expense of diagrams (and their periodical corrections) would be objectionable. The application of this system to the Admiralty Charts is altogether impracticable."

SEALING in 1907, according to a note by Mr. T. Southwell in the April *Zoologist*, was, owing to bad weather and the heavy ice-pack, nearly as bad as in 1905, which was the worst since 1898. Two of the fleet of twenty-four vessels were wrecked, and the number of skins secured by the others fell short of last year's total by close on 100,000, with a decrease of rather more than 30,000*l.* in money value. The total number of seals killed was just over 245,000, the market price being 4·20 dollars per cwt. for those of young animals and 3 dollars for those of adults.

ACCORDING to *Museum News* for April, an exhibition of South American birds' nests has been installed in the children's museum, which has proved highly attractive alike to children and to adults. Excellent examples of protective resemblance are shown among the nests of certain flycatchers, in some of which the lichen-covered walls blend insensibly into the supporting branch or simulate a knot or other natural excrescence. Other exhibits are nests of the slate-headed tody swinging at the end of long, slender branches, and looking like bunches of drift-grass left in their present positions by receding waters. Nests of two species of spiny-tails (a group of woodhewers) are also shown, which by their dissimilarity in structure and material would not suggest relationship in their builders. The nests of five species of spiny-tails agree, however, in having a lining of grey lichens.

A COLLECTION of valuable and scarce books appertaining to botany and zoology, including a series of zoological works by J. Gould and D. G. Elliot, is offered for sale in the antiquarian catalogue recently issued by Mr. B. Quaritch.

A CATALOGUE of new or noteworthy flowering plants from Mexico, Central America, and the West Indies, determined by Dr. J. M. Greenman, comprises a number of new species of Senecio and various composites, also additions to the Verbenaceæ, Euphorbiaceæ, and other orders. It is issued as Publication No. 126 of the Field Museum of Natural History.

THE account of the desert basins of the river Colorado in the delta region where it flows into the Gulf of California provides a remarkable record. Attention was directed to the locality by the rise of water in the Salton Lake at the head of the delta from November, 1904, to March, 1907, since which time the waters have receded. The recession affords an opportunity for noting the spread of the vegetation, that is chiefly halophytic and partially xerophytic. With this purpose, surveys have been made by workers from the desert laboratory of the Carnegie Institution, beginning at the time when the flood was at its height. The preliminary account, by Dr. D. T. Macdougal, is published as a Bulletin of the American Geographic Society (December, 1907). Reference is made

to a hot spring near Lake Maquata, where the water gave a temperature of 120° F. Two species of the algal genus Phormidium, and a new species of rain-water fish, *Lucania brownii*, were taken there.

THE Geological Survey of Western Australia has issued an important report (Bulletin No. 29) upon the geology of the Cue and Day Dawn districts, Murchison goldfield, by Mr. H. P. Woodward. Owing to the voluminous character of the report, it has been issued in two parts, the first of which is confined to the Cue and Cuddingwarra centres, and the second to the Day Dawn centre. Much of the latter is occupied by an elaborate report upon the Great Fingall mine, the subject being dealt with, not only from the standpoint of the geologist, but also from that of the mining engineer. This mine, which produced 95·38 per cent. of the total production of 778,606 ounces from the district up to the end of 1906, is a low-grade property, which, owing to excellent management, is being worked at a profit. The reports are illustrated by five large geological maps, twenty-three mine plans, and nineteen admirable photographs. Particularly striking is the view, here reproduced, of the waste heap to which the sands from the cyanide process are delivered by belt-carriers. This heap, being more than 100 feet in height, forms a conspicuous landmark.

Tailings Dump of the Great Firgall Mine.

A VIGOROUS article on the crisis in the French vineyard appeared in the *Times* (April 25), in which the author, Prof. L. Daniel, traces the sequence of events that have led to the present disastrous conditions. Primarily the fault is ascribed to the indiscriminate confidence placed in grafting as a panacea for combating phylloxera. The grafted vines also gave a large yield that suggested increased profits, so that growers were ready to overlook any possible disadvantages, such as deterioration in quality. As a result, there has been a large production of inferior wines, that are also unsuitable for storing. Prof. Daniel attributes the inferiority to the difference in root-growth, the American vine being a surface feeder, while the roots of the French vines penetrate deeper. It is noted how, in the course of time, grafted plants have deteriorated, and evidence has accumulated to show that phylloxera is amenable to treatment; in these circumstances growers are being officially advised to return to old methods, and aim principally at quality.

THREE bulletins have reached us from the University of Wisconsin, all dealing with matters of considerable practical importance. One describes the conditions necessary for growing lucerne, a crop which is common enough in the United States as a rule, but is not as yet much grown in parts of Wisconsin. Since the development of the plant depends on the presence of the proper bacteria in the soil, farmers are recommended in doubtful cases to inoculate the land by scattering on each acre about two tons of soil from old lucerne land. If no such soil is available, the University Experiment Station is willing to supply hundred-pound lots so that a start may be made on a few rods of land, from which, of course, a considerable area can afterwards be inoculated. Another bulletin deals with the necessity for properly housing pigs, and the third urges the importance of systematically examining herds for tuberculosis, and slaughtering all animals that give the tuberculin reaction.

A REPORT on the delimitation of the Turco-Egyptian boundary (June–September, 1906), by Messrs. E. B. H. Wade, B. F. E. Keeling, and J. T. Craig, which has just been published by the Survey Department of the Egyptian Ministry of Finance, furnishes an excellent example of the application of modern methods of surveying so as to yield a maximum of accuracy in result with a minimum expenditure of time. The survey operations consisted in running a traverse 210 kilometres in length, from a point on the beach at Taba, on the Gulf of Akaba, to Rafa, on the Mediterranean coast, fourteen points being determined on the route. The method employed was that of latitudes and azimuths, an assumed longitude being first taken for Taba, where the work began, and a final longitude obtained for Rafa, where it ended, by exchange of telegraphic signals with the Helwan Observatory, near Cairo. Notwithstanding the difficult nature of the country, both as regards topography and the troubles from dust-haze and mirage incident to work on a heated desert plateau, the traverse was completed in thirty-one days, including the computations and plotting of the boundary. The demarcation by permanent signals occupied fifteen days, and it is further interesting to note that the total cost of the survey operations amounted to £E460. The report includes detailed examples of the observations and reductions, and is valuable as a specimen of this class of work.

A CONVENIENT and handy form of refractometer, especially adapted for the rapid determination of the refractive indices of faceted gem-stones, but also applicable for liquids, has been designed by Dr. G. F. Herbert Smith, and two patterns of the instrument have been constructed and placed on the market by Mr. J. H. Steward. With the later (1907) pattern it is possible to determine a faceted stone in whatever form of mounting it may be set, and

a scale visible in the field of the instrument enables the refractive index to be read directly to the second place of decimals. The range extends from 1·300 to 1·775, which includes the refractive indices of corundum (ruby and sapphire), the only gem-stones falling beyond this being almandine, demantoid, zircon, sphene, and diamond. The two patterns of instrument have been described in detail by Dr. Herbert Smith in the *Mineralogical Magazine* (1905 and 1907), and a more popular account is given by him in a pamphlet published by Mr. J. H. Steward ("The Herbert Smith Refractometer, and its Use, particularly for the Discrimination of Faceted Gem-stones," London, 1907, pp. 28). In this pamphlet a concise summary is given of the methods applicable for the discrimination of faceted gem-stones, it being pointed out that the determination of the refractive indices is often the only trustworthy test that can be applied when the stones are mounted. A carefully compiled table of the constants of thirty-four mineral species used in jewellery contains some new determinations, and will be found useful for reference.

THE thirtieth yearly report of the Deutsche Seewarte, for the year 1907, shows that the work of that active and useful institution has been continued on the same lines as hitherto; the constant increase of its operations, as in the case of most other meteorological organisations, has made it necessary to add to its working staff. The number of observers in the mercantile marine was 962 at the close of the year; they are encouraged in their work by the award of medals and diplomas for excellent observations, as well as by a liberal presentation of official publications. The most important event of the year in the department of weather prediction was the acquisition of telegraphic reports from Iceland and the Færöe Islands, which have been found of great service; the early morning reports from the British Isles are also much appreciated. As in this country, special forecasts for agriculturists are issued during the summer season, but the dissemination of the information is on a much larger scale. Exploration of the upper air by means of kites and balloons is actively continued whenever practicable.

IN the monthly meteorological charts of the North Atlantic and Indian Oceans for May, issued by authority of the Meteorological Committee, every available space is, as usual, occupied with data of importance to seamen. The face of the charts shows the average statistics relating to the atmosphere and the sea for the month in question, with latest intelligence on such subjects as ice, monsoons, &c. Among the interesting matters dealt with on the back of the charts we find a discussion of the observations of the Sargasso or Gulfweed from the records kept for the Meteorological Office during the seven years ended 1907, and the monthly frequency of fog in the Gulf of St. Lawrence for the period 1892–1906. There are also charts showing the cyclone tracks in the South Indian Ocean for 1848–1905, and a picture of the Southern Ocean ice during each of the months April to June, for twenty-three years ended 1907; some of these huge icy masses are said to have projected 1000 feet above the water-line, and to have been from two to forty miles in length.

DR. MOSCHOU, of Smyrna, has invented some improvements in the beams and bearings for physical balances. Balance beams have previously been designed which are roughly elliptical in cross-section or are of a channel section. According to the present invention, a section is adopted which is approximately elliptical, but has vertical sides, and if desired the elliptical tube may be strengthened by a rhombic frame. The bearings of the balance have also been considerably modified; for the usual knife edges, discs taking the form of two truncated cones placed base to base are substituted. For the centre bearing there are two such discs secured to the elliptical beam, and at the ends of the beam similar discs are supported by small axles. In some cases two discs are provided at each end of the beam, and the balance pans are supported upon these by hooks, hollowed at their bearing surfaces so that they always take up the same position upon the discs whenever they are removed and replaced. When two discs are thus used, the swinging of the balance pans backward and forward is largely prevented.

PART V. of the *Verhandlungen der deutschen physikalischen Gesellschaft* for the present year contains the results of Dr. P. Nordmeyer's further work on the mean specific heats of pure substances between the two temperatures −188° C. and 18° C. The method is identical with that used previously, and depends on the determination of the weight of liquid air evaporated by a body at ordinary temperature placed in it. The following are the values obtained:—sodium, 0·253; magnesium, 0·222; calcium, 0·157; iron, 0·097; molybdenum, 0·063; thallium, 0·038; gold, 0·033; aluminium, 0·182; yellow phosphorus, 0·178; potassium, 0·170; bromide of potassium, 0·103.

AN eighth edition of Mr. Andrew Jamieson's "Elementary Manual of Applied Mechanics" has been published by Messrs. Charles Griffin and Co., Ltd. The book has been revised, some additions have been made to the text, and further examination papers included.

MESSRS. SMITH, ELDER AND CO. have almost ready for publication a work on "Animal Life," by Dr. F. W. Gamble. The volume comprises a series of studies in the life-history of typical members of the animal kingdom, describing their vital activities in relation to their structure, and the general scheme of development.

THE current issue of the *Central*, the organ of the Central Technical College Old Students' Association, contains a portrait of Dr. G. T. Moody, and articles on the electrification of railways, by Mr. Lionel Calisch, and on the City of Victoria and Hill district waterworks, Hong Kong, by Mr. D. Jaffé.

A THIRD edition of Dr. Alex. Findlay's translation of Ostwald's "Principles of Inorganic Chemistry" has been published by Messrs. Macmillan and Co., Ltd. The fundamental character of the book remains unaltered, and the changes in detail are not great, but here and there slight mistakes have been corrected and some additions made.

THE report of the council and proceedings of the Hampstead Scientific Society for the year 1907 has been received. The membership of the society now stands at 286, and its finances are in a satisfactory state. As usual, the lectures given at the general meetings during the winter have been appreciated widely. Among the list of lecturers we notice the names of Prof. E. H. Starling, F.R.S., and of Dr. C. W. Andrews, F.R.S. The activity of the various sections of the society has been well maintained.

MR. JOHN COOKE, editor of Murray's "Guide to Ireland," is preparing an account of the tumuli and other pagan antiquities of the Boyne Valley for the "Handbook" of the British Association. It is to be hoped that at last their astronomical orientation will be given. Mr. Nathaniel Colgan, author of the "Flora of Co. Dublin," and one of the editors of "Cybele Hibernica," will deal with the local botany. The geology of the immediate neighbourhood of Dublin is specially interesting, ranging as it does from the Cambrian Bray Head to the Carboniferous limestone of the great central plain.

OUR ASTRONOMICAL COLUMN.

DANIEL'S COMET, 1907*d*.—Signor Pio Emanuelli, of Rome, has favoured us with a manuscript copy of a daily ephemeris for Daniel's comet, calculated by him from the elements computed by Prof. E. Millosevich. An abstract from this ephemeris is given below :—

Ephemeris 12h. (M.T. Paris).

1908	α (1908·0) h. m. s.	δ (1908·0) ° ′	*r*	Δ
May 8 ...	14 7·6 ...	−0 51·1 ...	0·590 ...	0·467
16 ...	14 1·4 ...	−0 31·0 ...	0·600 ...	0·487
24 ...	13 56·2 ...	−0 18·8 ...	0·610 ...	0·508
31 ...	13 52·6 ...	−0 14·5		

From this it will be seen that the comet is now apparently travelling very slowly through the constellation Virgo in an easterly direction; its present magnitude is about 11·0, and it crosses the meridian about 11 p.m.

THE SOLAR ROTATION DETERMINED FROM HYDROGEN PHENOMENA.—From a discussion of the results obtained in a spectrographic determination of the solar rotation, using the hydrogen lines Hα, Hγ, and Hδ, Prof. W. S. Adams arrives at conclusions fundamentally important in any study of the solar structure; the full discussion, together with a description of the instrument and methods employed, appears in No. 3, vol. xxvii., of the *Astrophysical Journal* (April, pp. 213 *et seq.*).

The first conclusion is that the sun's rotational velocity as shown by the hydrogen lines is higher than that given by those of other elements and by the study of sun-spots and faculæ; the excess amounts to 1° in the angular motion at the equator. It is worthy of remark that Hα, which shows abnormal tendencies in its width, its intensity, and its behaviour at the sun's limb, gives slightly higher velocities than the other hydrogen lines. The second conclusion is that in the regions where the hydrogen lines are produced the equatorial acceleration of the solar atmosphere is non-existent, or too small to be measured by the present method. These conclusions point to the absorbing hydrogen being situated at a higher level than other absorbing media, *e.g.* calcium; a previous investigation (see NATURE, No. 1990, p. 158, December 19, 1907) showed that carbon and lanthanum gave lower velocities than general, and are, therefore, probably situated at a lower level.

The results of a study of the solar rotation, based on the measurements of hydrogen flocculi, are published by Prof. Hale in the same journal, and they confirm the absence of the equatorial acceleration in the absorbing hydrogen atmosphere of the sun.

THE CANALS AND OASES OF MARS.—In the *Century Magazine* for May (vol. lxxvi., No. 1, p. 127), Prof. Lowell continues his explanation and discussion of Martian features, taking the canals and oases as the special subjects of this article.

Recounting the history of the canaliform marking since their discovery by Schiaparelli in 1877, Prof. Lowell strongly emphasises the numerous points which go to prove their actual reality. The narrowest canal appears as it would were it but three miles across, but the average width is some twenty miles. They vary in length from 250 to 2500 miles, and one, the Eumenides Orcus, extends for some 3450 miles. Schiaparelli mapped 113, but 436 canals are now known to the Flagstaff observers. Of the oases, first seen by Prof. W. H. Pickering in 1892, there are now 186 marked on the Flagstaff map of Mars. The special features of all these markings, their seasonal variations, their similarities and concordant behaviour, and the weight of evidence added by the geminated canals, are all discussed by Prof. Lowell, and the results are shown to be consistent with the theory that the features are there for a set purpose, their functions having been determined by sentient beings for the sustenance of life and vegetation on a planet which has reached a stage further in the evolutionary process than has the earth.

THE COLOUR SENSIBILITY OF SELENIUM CELLS.—In a recent determination of the moon's light, Messrs. Joel Stebbins and J. C. Brown, of the Illinois University Observatory, found that the results depended upon the cell used, and suggested that the variation was due to differences between the colour-sensibility curves of the several cells (see NATURE, January 16 and 30, pp. 258 and 302). In a recent investigation Mr. Stebbins found that this explanation is correct, and in No. 3, vol. xxvii., of the *Astrophysical Journal* (April, p. 183) he gives the numerical results and a series of colour curves illustrating the variations of the four cells employed.

THE ASTRONOMICAL SOCIETY OF ANTWERP.—The third annual report (1907) shows that this society is progressive, and is fulfilling its primary purpose, the popularisation of astronomical science, exceedingly well. The instrumental equipment has been largely added to, the various meetings for practical work and for lectures are well attended, and there are now about 140 names on the list of members. An important event in the history of the society during the past year was the foundation of the *Gazette astronomique*, a most useful monthly journal for amateur observers.

MICROGRAPHIC STUDY OF LEATHER.

UNDER the title "Étude micrographique du Cuir," M. Henri Boulanger has published in the *Bulletin de la Société d'Encouragement* for February of this year a series of interesting drawings showing the microscopic appearance of various sections of raw and tanned hide. The chief interest in these consists in the demonstration of the changes which take place in the skin during the process of tanning. About thirty years ago a very similar study was undertaken by the late Franz Kathreiner, of Worms, on the microscopic preparations of raw and tanned calf skin, in all the various stages of the tanning process, and the writer has had the privilege of seeing these very beautiful preparations; unfortunately, Kathreiner's results were never published.

The microscopic appearance of sections of raw skin is well known to those who have made a scientific study of tanning. but that of leather has not received so much attention owing to the difficulty of preparing sufficiently thin sections to be of use, and further of differentiating the constituent parts.

The author himself remarks that it is almost impossible to make a satisfactory section of the flesh side, and he has therefore confined his studies exclusively to the "grain" side of the skin. This is commonly called the epidermis, but it is difficult to apply strictly the vocabulary of the histologist; in this case the true epidermis disappears completely in the process of preparing the skins for tanning, and what the tanner calls the "grain" of the skins is the hyaline membrane covering the upper surface of the Rete Malpighi.

M. Boulanger's method of preparing the sections of raw skin has the advantage of being a rapid one; small pieces of skin are soaked for twelve hours in a solution composed of:—distilled water, 5 grams; glycerin, 5 grams; acetone, 90 grams. They are then allowed to dry, embedded in hard paraffin, and are ready for the microtome. The staining and mounting of the sections is carried out by the usual methods. The microscopic appearance of the sections was reproduced by coloured drawings made with the camera lucida, since a photograph will not show the various depths of the section. The illustrations shown are photographs of these drawings. Fig. 1 shows the appearance of a section of the grain side of a fresh cow-hide taken from the breast between the fore legs; in scientific language, the upper surface of the dermis—the fibro-elastic layer. It is stained with carmine alum, and shows clearly the flat, inert cells of the epidermis, which it is often difficult to preserve intact in microscopic sections, especially in a hide or skin which has been salted. Immediately below this are the living cells of the Malpighian layer; the nuclei of these cells are well shown in the figure. Just below this layer, which will eventually form the "grain" of the tanned leather, are seen the papillæ of the dermis; the dark spots are the nuclei of the cells of the connective tissue. A hair follicle is also shown, as well as a hair in vertical section. The magnification of the plate in the memoir is 285 diameters, and is one-half this amount in the accompanying reproductions of two figures. Compare the appearance of Fig. 1 with

that of Fig. 2, which shows a section of cow-hide tanned with oak bark and curried with *dégras*.

Before describing Fig. 2, it is necessary to explain the mode of preparation of the section. A small strip of leather about 10 mm. wide is taken, and the flesh side shaved away until the piece has a thickness of about

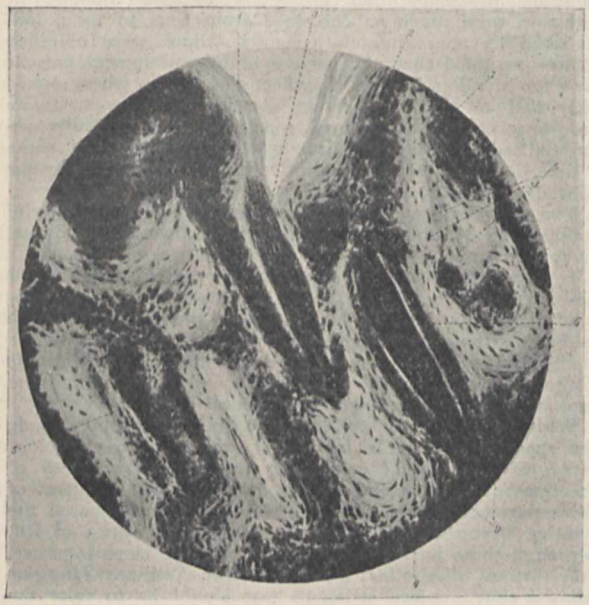


FIG. 1.

2 mm. The shaved strip is placed in melted tallow, not too hot, for about a quarter of an hour; after cooling, the strip is embedded in hard paraffin and cut in a Ranvier microtome, the sections degreased with xylol, then washed two or three times with alcohol, and stained with Weigert's fuchsin; the staining takes about three hours; the

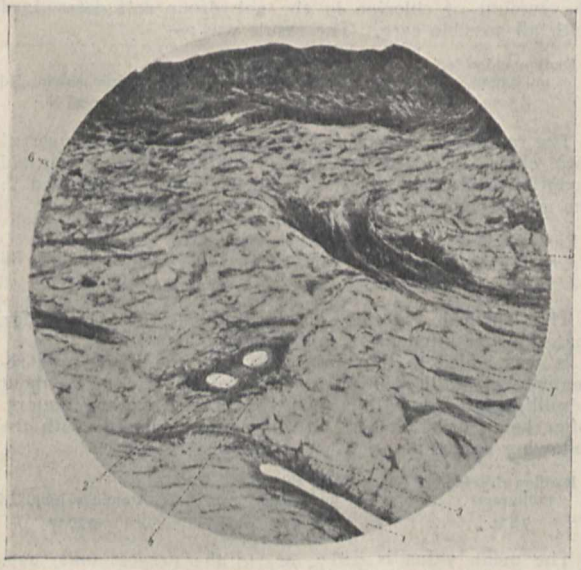


FIG. 2.

Weigert solution is poured off, and a few drops of absolute alcohol put on to the section; this removes excess of dye, and differentiates the various parts. It is now washed twice with alcohol, passed two or three times through xylol to eliminate the alcohol, and finally mounted in balsam.

In M. Boulanger's view, the skin, when freed from the hair and the histological epidermis (both of which are got rid of in the preparatory processes), is composed of two tissues, an upper and a lower, intimately united, although of distinctly different natures. No scientific designation has been given to these two distinct layers, but the whole has been called the dermis; in view of their special constitution, and to distinguish them, he calls the "grain" the fibro-elastic layer and the "flesh" the layer of giant connective fibres. The elastic fibres in their natural state take up Weigert's stain readily, and they retain this property after tanning; both before and after the tannage they form the essential framework of the skin or leather; without them there is no elasticity or suppleness, and tanning does not appear to alter their constitution. The connective fibres, on the contrary, are completely changed, so that we may conclude that the tannin acts differently on the two tissues.

The present writer will not here discuss this conclusion, though in his opinion there is no such distinct difference between the two portions of the skin, but that in the "grain" the connective tissue is fine and closely compacted, whereas in the "flesh" it becomes loose and coarse; thus the difference is in degree, and not in constitution. Boulanger's fibro-elastic layer must not be confounded with the elastic yellow fibres which form a comparatively small part of the volume of the skin. Comparing the two figures, there is a striking contrast in the general setting of the elastic fibres. In the raw skin they ramify in all directions, whereas in the tanned skin they only exist in a longitudinal direction, as a consequence of the dilation and preparation that the skin has undergone.

M. Boulanger has utilised his method in the study of leather for use as belts, &c., the results of which are published in his book, "Essais du Cuir dans ses Applications industrielles." There is no doubt that the method of microscopic examination of leather might be of considerable use after much practice in the manipulation and comparison of various leathers has been acquired. It would then be possible to determine whether the leather under examination had been made from a salted skin or a fresh skin, of European origin, or from a foreign dried skin, the sex of the animal, cow, ox, or bull; whether the leather had been adulterated, overloaded with tannin or weighting materials, &c., in short, the history of the pelt might be deduced from the study of the tanned leather. Let us hope that the younger generation of tanning students now being trained in the leather industries department at the University of Leeds and at Herold's Institute in Bermondsey will keep up the reputation of England in this work. J. T. W.

THE ATOMIC WEIGHT OF RADIUM.[1]

ALTHOUGH there has been a considerable amount of discussion, based upon spectroscopic considerations and on its supposed mode of genesis, respecting the place of radium in the system of the elements, and inferentially, therefore, concerning its atomic weight, we are indebted for the only direct experimental determinations of this value hitherto made known to the discoverer of the element, Mme. Curie. Her first observations, published in 1902, were made on about 90 milligrams of the chloride, and furnished the value 225.

In the autumn of last year Mme. Curie communicated to the French Academy the results of a second series of estimations made upon about 4 decigrams of the carefully purified chloride; these afforded the value 226·2 as the mean of three closely concordant determinations (Ag = 107·8, Cl = 35·4).

In 1906, at the instance of Sir William Huggins, then president of the Royal Society, and by the aid of the kind interest shown by H.R.H. the Prince of Wales, the Austrian Government placed about 500 kilograms of pitchblende residues from Joachimsthal at the disposal of the Royal Society. These residues were worked up by M.

[1] Bakerian Lecture for 1907. Delivered at the Royal Society by Dr. T. E. Thorpe, C.B., F.R.S.

Armet de Lisle at Nogent-sur-Marne. The funds were defrayed from a grant made by the Goldsmiths' Company to the Royal Society, in 1904, for the purpose of the investigation of radium.

The process of extraction produced about 413 grams of anhydrous barium chloride, containing radium chloride sufficient to give the salt a radio-activity 560 times that of uranium.

This salt was received by the Royal Society in the autumn of 1906, and was handed to me in January, 1907, with the request that I would extract the radium chloride from it, and undertake, if possible, a re-determination of the atomic weight of the element.

The method of extraction was substantially that adopted by Mme. Curie, namely, systematic fractional crystallisation, first from water and then from increasingly strong hydrochloric acid, until finally the acid used was the strongest that could be obtained by distillation.

Whilst still engaged in the isolation of the radium chloride from the material furnished by M. Armet de Lisle, I received a further small supply of radium from the Royal Society. It was bought in Cambridge, and purported to be radium bromide, but on removing it from the capsule, in which it had been stored since 1903, it was found to be wholly insoluble in water. On treatment with pure dilute hydrobromic acid it readily passed into solution. The salt obtained by evaporation was sent to Prof. Rutherford, who had kindly undertaken to make any measurements of radio-activity which I needed. He estimated the amount of radium present as equivalent to 33 milligrams of radium bromide. This salt was eventually converted into chloride, and was purified by repeated crystallisation from strong hydrochloric acid.

Determination of Atomic Weight.—This was effected by ascertaining the amount of silver chloride yielded by a weighed quantity of the anhydrous radium chloride—the principle of the method already employed by Mme. Curie.

A method was devised whereby the whole of the operations of drying and weighing the radium chloride, precipitating, washing, drying, and weighing the silver chloride, might be performed in one and the same vessel, thus obviating the necessity of transferring the silver salt and of separating it by any of the ordinary processes of filtration.

The vessel in which these operations were made consisted of a thin glass tube with a conical base furnished with a hollow, well-ground stopper. It had a capacity of about 15 c.c., and was as light as was consistent with the requisite strength, and could be suspended from the balance-arm by fine platinum wire. In all the weighings a precisely similar bottle of almost identical weight and capacity, suspended in like manner, was employed as a tare. The weighings were made on a very sensitive assay balance, with 4-inch arms, carrying a maximum load of 12 grams, and provided with light stirrup pans.

The washed silver chloride was first dried at 100°, and then heated in the air bath to 160° for about a couple of hours, and, after standing in the desiccator over phosphoric oxide for about eighteen hours, was weighed in the manner described.

In order to test the practicability of the method and to acquire experience of its working, as well as to gain some idea of its accuracy before actually making use of it in the case of the radium salt, a series of determinations of atomic weight of barium was made with purified barium chloride.

The results were as follows :—

Ag = 107·93. Cl = 35·45.

Barium chloride, milligrams	Silver chloride, milligrams	Atomic weight, Ba
114·7	157·8	137·5
172·1	236·8	137·5
57·1	78·8	136·9
62·6	86·1	137·6
68·1	93·7	137·5

The value for barium adopted by the International Committee on Atomic Weights, 1907–8, is 137·4.

It will be seen from these numbers that a close approximation to the true atomic weight of barium can be obtained by the method described, the maximum error being about half a unit, or less than 0·5 per cent. Considering that the atomic weight of radium is probably nearly double that of barium, the same fortuitous errors would affect its value to about a unit.

As the work of isolating and purifying the radium chloride proceeded, determinations of the amount of chlorine were made as described from time to time, and as soon as approximately constant values were obtained it was assumed that any barium or other impurity present was too small in amount to affect the results when regard was had to the unavoidable experimental errors. The resulting chloride was then repeatedly and carefully recrystallised from pure, strong hydrochloric acid, the "tails," which were comparatively rich in radium, being specially set apart.

The purified salt finally extracted from the material supplied by M. Armet de Lisle weighed, when anhydrous, 64 milligrams.

I regard this salt as substantially radium chloride. I am not, however, in a position to say that it was absolutely free from barium. At the same time, I have reason to believe that the amount still present was probably too small materially to influence the result, considering the limited quantity of the salt I had to work with, and the consequent relatively large experimental errors.

With the aid of Sir William Huggins, who kindly made the spectroscopic trials for me, I was able to carry out Mme. Curie's test of comparing the relative intensity of the lines of barium and radium in the spark spectrum of the separated radium chloride. Mme. Curie compared the relative strengths of lines 4554·2 of Ba and 4533·3 of Rd. Although these have the advantage of being close together, they are of dissimilar intensity. Sir William Huggins advised that a more stringent test would be to take the line 5536·2 of Ba of intensity 10, and compare it with the Rd lines 5813·8 and 5560·8, which are also of intensity 10. On actually making the trials, which were repeated several times, the green Ba line 5536·2, although visible, was seen to be relatively very feeble—less intense, indeed, than that afforded by the most dilute solution of barium chloride we were able to employ.

With this material, therefore, I attempted to make the determination of atomic weight. Accordingly, the greater portion was transferred to the vessel already described, and the amount of chlorine in the anhydrous salt determined with all possible care. The result was :—

Radium chloride, milligrams	Silver chloride, milligrams	Atomic weight, Rd
62·7	60·4	226·8

The radium was recovered from the solution, re-converted into chloride, added to what remained of the original quantity, and the amount of chlorine again determined in the anhydrous salt. The second result was :—

Radium chloride, milligrams	Silver chloride, milligrams	Atomic weight, Rd
63·9	61·8	225·7

The purified chloride obtained from the Cambridge material amounted to 24 milligrams.

It was added to the main bulk, and the whole was repeatedly crystallised from strong hydrochloric acid, about 6 milligrams being thus removed in the mother liquors. After being dried at 150° it was again analysed, with the following results :—

Radium chloride, milligrams	Silver chloride, milligrams	Atomic weight, Rd
78·4	75·3	227·7

The mean value is 226·7, or, to the nearest unit, 227. This, it will be observed, is in very close accord with Mme. Curie's latest number.

I think, therefore, it is reasonably well established that the atomic weight of radium is now known to within a unit which, considering the relatively high number, is, in the present circumstances, as fair a degree of exactitude as could be anticipated.

KINEMATOGRAPHY IN NATURAL COLOURS.

AT the inauguration, on May 1, of Urbanora House, where the Charles Urban Trading Co. make kinematograph films, Mr. G. Albert Smith gave a demonstration of the first examples that he has prepared of his system of animated photography in natural colours. The results were excellent, the colours being bright and clean, and so far as one could judge from the drapery, flowers, and flesh tints, they were very good copies of the originals. The method which Mr. Smith has practically perfected allows of the use of the ordinary bioscope and projection apparatus and the ordinary film. The film itself is not coloured at all, but consists, as in other methods, of colour records, the colour being supplied by stained films behind it.

The three-colour method of projection, of which Mr. Ives was the chief pioneer from a practical point of view, has been described in this Journal, and consists, shortly, in photographing the redness, greenness, and blueness of the subject, and then, by means of colour screens placed behind these photographs and three projection lanterns, combining the coloured images on the screen. Kinematography with three lanterns would offer great, if not insuperable, difficulties, besides requiring new and very complicated apparatus. Mr. Smith therefore makes his colour records alternately on the same strip of film by fixing a disc that carries the necessary colour screens in front of the film and causing it to rotate synchronously with it. As seen on the sheet, the alternating colours combine perfectly. To simplify the matter further, Mr. Smith has done away with the blue screen altogether, and broadened the spectrum bands transmitted by the red and green screens, the latter including some blue. As the blue in three-colour work is always a dark colour, its elimination, together with the readjustment of the other two colours, is justified in the result, whether it is theoretically correct or not. The method thus simplified left the difficulty of the comparative insensitiveness to red of ordinary films. The method of rendering the film so sensitive to red that the red image may be photographed at the necessary speed Mr. Smith does not describe, but apparently he used a bathing process.

Thus it has been demonstrated that it is now possible to represent colour and movement at the same time in a thoroughly practical manner, and with comparatively simple apparatus. C. J.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The date of the installation of the Chancellor in the Senate House is fixed for Wednesday, June 17.

Graces will be offered on Thursday, May 14, recommending the establishment of the proposed new professorship of biology, and gratefully accepting the proposal of a member of the University to contribute the sum of 300*l.* per annum for five years towards the stipend of the professor, this offer to be increased to 400*l.* per annum for any portion of the five years during which the professor may be holding a professorial fellowship.

It is proposed to continue the Caley lectureship now held by Dr. Baker and the Stokes lectureship now held by Dr. Hobson in mathematics; each lecturer is to receive a stipend of 200*l.* a year, payable by the University so far as the benefactions received for these purposes are insufficient. It is also intended to continue the appointment of the lecturers in mechanical engineering and in electrical engineering, which would lapse at Midsummer unless the University otherwise determine, and it is proposed in future to appoint three demonstrators of mechanism and applied mechanics in place of the two who now exist.

The special board of studies recommends the appointment of a university lecturer in agricultural physiology for five years from Midsummer, at an annual stipend of 150*l.*, payable out of the agricultural education fund.

The election to the professorship of political economy will take place on Saturday, May 30. Candidates are requested to communicate with the Vice-Chancellor on or before Monday, May 18.

The professor of botany records the gift of more than 4000 specimens of British plants, in excellent order, and mounted and prepared with unusual care. These have been presented by the Rev. J. D. Gray, Clare College, Vicar of Nayland, Suffolk.

The syndicate appointed to consider the steps to be taken for the erection of a building for the department of agriculture recommends that it be authorised to accept a tender for the building described in a report to the Senate, provided the cost does not exceed the architect's estimate of 13,000*l.* If this proposal should be accepted by the Senate and the building be proceeded with, it will almost exhaust the funds collected by the Cambridge Association for the agricultural school, and leave nothing for furniture and fittings or for maintenance. It is hoped that the funds of the agricultural building, in which the late Duke of Devonshire took so keen an interest, and which he did so much to collect, will be increased materially before the end of the year.

LONDON.—A course of eight lectures on the "Structure and Functions of the Central Nervous System" will be given in the physiological department of University College by Dr. W. Page May on Wednesdays at 5 p.m., beginning on Wednesday, May 13. The lectures are open to all students of the University and to qualified medical men on presentation of their cards.

PROF. H. POINCARÉ, professor of astronomy in the Paris École polytechnique, has resigned his chair, and has been given the title of honorary professor.

THE new Education (Scotland) Bill introduced in the House of Commons on March 26, and read a second time on Tuesday, May 5, is not so comprehensive a measure as the Bill of last session. It is interesting, however, to notice how much larger a part educational matters pure and simple take in the Scottish Bill compared with Education Bills affecting England. The Bill for Scotland now before Parliament proposes to give school boards additional general powers for the supply of meals subject to provisos with regard to defraying expenses, for bringing opportunities for education within easier reach of children in outlying districts, and for collecting and distributing information as to employments open to children on leaving school. It makes it the duty of the parent to provide efficient education for his children from five to fourteen years of age, and gives the school board power to summon to one of its meetings parents neglecting their duty, and if satisfactory reasons are not forthcoming to issue an attendance order, which, however, may be made the subject of appeal to the Sheriff. The school board is given power also, in issuing exemption certificates, to impose as a condition of exemption such attendance as it shall prescribe, after the age of fourteen and until such age not exceeding seventeen years as the school board shall think fit, either at a day school or continuation class, or both. The school board must provide continuation classes, and may make, vary, or revoke bye-laws regulating attendance at continuation classes. It is made a punishable offence to employ a boy or girl at any time when his attendance is by any bye-law required at a continuation class, and parents must assist the school board under liability to fine. The Bill is thus a first step to make education in Scotland compulsory up to the age of seventeen, through continuation schools.

A DISCUSSION took place in the House of Commons on April 29 on the subject of education in India, and a motion was brought forward for "an impartial and searching inquiry into the scope, character, and methods of education in India." The grounds on which this proposal was urged were that the Indian Government had pronounced in favour of free elementary education, but no progress had been made towards it. Also that only one-tenth of the boys of school-going age were actually at school, while the proportion of girls at school was very much smaller even than this. It was also pointed out that the "amount of money spent on education was deplorably inadequate,

being only about 1½*d.* per head of the children of school age." It was also urged that the education given had been a "great deal too literary," and that the "whole training had not been sufficiently scientific and practical." The proposal was supported by two or three members and opposed by others who are well acquainted with India and with educational problems, and it was pointed out that "it was a bad thing too frequently to pull up a plant by its roots to see how it was growing." Mr. Hobhouse, who replied on behalf of the Under-Secretary of State for India, had no difficulty in showing that the request for a committee of inquiry was unnecessary. He assured the House that educational questions had within the past few years been thoroughly investigated and discussed in India by various conferences, commissions, and committees, that the educational system had been recently thoroughly overhauled and re-modelled, and that it is now on more practical and thorough lines than formerly, and that special attention had been paid to primary, secondary, and technical education. Also that the expenditure on education had been almost doubled within the last ten years, and that every effort would be made to increase this expenditure, due consideration being given to other pressing wants in the country. He assured the House that the Secretary of State for India was in fullest sympathy with the object which those proposing the motion had in view, but he was unable to accede to the request, "because the work of education in India had progressed and was steadily being pushed forward, and any inquiry of the sort suggested would not really expedite it." The motion was then withdrawn.

WHEN the British Association met in Bristol ten years ago, Sir Norman Lockyer referred at the closing meeting to the fine educational establishments of the city, and expressed the hope that at some future meeting the association would find Bristol at the head of some great south-western university. Since that time the movement for a University of Bristol has made substantial progress, and frequent references have been made to it in these columns. An important meeting was held at Bristol on April 25 under the auspices of the Bristol and District Workers' Educational Association, when an earnest appeal on behalf of the scheme for a university for Bristol was made by the Bishop of Hereford, the president of the University College. Dr. Percival said he was not sure that the people of Bristol at large had really grasped the extent of the advantages which would accrue to the city in connection with the establishment of a university for Bristol and the west of England. Bristol claims to be the "lantern of the west," and if she is to maintain that claim in future and to maintain her position in the forefront with all the other great cities of England, all grades of citizens must unite in the endeavour to crown their system of educational institutions by the establishment of a university. As local patriots he appealed to them to give their sympathy and their efforts in support of the movement. He put this question to himself, "Why should not I, as a citizen of Bristol, be able to claim as much as if I belonged to Liverpool, Manchester, Sheffield, Leeds, or Birmingham?" Every one of those great cities has secured its university. But the question may naturally be asked, "What are we to gain by a university?" He said he could answer that question in almost a single word. We need only look at a country like Scotland to see what is gained by the possession of popular universities. The population of Scotland is only about 4½ millions, and Scotland has its four ancient universities. If any part of the kingdom or the Empire has profited more by education than all the rest it is Scotland, and Scotland owes its preeminence to the fact of its having enjoyed and made use of those four universities. If we turn from Scotland, Wales is close behind, and has profited immensely by her university colleges and national university. Then in Ireland we are beginning to multiply the universities, and should the citizens of Bristol be content to stand aside? He assured them from a long experience that nothing they could do in Bristol would be better for the education and the future well-being of the working classes of the city than that they should use their best efforts to secure a university.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, April 2.—Sir William Ramsay, K.C.B., F.R.S., president, in the chair.—Rate of hydrolysis of chloroacetates, bromoacetates, and α-chlorohydrin by water and by alkali, and the influence of neutral salts on the reaction velocities (preliminary note): G. **Senter.** The results of an investigation of the rate of displacement of halogen by hydroxyl for bromoacetic acid, its sodium salt, and for α-chlorohydrin, and the effect of certain neutral sodium salts on the reaction velocities are given. These confirm the view that the effect of neutral salts is mainly due to their action on the reacting substances, and appear to be incompatible with the hypothesis advocated by Armstrong and his co-workers, that neutral salt action is due to combination between salt and solvent, with consequent concentration of the solution.—The constituents of Cyprus origanum oil. Isolation of a new terpene, "origanum": S. S. **Pickles.** The oil consists mainly of carvacrol. There are also present (1) a hydrocarbon, $C_{10}H_{16}$, apparently a new terpene, for which the name *origanene* is proposed (2·5 per cent.); (2) cymene, which, together with associated terpenes, constitutes 8·5 per cent.; (3) terpene alcohols (3·5 per cent.); and (4) high boiling residue (1·3 per cent.), besides very small quantities of a second phenol, and probably *iso*butyric acid. Origanene is probably $\Delta^{1:8}$-p-*menthadiene*.—The displacement of halogen in *l*-phenylchloroacetic acid by hydroxy- and methoxy-groups. A contribution to the chemistry of the Walden inversion: A. **McKenzie** and G. W. **Clough.**—The condensation of epichlorohydrin with phenols: D. R. **Boyd** and E. R. **Marle.** The condensation product of phenol and epichlorohydrin is glyceryl diphenyl ether, and not phenyl glycide ether, as Cohn and Plohn suggested. Similarly, the crystalline compound obtained from *p*-cresol and epichlorohydrin is glyceryl di-*p*-tolyl ether.—A new general method of preparing diazonium bromides: F. D. **Chattaway.** Primary aromatic hydrazines react quantitatively with the diazonium perbromides, producing diazonium bromides.—The absorption spectrum of triphenylmethane: A. G. G, **Leonard.** The cause of the difference between the absorption curve plotted by Hartley in 1887 and that plotted by Baker in 1907 is shown to be due to the presence of an impurity in the sample originally examined.—The nature of the impurity found in preparations of triphenylmethane: W. N. **Hartley.** The impurity referred to in the preceding paper appears to be triphenylmethyl.—The constitution of coordinated compounds: S. H. C. **Briggs.** The existence of the two compounds $(Pt6NH_3)Cl_4$ and $(PtCl_6)K_2$, in which the platinum atom is the basis of a complex cation and anion respectively, suggests the view that the platinum atom has both positive and negative affinities, and formulæ giving expression to this view are suggested and discussed.—A combined stop-cock and capillary connecting tube for gas burettes: A. E. **Hill.** The apparatus is figured and described in the original.—The hydrolysis of amygdalin by emulsin, part i.: S. J. M. **Auld.** It has been shown that Jorissen and Hairs's "emulsin" is really a mixture of two enzymes, viz. true emulsin and a maltase-like ferment, and the effect of varying the concentration of amygdalin and emulsin has been investigated, as also the action of many inhibitants.—Complex nitrites containing potassium and lead (preliminary note): A. N. **Meldrum.**—The composition and formula of Wells's potassium lead periodide: A. N. **Meldrum.**—The molecular complexity of amides in various solvents: A. N. **Meldrum** and W. E. S. **Turner.** Determinations of the molecular complexity of eleven amides in various solvents confirm the Nernst-Thomson theory that the smaller the dielectric constant of the solvent the greater is the association of the solute.—The optical activity of compounds having simple molecular structure: W. J. **Pope** and J. **Read.** Chlorosulphoacetic acid and chlorobromomethanesulphonic acid each contain an asymmetric carbon atom in the molecule, but, although their strychnine and quinidine salts crystallise well, no evidence was obtained that the acids are resolvable into enantiomorphously related components.—Acetylketen: a polymeride of keten: F. **Chick** and N. T. M. **Wilsmore.**—Saponification of ethyl formate by water in presence of acids as catalytic agents: A. **Lap-**

worth.—The triazo-group, part iii., bistriazo-derivatives of ethane and of acetic ester: M. O. **Forster**, H. E. **Fierz**, and W. P. **Joshua.**

Physical Society, April 10.—Dr. C. Chree, F.R.S., president, in the chair.—An experimental investigation of the nature of γ rays: Prof. W. H. **Bragg** and Mr. **Madsen.** The view that the γ rays are not ether pulses, but are material and consist of neutral pairs of one negative with one positive electron, developed in previous papers (*Phil. Mag.*, October, 1907), is held to be established by the experiments described in this paper with the secondary radiation produced by the γ rays of radium.—Experiments on artificial fulgurites: Miss D. D. **Butcher.** The first part of the paper deals with natural fulgurites, and the second with the production of artificial fulgurites. The experiments show:—(1) The tubes are formed by fusion of the powder which surrounds the column of air in which the spark passes. The length and thickness of the tube depend on the energy of the spark, and also on the character of the spark, *i.e.* whether it is unidirectional or oscillatory. (2) There is no appreciable difference in the two ends of a tube provided that the two electrodes are alike. When one electrode is a point and the other a flat plate, any branching that may occur will be towards the plate, whichever electrode is made positive. In nature, the flat plate would be represented by the moist lower strata of the soil. Therefore we cannot say from the character of the tube whether the lightning discharge was from a positive or negative cloud. (3) The difference between thick and thin tubes is due probably to a difference in the sharpness of the flash and the resulting explosive effect. When the explosive effect is great and the quantity of material melted is small, the result will be a large-bored, thin-walled tube. Whether this remains circular or becomes pressed together and distorted depends merely on whether the fused matter has time to cool before the outward pressure of the blowing has been overcome by the inward pressure on the surrounding sand or not. In nature, the damp sand or soil probably acts as the damp string in these experiments, and consequently causes many lightning discharges to be unidirectional. In the experimental tubes the outward pressure was so great, and the quantity of fused material so small, that the walls were broken through and left as a mere network.—Short-spark phenomena: W. **Duddell.** The paper deals with two effects which the author has observed in connection with some measurements of the current in the secondary circuit of an induction-coil. The apparatus in use consisted of a 12-inch Newton induction-coil, which was supplied from the 200-volt direct-current mains. A large resistance was placed in series with the primary of the coil to limit the current, and the current was interrupted by means of a mercury-jet interrupter. The secondary circuit contained a galvanometer to measure the mean current, and a thermo-ammeter to measure the root mean squared current. When there was no spark-gap in the secondary circuit and the coil was in action, the mean current, as read by the galvanometer, was zero, and the root mean squared current about 3·8 milliamperes. If, now, a microscopic spark-gap, say between two aluminium points, was introduced into the secondary circuit, two curious effects took place. Firstly, the R.M.S. current enormously increased in value, and, secondly, a very large deflection was produced on the galvanometer in the direction corresponding to that due to making the primary circuit. The introduction of a spark-gap 1/10 mm. long caused the R.M.S. current to rise to 38·5 milliamperes, and this continued to increase with increasing length of spark-gap until it reached a maximum with a gap about 1·4 mm. The author thinks that this effect is due to very high frequency oscillations set up in the wires connected to the secondary circuit of the coil when a spark-gap is introduced. He has observed the effect with brass, iron, zinc, and aluminium electrodes, but the latter metal is the best to use.

Mathematical Society, April 30.—Prof. W. Burnside, president, in the chair.—A general convergence theorem and the theory of the representation of a function by a series of normal functions: Dr. E. W. **Hobson.** A general convergence theorem is established, which, when applied to series of Sturm-Liouville functions, suffices to show that the question whether the series converges, or not, at a particular point, depends only upon the nature of the function in an arbitrarily small neighbourhood of the point, whilst the nature of the function throughout the whole interval of representation is restricted only by the condition that it must possess a Lebesgue integral in the interval. The theorem is further employed to show that, subject to the same condition as regards the nature of the function, the question whether the series converges uniformly, or not, in an interval in which the function is continuous, depends only upon the nature of the function in an interval which encloses the interval of continuity in its interior, exceeding it in length by an arbitrarily small amount.—The ordering of the terms of polars and transvectants: L. **Isserlis.** Between any two non-adjacent terms T_1, T_2 of a polar or a transvectant a series of terms $T_{1,1}$, $T_{1,2}$, . . . $T_{1,i}$ can be placed so that any term in the series T_1, $T_{1,1}$, . . . $T_{1,i}$, T_2 shall be adjacent to the terms on either side of it. In the paper a method is developed for actually ordering all the terms in this way.—Oscillating successions of continuous functions: Dr. W. H. **Young.** The paper deals with the theory of series which neither converge nor diverge to a definite limit. In such cases the sum function is replaced by two functions, the upper and lower functions of a sequence. The theory of uniform convergence and divergence is extended to series of functions which oscillate at every point.—The relation between the convergence of series and integrals: T. J. I'A. **Bromwich.** It is proved that when $\phi(x)$ tends steadily to infinity, as x increases, but more slowly than x, the behaviour of the integrals

$$\int^{\infty} f(x) \sin \phi(x) dx, \quad \int^{\infty} f(x) \cos \phi(x) dx,$$

determines the character of the series

$$\sum^{\infty} f(n) \sin \phi(n), \quad \sum^{\infty} f(n) \cos \phi(n).$$

—The multiplication of series: G. H. **Hardy.**—Porisms: H. **Bateman.**—The influence of viscosity on wave motion: W. J. **Harrison.**—Informal communications were made as follows:—(1) Mersenne's numbers; (2) Quartans with numerous quartan factors: Lieut.-Colonel A. **Cunningham.** In the first a factor 150287 was reported of the number $2^{163}-1$. This result reduces to 18 the number of Mersenne's numbers (of the form 2^q-1) which have not yet been verified, and none of these 18 numbers contains any factor less than 200,000. In the second it was shown how to construct numbers of the form x^4+y^4 which shall have any desired number of divisors of the same form.

PARIS.

Academy of Sciences, April 27.—M. H. Becquerel in the chair.—A problem relating to the theory of left-handed curves: Gaston **Darboux.**—The application of wireless telegraphy to the improvement of meteorological warnings: G. **Bigourdan** (see p. 14).—The zoological relations of the shrimps of the order of Stenopidæ: E. L. **Bouvier.**—Entropy: M. **Auric.** An expression for entropy derived from the density of the ether, assuming its pressure to represent the absolute temperature.—The ionisation of air by ultra-violet light: Eugène **Bloch.** On repeating the original experiments of Lenard, it was found that the greater part of the Lenard effect could be traced to the presence of particles in the gas. When the gas is completely freed from dust, the Lenard effect, if it exists, represents only a small fraction of the effect due to the dust.—The velocity of transport of the ions H, Cl, and OH in the electrolysis of solutions of hydrochloric acid: E. **Doumer.** From the experiments described the author concludes that the ionisation of water takes an active part in the electrolysis of solutions of hydrochloric acid, and the velocity of transport of the Cl and H ions is sensibly the same.—The detection of helium in minerals containing uranium: F. **Bordas.** The method described in a previous paper (selective absorption with charcoal at low temperatures) has been applied to numerous minerals containing uranium. Its delicacy is sufficient to detect helium in 1 milligram to 2 milligrams of brøggerite, liebigite, or æschynite. Minerals containing

definite crystallised uranium compounds, such as torbernite, autunite, and Californian carnotite, give no helium. A list of minerals containing uranium in which helium has been detected is given.—The direct use of copals in the manufacture of varnish without a preliminary heating: Ach. **Livache.** The necessity for preliminary heating of the copal, with its accompanying loss, can be avoided by using amyl alcohol containing some tenths per cent. of acid as the solvent.—The levers in the organism: Aug. **Michel.**

CALCUTTA.

Asiatic Society of Bengal, April 1.—Skull of a gigantic ray of the genus Ceratoptera: Captain R. E. **Lloyd.** The specimen was cast ashore at Puri, on the Orissa coast, and forms the type of a new species. The genus does not appear to have been recorded hitherto from Indian seas.—Fresh-water sponges from the Bombay Presidency and Burma: Dr. N. **Annandale.** The two collections were made in November, 1907, in the Western Ghats, and in March, 1908, at Rangoon and the Amherst district of Tenasserim. The Bombay collection includes several species originally described by Carter from that Presidency, as well as others new to science, not hitherto known from India, or only recorded from Bengal.

DIARY OF SOCIETIES.

THURSDAY, MAY 7.

ROYAL SOCIETY, at 4.—Election of Fellows.—At 4.30.—Helium and Radioactivity in Rare and Common Minerals: Hon. R. J. Strutt, F.R.S.—The Action of Resin and Allied Bodies on a Photographic Plate in the Dark: Dr. W. J. Russell, F.R.S.—Seleno-aluminium Bridges: Prof. G. M. Minchin, F.R.S.—A Tantalum Wave-detector, and its Application in Wireless Telegraphy and Telephony: L. H. Walter.

ROYAL INSTITUTION, at 3.—Mendelian Heredity: William Bateson, F.R.S.

CHEMICAL SOCIETY, at 8.30.—The Interaction of Diazonium Salts with Mono- and Di-hydric Phenols and with Na hthols: K. J. P. Orton and R. W. Everatt.—The Condensation of Benzoin with Methyl Alcohol: J. C. Irvine and D. McNicoll.—The Mutual Solubility of α-Methylpiperidin and Water: O. Flaschner and B. MacEwen.—The Melting Points of the Anilides, β-Toluidides, and α-Naphthylamides of the Normal Fatty Acids: P. W. Robertson.—The Refraction and Dispersion of Triazo-compounds: J. C. Philip.—The Dissociation Constants of Triazoacetic and α-Triazopropionic Acids: J. C. Philip.—The Absorption Spectrum of Camphor: W. N Hartley.—The Viscosity of Solutions: C. E. Fawsitt.—The Action of Fused Potassium Hydroxide and of Hydrogen Peroxide on Cholesterol, Preliminary Note: R. H. Pickard and J. Yates.—The Fermentation of Mannose and Fructose by Yeast Juice, Preliminary Communication: A. Harden and W. J. Young.—The Volumetric Estimation of Silver: W. R. Lang and J. O. Woodhouse.—The Constituents of Olive Leaves: F. B. Power and F. Tutin.—The Constituents of Olive Bark: F. B. Power and F. Tutin.

LINNEAN SOCIETY, at 8.—Colony-formation as a Factor in Organic Evolution: H. M. Bernard.—Antipatharia from the Voyage of H.M.S. *Scalark*: C. Forster-Cooper.—A List of the Fresh-water Fishes, Batrachians, and Reptiles obtained by Mr. J. Stanley Gardiner's Expedition to the Indian Ocean: G. A. Boulenger, F.R.S.—A Cinematographic Representation of the Movements of Peripatus and other Invertebrate Animals: F. Martin Duncan.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Abbreviated Formulæ for Structural Engineers: E. Fiander Etchells.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Manufacture of Electrical Condensers: G. F. Mansbridge.

FRIDAY, MAY 8.

ROYAL INSTITUTION, at 9.—Ice and Its Natural History: J. Y. Buchanan, F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Theory of the Motion of the Moon; containing a New Calculation of the Expressions for the Coordinates of the Moon in Terms of the Time: Prof. E. W. Brown.—The Proper Motion of Small Stars: S. W. Burnham.—Second Index Catalogue of Nebulæ and Clusters of Stars found in the Years 1805 to 1907: J. L. E. Dreyer.—Results of Micrometer Observations of Double Stars made with the 28-inch Refractor in the Year 1907: Royal Observatory, Greenwich.—*Probable Papers*: An Empirical Law of Astronomical Refraction: Prof. H. H. Turner.—On the Practical Testing of Concave Parabolic Mirrors: Rev. C. D. P. Davies.

PHYSICAL SOCIETY, at 8.—A Modified Theory of Gravitation: Dr. C. V. Burton.—An Examination of the Formulæ for the Grading of Cables C. S. Whitehead.—Illustrations of Geometrical Optics: R. M. Archer.

SATURDAY, MAY 9.

ROYAL INSTITUTION, at 3.—Chile and the Chilians: G. F. Scott Elliot.

MONDAY, MAY 11.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Geographical Conditions and Railway Construction in the Balkan Peninsula: Noel Buxton.

TUESDAY, MAY 12.

ROYAL INSTITUTION, at 3.—Why Light is believed to be a Vibration: Prof. F. T. Trouton, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.

FARADAY SOCIETY, at 8.—The Industrial Uses of Ozone in Connection with Water Purification: F. Mollwo Perkin.—Determination of Boiling Points of very small Quantities of Liquids: L. O'Dowd and F. Mollwo Perkin.—An Apparatus for Measuring Dielectric Constants of Non-conducting Liquids: Dr. Veley, F.R.S.

WEDNESDAY, MAY 13.

ROYAL SOCIETY OF ARTS, at 8.—The Underground Water Supplies of the Thames Basis: Clayton Beadle.

THURSDAY, MAY 14.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: The Structure of the Central Nervous System of the Higher and Lower Animals: Prof. Gustaf Retzius, For.Mem.R.S.

ROYAL INSTITUTION, at 3.—Mendelian Heredity: W. Bateson, F.R.S.

MATHEMATICAL SOCIETY, at 5.30.—On the Invariants of the General Linear Homographic Transformation in Two Variables: Major P. A. MacMahon.—On the Order of the Group of Isomorphisms of an Abelian Group: H. Hilton.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Switch Gear Control Apparatus and Relays for Alternating-current Circuits: Dr. C. C. Garrard.

IRON AND STEEL INSTITUTE, at 10.30 a.m.—On Improvements in Plate Rolling Mills: A. Lamberton.—On the Physical Qualities of Steel in Relation to its Mechanical Treatment: J. E. York.—On a New Fatigue Test for Iron and Steel: Dr. T. E. Stanton.—On an Experimental Electric Furnace for the Smelting of Iron: Prof. B. Igewsky.

FRIDAY, MAY 15.

ROYAL INSTITUTION, at 9.—The Past and Future of Tuberculosis: H. T. Bulstrode.

IRON AND STEEL INSTITUTE, at 10.30 a.m.—On Cast Iron in the Construction of Chemical Plant: F. J. R. Carulla.—On the Application of Colour Photography to Metallography: E. F. Law.—On the Utilisation of Blast-Furnace Slag for Portland Cement: C. von Schwarz.—On the Department of Metallurgical Chemistry in the National Physical Laboratory: W. Rosenhain.—On the Pyrometric Installation of the Ordnance Factories, Woolwich: J. Wesley Lambert.

ROYAL SOCIETY OF ARTS, at 8.—The Dangers of Coal Dust and their Prevention: W. E. Garforth.

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