THURSDAY, DECEMBER 17, 1908.

THE AUTOBIOGRAPHY OF A PRACTICAL PHILOSOPHER.

Memories of My Life. By Dr. Francis Galton, F.R.S. Pp. viii+339; with 7 illustrations. (London: Methuen and Co., n.d.) Price 10*s.* 6*d.* net.

THOSE who are interested in the history of the growth of science in this country and in the men who participated in its development will thank Dr. Galton for having provided them with a characteristic account of his own life and of his relations with three generations of men of thought and action. Although Dr. Galton has provided a *précis* wherein those who know something of the author and his deeds can read between the lines, a biographer is still needed who will portray to the world what manner of man he is. Probably many will feel that the autobiographer's "fear" is well grounded that he may "have failed through over omission."

That love of accuracy which runs through all his work appears on every page of the memories, dates are scattered with profusion, and the frequently recorded personal incidents will delight the heart of future bibliographers. The book contains two excellent portraits and a bibliography of the author's writings.

Very briefly, in a chapter on parentage, Dr. Galton indicates the origin of his hereditary tendencies, and the following four chapters narrate the influences of companions, school, and university which moulded his "status of pupilhood." His paternal grandfather was a statistician, and so was his father; as to his mother, it is only necessary to state she was a Darwin. To his progenitors he was indebted for "a considerable taste for science, for poetry, and for statistics; also, partly through the Barclay blood, a rather unusual power of enduring physical fatigue without harmful results," and, it may be added, certain of the qualities of the Quakers, though adhesion to the Society of Friends practically ceased with his grandfather's generation. On the whole he gained little from the schools he attended, and at the age of sixteen he took up his abode, as indoor pupil, in the Birmingham General Hospital; his early experiences and the ideas that occurred to him make interesting reading. Later he went to King's College, London, and enjoyed to the full the wider intellectual outlook and companionship of distinguished men. The passion for travel seized him in 1840, and he went to Giessen to study chemistry, but he played truant, and made an adventurous voyage down the Danube to the Black Sea. A visit to Constantinople and Smyrna fired his imagination. This little expedition proved to be an important factor in moulding his after-life; it vastly widened his views of humanity and civilisation, and confirmed his aspirations for travel. The first year at Trinity College, Cambridge, "was a period of general progress, without much of note." The reading parties in the long vacations and the later terms were full of the inspiriting influence of older and younger men who have left their mark on the intellectual history of Britain, and he points out "the enormous advantages offered by a university to those who care to profit by them." His health broke down in his third year, and it comes as a shock to learn that he was obliged to content himself with a poll degree; but this has since been made up to him by his university giving him an honorary degree of doctor in science (1895), and his college electing him to an honorary fellowship (1902).

The following seven years fall into three periods. A visit to Egypt, when he visited Khartum, went some distance up the White Nile, and had several journeys across the desert, was not the pleasure trip it is to-day. This was followed by a tour in Syria. Some four years were then spent at home, reading, hunting, and sailing; it was at this time he invented an apparatus, the telotype, for printing telegraphic messages.

In 1850 he fitted out an expedition to a portion of south-west Africa which was then absolutely unexplored. The results of this noteworthy expedition were published in "Tropical South Africa" (1853), and laid the basis of our present knowledge of the country and people of Damaraland. Recognition followed this hazardous and fruitful enterprise in the bestowal of the gold medal of the Royal Geographical Society, the fellowship of the Royal Society, and the membership of the Athenæum Club. A further result of this experience was the publication of that eminently practical book, "The Art of Travel," which is replete with common sense. Dr. Galton for many years served on the council of the Royal Geographical Society, and was intimately connected with the expeditions of the great African travellers Burton, Speke, Grant, Baker, and Livingstone. It was due to his initiative that the society interested itself in geographical education at first in public schools and latterly in the Universities of Oxford and Cambridge.

In 1853 Dr. Galton married and settled in London. Then began a life full of intellectual activity which has persisted to the present moment; various tours were taken in Britain and on the Continent, and a passion for mountaineering was developed, but no extended expedition was attempted. Dr. Galton early became a member of the managing committee of the Kew Observatory, then the central magnetic observatory of the world; he became chairman in 1889, and held that post until 1901, when the observatory ceased to be an independent body; now it is merged into the National Physical Laboratory. The peculiar inventive genius of Dr. Galton here had full scope, and he busied himself with standardising sextants, thermometers, and other instruments of precision. His interest in the movements of the air led him to map out the data. He was the first to recognise the downrush of air associated with a high barometer and a clear sky, with an outflow having a clock-ways twist which is the exact opposite of a cyclone and supplementary to it. He named this system an "anticyclone."

Always interested in the problems of heredity, Dr. Galton has devoted the best years of his life to a study of heritability in man, as the following land-

marks testify:—"Hereditary Genius" (1869), "English Men of Science" (1874), "Human Faculty" (1883), "Natural Inheritance" (1889), and his later writings on eugenics. Impressed with the necessity of obtaining a multitude of exact measurements relating to every measurable faculty of body or mind for two generations at least, he first stimulated schoolmasters to weigh and measure their boys, and established an anthropometric laboratory at the International Exhibition of 1884, and subsequently at South Kensington, several of the instruments employed being designed by him. These have formed the model of similar laboratories elsewhere. It was in this connection that he made an exhaustive study of finger-prints as a means of identifying persons, which led to the adoption of the system by the Criminal Departments of Britain, India, and many foreign countries; he also demonstrated that the patterns of the papillary ridges have no racial significance. Numerous experiments were made in composite photography, of which an interesting account is given. In order to ascertain the relative position of individuals, the well-known "centile" method was devised. As a side-issue he suggested the appropriateness of utilising the *median* vote in councils of juries. Being satisfied of the inheritance of mental qualities and that heredity was a far more powerful agent in human development than nurture, he endeavoured to ascertain the degree in which breeding might, at least theoretically, modify the human race. The general result of his inquiry was to support the view "that man is little more than a conscious machine, the slave of heredity and environment, the larger part, perhaps all, of whose actions are therefore predictable."

The strong practical bent that manifests itself in whatever Dr. Galton does constrained him to apply the conclusions to which his studies on human faculty and heredity had led him. Hence of late years he has occupied himself with eugenics, though so far back as 1865 he had formulated its leading principles, and he introduced the term in 1884. He thinks that "stern compulsion ought to be exerted to prevent the free propagation of the stock of those who are seriously afflicted by lunacy, feeble-mindedness, habitual criminality, and pauperism, but that is quite different from compulsory marriage. . . . A democracy cannot endure unless it be composed of able citizens; therefore it must in self-defence withstand the free introduction of degenerate stock. . . ."

The aim of eugenics is to check the birth-rate of the Unfit, and to promote the improvement of the race by furthering the productivity of the Fit by early marriages and healthful rearing of their children, and thereby "to replace Natural Selection by other processes that are more merciful and not less effective." In his last utterance on this subject (*cf.* NATURE, October 22, 1908, vol. lxxviii., p. 645) Dr. Galton gives practical suggestions for creating a public opinion; he rightly recognises the enormous influence wielded by social opinion among all races and classes of mankind, and he would direct this tremendous force towards a favourable consideration of eugenics, trusting that practical results would ensue to the great betterment of mankind.

This bald, epitomised sketch of the life and activities of Dr. Galton indicates the wide range of his interests and powers. The practical application of scientific principles seems to be always in his mind, never from the point of view of the patentee or exploiter, but invariably disinterestedly, and his eugenic investigations were fired by a burning zeal for the well-being of his fellow-men. The transparent honesty and naïveté of the man are revealed in these straightforward memories. Perhaps we are too close to him to be able to judge how great his life's work will loom when the history of the science of our day comes to be written, but his energy, enthusiasm and character have stimulated many during the past and the present generation, and when these qualities are associated with sound work accomplished and the promulgation of larger views of life and duty, we can confidently await the verdict of posterity.

A. C. HADDON.

AN INTRODUCTION TO THE STUDY OF NATURAL HISTORY.

Animal Life. By Dr. F. W. Gamble, F.R.S. Pp. xviii+305. (London: Smith, Elder and Co., 1908.) Price 6*s.* net.

THIS is a fascinating introduction to the study of animal life, marked by freshness of outlook, stimulating exposition, and vivid style. To Dr. Gamble—editor though he be of an austere "Practical Zoology"—animal life is "a pageant," "a moving spectacle," and his inquiry is kinetic throughout. What is all this bustle about, what are the leading motives, what are the ends achieved? In developing his subject he has proceeded by the use of three leading motives that differentiate animals from plants—movement, the acquisition of solid food, and the nervous control of response to changing order, and the three main problems the solutions of which he considers are the maintenance of self, the development of self, and the progress of the race, though he is careful to point out that the last is "rather a motive that possesses animals than is possessed by them." He begins by contrasting animal and plant life:—

"Mass, stationariness, and pliability—the notes of plant life—are replaced in animals by purposeful evasion, activity, and intractability."

Then the fulness of the earth and the abundance of the sea is his theme, and "the mighty gamut of the scale of being." But amid all the multitude of forms and endless variety of architecture there are only a few chief styles, the history of which is briefly sketched. The stage has not always had its present-day scenery and troup of players. There has been a rise and fall of races.

"Wave after wave of life has risen from the inexhaustible depths of nature, towered to a great height, and has then fallen; yet undelayed the onward movement continues."

Nothing could be better than the chapter on animal

locomotion, which is informative, stimulating, and beautiful. It is interesting to hear of the elbow-joint of the bat-fish, of the agile Malayan lizard that runs securely over the tops of grass shoots, and of the movement of the vanes on the grebe's foot, but it is even more profitable to be led from a few simple experiments with a pennyworth of mussels to some clear ideas in regard to cilia, and then to a recognition that all movement partakes of this mysterious innate character, self-caused and self-sustained. With admirable vividness and a frank enthusiasm, the author pourtrays the finish and unweariedness of animal movement, which increases in perfection as we ascend the scale of being and reaches its highest manifestation in the migration of birds.

But movement implies expenditure of energy, and that leads the author to discuss the varied quest for food—the vegetarian habit and the protection of plants against wholly destructive visitors, the probable origin of the carnivorous habit among marine animals, the stress of terrestrial life, and the three paths by which land animals have become carnivorous. But

"Life is a fire, now slow, now fierce, and therefore needs air as well as fuel. Changefulness is of the very essence of being, and all our rest is but hidden activity. . . . The fire was lighted long ago. The twinkling flames hidden in thought, patent in conduct, have come from the vestal lights of other generations. Every moment of restful or restless activity they maintain the transformation of our bodies. . . . Food is but the laid fuel; oxygen, that which fans it."

This is the beginning of a fine chapter on the breath of life—that is to say, on the comparative physiology of respiration, in which Dr. Gamble shows that evolution corresponds in great part with the successful quest for oxygen.

"Man himself carries in his ears an unmistakable sign of his gill-breathing, watery past, and of the depths he has left behind him."

Breakdown by oxygenation, re-construction by feeding, are the two emulating processes in animal organisms; there is "the downward pull of oxidation and the upward thrust of nutrition," and more and more we see how the trembling balance of life becomes steadied by firm central nervous control. Thus we are led to the seventh chapter, on the nervous and sensory system, which is very illuminating. "Every living thing is an old hand," and the nervous system is the seat of organic memory.

"Not only day and night, winter and summer, seedtime and harvest, set agoing the inward pendulum of animal life, but the life and death of their associates, the swing of the tides, all the great secular movements, beat with alternating force upon the receptive nervous tissue."

In another very interesting part of the chapter the habits of a shrimp and prawn are taken as an example of the way in which the conduct of these animals is built up out of responses to light, pressure, and taste. It is also shown that the stiffening of relatively simple responses into habit and tradition is a necessary prelude to advance in higher responses. Colour plays so large a part in the business of life that it is in accordance with the perspective of this volume that it should have a chapter to itself. It is a subject with which the author's experience has made him peculiarly well qualified to deal, and we cannot but express our admiration for the way in which he works out the thesis that

"the pigments of animals are older than the effect they produce, and that the old nutritive, purifying, and respiratory uses of colour are the basis for the more recently evolved protective, warning, or mimetic values of colouration."

The summing-up of the book is in the second last chapter, on the welfare of the race, of which the last chapter—on the life-histories of insects—is in greater part a series of illustrations.

"The endowments of the individual, which have at first sight such an appearance of being purely personal acquisitions and advantages, are in reality of racial value,"

and in the love of mates the higher animals

"gather all their gifts to pour them into the lap of the future." "The life of animals and of working men agrees in this, that, consciously or unconsciously, it is a strife to give their children the best chance. Their response to this spirit takes varied forms, but ultimately it is an answer to the same stimulus, and though it seems to arise within us, it is the spirit of a hive whose boundaries are not limited by the seen or tangible."

This book, the interesting contents of which we have hinted at, will delight all who read it, both those who know much and those who know little. It will charm with its style and with the wonders which it discloses. The illustrations, it should be noted, are fresh and interesting, being in great part photographs of specimens in the Manchester Museum. It will help students to organise their knowledge in the light of the general ideas which it expounds, and it will suggest observation and reflection. Sometimes, perhaps, the author is the least thing too exuberant, as when he says:—

"On our rocky coasts, from April to July, the puffin, the guillemot, and other spring migrants of the sea have made the rocks *musical with their chorus*."

Sometimes, perhaps, the author's epigrammatic style makes a difficulty instead of removing one, for there is a little of the conundrum in a sentence like this:—"Soil is the remains of the vesture that waves in the wind and water, held in a meshwork of moulds," and many will be puzzled, not enlightened, by being told that "in man and creature colour is sacramental." But we have confidence in tendering to Dr. Gamble the thanks of thousands of students of animal life, who will find, or have found, in this book one of the most charming introductions to natural history, a book full of insight and suggestion, with a delightful *note personnel*, a contribution not only to science, but to literature. J. A. T.

THE COMMERCIAL PRODUCTS OF INDIA.

The Commercial Products of India, being an abridgment of "The Dictionary of the Economic Products of India." By Sir George Watt. Published under the authority of H.M. Secretary of State for India in Council. Pp. viii+1189. (London: John Murray, 1908.) Price 16*s.* net.

IT is now almost a quarter of a century since the publication of Dr. (now Sir George) Watt's "Dictionary of the Economic Products of India" was commenced. That monumental work is now out of print, and the necessity for the issue of a new and revised edition has been evident for some time. The reissue of the complete Dictionary, however, is likely to be postponed for a good few years, so all the more do we welcome meanwhile the appearance of the present work, and we congratulate Sir George Watt on the completion of his three years' task.

As its subtitle indicates, the book is practically an abridgment of the Dictionary, published under the authority of His Majesty's Secretary of State for India in Council, and written mainly by Sir George Watt under the direction of a supervisory committee appointed by the Secretary of State. The scope of the work was to be "confined to products which are of present or prospective industrial or economic importance," and, on the whole, it has kept fairly well to those limits. The Dictionary consists of six volumes with a total of more than five thousand pages, while the present abridgment is in one volume of a little more than a thousand pages, well printed, and well got up. There is, of course, room for difference of opinion as to the importance or otherwise of some of the products discussed in the abridgment, but, in the main, excellent discrimination has been shown in their selection, for which, however, we understand the author is not responsible.

The articles themselves are modelled on the familiar lines of the Dictionary, and offer evidence of great industry in the consultation and quotation of all possible references, although with regard to the latter a stricter system of selection would have reduced the bulk without detracting from the value of the book. Uniformity of treatment of the heterogeneous items constituting a work of this kind is not, of course, feasible even if it were desirable, but this cannot be held entirely to excuse the uneven quality of the abridgment. Some of the articles give fairly succinct, business-like accounts of their respective subjects, as, for instance (amongst the longer articles), those on india-rubber or flax, and (amongst the shorter ones) those on *Calotropis gigantea, Dioscorea,* or *Pterocarpus*. Others, again, are unnecessarily spun out by failure to discriminate between essential and superfluous information and between proved facts and mere opinions not worth recording. The following examples illustrate this defect.

In the article on tea the historical part is padded with statements such as:—

"We read that Wang Meng, father-in-law of the Emperor in the middle of the fourth century was fond of drinking tea, and set it before his friends, but they found it too bitter, and generally declined, feigning indisposition."

Under *Acorus Calamus,* which, by the way, is scarcely an important product, we are informed that "Dr. Childe, second physician to the Sir Jamsetji Jijibhai Hospital, Bombay, tried an authentic tincture for malaria, dyspepsia, dysentery, and chronic bronchitis, and after careful experiment pronounced it inert." Again, in the article on Rhea, prominence is given to the fascinating effect on the author of the undying faith of a very old lady in the ultimate success of that distinctly doubtful crop.

We admit the difficulty of abridging a description in which one has also to incorporate the most recently acquired knowledge, but this difficulty should not necessitate the actual expansion of a dictionary article. Yet several of the articles in the abridgment are actually longer than the corresponding ones in the Dictionary. Thus in the Dictionary fifteen pages are devoted to *Boehmeria nivea,* and fourteen to *Camellia theifera,* while in the abridgment the number of pages are respectively sixteen and thirty-five.

We mention these defects from the point of view of one who hopes to have frequent occasion to consult the work, but dislikes the trouble of sifting the gold from the dross. Despite those blemishes, however, which we trust a more rigorous application of the blue pencil will cause to disappear in the next edition, there can be no question of the great value of Sir George Watt's book. He has laid a fresh debt of gratitude on all interested in India or its products by performing a work that very few but himself would have had the interest, industry, and patience necessary to accomplish. A. T. GAGE.

THE PHYSICS OF EARTHQUAKES.

The Physics of Earthquake Phenomena. By Dr. C. G. Knott. Pp. xii+283. (Oxford: Clarendon Press, 1908.) Price 14*s.* net.

EARTHQUAKES, once regarded as portents and warnings to mankind, have become an object of human curiosity, and now form a branch of knowledge of which the principal external relations are threefold. They are of interest to the physicist, and their interpretation demands the application of the knowledge he has won; they interest the geologist as an explanation of, and as explained by, his observations of the structure of the earth; and they interest the man of commerce or affairs by their effect on man and on commerce and industry. With these varied outlooks it seems almost impossible that any one man should write a satisfactory handbook of seismology, and recent attempts leave much to be desired in their incomplete or inaccurate treatment of one or more branches of the science. Dr. Knott has confined himself to the physics of earthquakes, a department of their study with which he is well qualified to deal, and of which, more than of any other, an adequate text-book was required.

To a large extent the book deals with matters contained in other manuals, the treatment differing only

in form and more than usual correctness, and frequently in an unusual point of view. This is particularly noticeable in the chapters devoted to seismographs, which are refreshing in the absence of any polemical advocacy of one pattern of instrument or depreciation of another; there is little in the way of description of particular instruments or types of seismograph, and no attention is devoted to details of mechanical construction, which may vary according to the purpose of the instrument, but instead we have an impartial statement of the principles on which their construction is based and which control their action. The dynamics of the horizontal pendulum, which have been the subject of both mathematical and experimental investigation, are treated in a manner which makes them clear to anyone able to follow the simple mathematics used in the text, but it is unfortunate that Dr. Knott had not more mercy on those less mathematically disposed than himself, and expressed his numerical results in a form more immediately intelligible than that adopted by him.

This question of the behaviour of the horizontal pendulum in response to a periodic undulatory tilting, as opposed to its response to a static tilt, is one which has an important bearing on the design of seismographs; in most of these the design has been to eliminate resistance so far as possible, but there is another school which deliberately introduces a damping device of sufficient power to make the pendulum dead-beat or aperiodic, and it has been claimed that this damping renders the record accurate and capable of interpretation in terms of the displacement produced by a static tilt. Dr. Knott's figures show that this claim is unfounded. Where the period of the undulation is not less than three times that of the free swing of the pendulum, the amplitude of the record is within 10 per cent. of the displacement due to a static tilt of the same angle, the error being in excess in the case of the free and in defect in the case of the damped pendulum. When the period of the undulation approaches nearer to equality with that of the pendulum, the amplitude of the record increases largely in the case of the undamped pendulum and becomes diminished in the case of the damped pendulum, but in neither type is it possible to determine the true value of the angular tilt from the amplitude of the record. From this it will be seen that the result of a complete damping of the pendular swing is a diminution of sensitiveness of the instrument, and as it is only when the period of the undulation reaches three times that of the pendulum that either form gives a record capable of approximate interpretation in terms of the static tilt, there is no material difference in accuracy between the two when this limit is reached.

The periodicity of earthquakes is discussed at some length, with the general result that there is little evidence of the reality of any of the periods believed to have been established. We are not only in complete agreement with this conclusion, but would go even further than Dr. Knott in our distrust of the utility of applying the method of harmonic analysis to the discussion of effects the causes of which do not vary in a harmonic manner, and the method seems particularly inapplicable to the discussion of the effect of tide-producing stresses in the causation of earthquakes. The amount and direction of this stress, at any given instant and place, depend on the zenith distance, not on the hour angle, of the tide-producing body, and though these vary with each other, they do not vary in any uniform proportion. In these circumstances an harmonic analysis of the time of occurrence of earthquakes seems calculated to obscure rather than elucidate any direct effect of the tide-producing force, though it might reveal a tidal effect of a different nature.

For the rest the book is an adequate and clearly expressed treatment of the subject it professes to deal with. It cannot be described as easy reading, yet the difficulty lies entirely in the accuracy of its expression, and the consequent necessity for the frequent use of words unfamiliar except to the trained physicist, but anyone who is desirous of understanding, and will take the trouble to master the meaning of these unfamiliar terms, will find no difficulty in following the argument.

METHODS OF ACCURATE CALORIMETRY.

Méthodes de Calorimétrie usitées au Laboratoire thermique de l'Université de Moscou. By Profs. W. Louguinine and A. Schukarew. Translated from the Russian by G. T. Gazarian. Pp. iii+192. (Paris: A. Hermann; Genève: Georg et Cie., 1908.) Price 8 francs.

THIS volume by the well-known director of the thermal laboratory at Moscow University and his chief of staff does not claim to be a comprehensive treatise on all branches of calorimetric work, but, nevertheless, it will be welcomed as placing before a wider public the results of much valuable research hitherto comparatively unknown, especially in detail. Some of Prof. Louguinine's ingenious devices for carrying out accurate calorimetric investigations have been partly described in specialist treatises, but we have here complete descriptions, with full and clear working drawings, published, we believe, for the first time, except in their original Russian.

In calorimetry, perhaps to a greater extent than in most branches of physics, very much of the success attained in a particular experiment depends on attention to what might be considered small details. In our opinion, one of the most valuable features of the book is the large number of "wrinkles" or "tips" given by the writers from their own experience on just those points on which the ordinary books are silent.

The first chapter is an excellent discussion of the various types of thermometers used in calorimetry. The writers point out the absurdity of adhering to the German form of thermometer with milk-glass scale, carrying the graduations behind a thin capillary tube and enclosed in an outer sheath. Even if the milk-glass scale is fastened more or less by fusion at one or the other end of the tube, the type has many drawbacks, and would probably have been replaced long

ago by the solid-stem type of thermometer had it not been for the fact that it is nearly impossible to make clear fine divisions on the kind of glass of which these thermometers are usually made. The sensitiveness, length of degree, size of bulb, &c., of thermometers for calorimetric purposes are dealt with in detail, the authors' conclusions being closely in accord with the recommendations of the Bureau International des Poids et Mésures.

The chapter dealing with the "cooling correction" is specially valuable, particularly the clearly described way of graphically applying the Regnault-Pfaundler method.

In the chapter on specific-heat determination, Prof. Louguinine's tramway calorimeter is described. Details are given as to the curious fact, known to most who have worked at the subject, that it is extremely difficult in any form of vapour-heated vessel to arrange that the substance to be heated really reaches the temperature of the heating vapour employed, even if this be a vapour like steam, with a relatively enormous latent heat. A list of suitable substances for attaining various steady temperatures is also given.

An interesting chapter by Prof. Schukarew deals with some modifications of the Joly calorimeter, presenting some obvious advantages and giving increased precision.

In conclusion, we may say that the book is well got up, and the illustrations are numerous and excellent. A fault, however, is the large number of misprints and errata, many of which are not corrected in the list given at the end. It is startling to find many proper names, some those of leading authorities in the domain of heat—such as Bunsen, Velten, Callendar, Plattner, Wiedemann, Walferdin, Griffiths, and Dieterici—mis-spelt time after time.

J. A. HARKER.

TROPICAL AGRICULTURE.

Southern Agriculture. By F. S. Earle. Pp. vi+297. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1908.) Price 5*s.* net.

FOR many years there was a noteworthy dearth of books in English dealing generally with agricultural methods in the tropics and subtropics, and affording a concise summary of our knowledge of the plants of those regions. The information, it is true, was available in published form, but scattered in handbooks and pamphlets on particular plants and subjects, or buried in the files of numerous botanical and agricultural journals, so that those not actually engaged in the subject often found considerable and at times insuperable difficulties in obtaining a good, practical account of, for example, the principal fruits or the fibre-producing plants of warm countries.

To the still comparatively small series of books which supply such information, "Southern Agriculture," by F. S. Earle, is the latest addition. It does not profess to cover the whole range of tropical agriculture—which, indeed, would not be practicable in a volume of its size—but it so happens that the conditions in the southern States and the American possessions in the West Indies are so diverse, ranging from normal and arid subtropical regions to the thoroughly tropical West Indian islands, that the book will prove of utility to a much wider circle than those immediately interested in the area with which it specifically deals. This is particularly marked in the first part of the book, entitled "General Considerations." Here Mr. Earle has given us the benefit of his experience in various lands, and in dealing, for instance, with such subjects as irrigation he brings out well the principles underlying practice in countries possessing very different conditions, explains how irrigation may be of value in humid as well as in dry countries, and gives useful descriptions of the methods in vogue in various districts. Other sections in this part which should be of wide interest are those relating to the improvement of the soil, marketing products, farm policy and management, and plant diseases. The division of plant diseases into three general groups—environmental, functional, and diseases due to parasites—and the clear discussion of the methods of dealing with each group will serve to illustrate the successful attempt to make the work more than a mere compilation of facts.

The second part, "The Chief Southern Agricultural Crops," is somewhat unequal in its treatment, but this is apparently in the main intentional, and is correlated with the relative local importance of the plants. Sugar-cane, the cereals, pasture and forage crops, tobacco, cotton, and, in particular, the fruits, are dealt with at considerable length, an account being given, not only of their botanical identity and mode of cultivation, but also of their principal pests, both insect and fungoid. Coffee and cacao are less fully treated, the large group of vegetables are disposed of in a few pages under the name of "Truck Crops," and a few notes on forestry and domestic animals conclude the volume.

The book contains the best account available, within small compass, of the agriculture of the warmer regions of North America and the West Indies, and, as already indicated, has in addition many features which will ensure it being of use also in other parts of the world.

W. G. FREEMAN.

ANALYTICAL CHEMISTRY.

Qualitative Analyse vom Standpunkte der Ionenlehre. By Dr. Wilhelm Böttger. Second, revised and greatly enlarged edition. Pp. xvi+524. (Leipzig: Wilhelm Engelmann, 1908.) Price 10 marks.

IN the second edition of this book, which made its first appearance in 1902, the author has made very considerable additions, resulting in an approximate doubling of the original size. As the title indicates, it is written from the point of view of the theory of electrolytic dissociation. This fact, in itself, may be sufficient to condemn the book in the opinion of the chemists of the anti-ionic school, but there can be no doubt that the basis furnished by the ionic theory is the one which at present must be recognised as meeting with the approval of the great majority of scientific chemists.

The arrangement of the subject-matter is such that

the chapters dealing with general questions and those treating of special matters are separated from one another. There are five sections, of which the first deals with the fundamental conceptions and relationships which are of importance in connection with the scientific study of analytical chemistry. Simple experiments to illustrate the difference between strong, weak, and non-electrolytes, the influence of mass in chemical change, the changes in the properties of acids and bases on the addition of their salts, the formation of complex ions, the difference between double salts and complex salts, are described among others. In the opinion of the reviewer, these preliminary exercises form the very best foundation of any attempt to build up a system of instruction in analytical chemistry which is to have an educational value and provide a mental stimulus for the student.

In the second section the usual instructions for the carrying out of the many operations incidental to analytical work are given. The third is devoted to characteristic reactions of cations and anions, which are arranged in the usual groups, and in the fourth section the processes of qualitative analytical separation are dealt with. In the fifth, the reactions serving for the recognition of the rarer elements are grouped together, and a detachable booklet contains tables for laboratory use.

The text throughout affords evidence of the author's familiarity with the recent literature bearing upon the constitution of aqueous solutions, a knowledge of which is of essential importance for the proper interpretation of the reactions which serve as the basis of analytical work.

The systematic presentation of the subject in terms of the ionic theory and the use of ionic equations may possibly present certain difficulties to the student, but the fact that greater demands are made upon the mental capacity is not without its compensations. At the same time, experience has shown that many reputed difficulties are more imaginary than real, and if, as is undoubtedly desirable, the study of analytical chemistry in the universities and polytechnics is not commenced until the second year of the student's course, Böttger's work will no doubt be adopted by many teachers who desire to eliminate from their courses the unsatisfactory features characteristic of many types of so-called guides to qualitative analysis.

In the interests of English students, it is hoped that the appearance of an English translation of the second edition of the book will not be long delayed.

H. M. D.

OUR BOOK SHELF.

The A.D. Infinitum Calendar. (Liverpool: Collin and Irene.)

We presume that the title of the above is intended for a sort of pun, and that the A.D. may be written as in the heading with dots, or as below when we are told that it is available for any year from A.D. 1 *ad infinitum*, where the *ad* is taken as a Latin preposition.

We have had many perpetual calendars brought before us, but this is perhaps the most ingeniously contrived for giving by inspection and the adding together of four small numbers (none exceeding six, so that it is easily done in the head) the day of the week corresponding to any day of the year. As a specimen we may take the day on which we are writing, *i.e.* November 18, 1908. For the tens of centuries (19) we take out the number 5; for the number in the century (08,* marked with an asterisk because it is a leap-year) we have 3; for the month November 6; and for the 18th day of it 4. Then by adding 5+3+6+4 we obtain 18, which gives Wednesday in the last column for the day of the week. In the second column (for months called A) January and February are inserted twice, for common years or leap-years, the latter being marked with an asterisk.

As the calendar stands, it will serve until the year 3099, which will do for a *few* generations; but the authors naïvely add that it can easily be extended to go on to the end of time. A caution is perhaps necessary owing to its being so often forgotten that the alteration of the style (on the Continent in 1582 and in England in 1752) effected a two-fold change. The mere altering the rule for observance of leap-year only necessitated a slight shift, easily allowed for in a table. But the dropping of ten days from the Julian to the Gregorian reckoning, which became eleven in the eighteenth century and is now thirteen, was a different matter. Neither the calendar before us nor any similar one can give the days of the week correctly by the Julian reckoning of the days of the month after the change of style, the days of the week agreeing, but those of the month disagreeing by a number which is not a multiple of 7. W. T. L.

The Extra Pharmacopoeia of Martindale and Westcott. Revised by Dr. W. Harrison Martindale and W. Wynn Westcott. Thirteenth edition. Pp. xl+1164. (London: H. K. Lewis, 1908.) Price 10*s.* 6*d.* net.

This new edition of Martindale and Westcott's "Extra Pharmacopœia" contains an enormous amount of matter in a small compass, and although 1164 pages in length, 124 pages more than the last edition, by the use of thin paper it remains a volume that can easily be carried in the pocket. In addition to the preparation of our own and of many foreign pharmacopœias, a large number of other drugs and proprietary substances are included, together with tables of atomic weights, weights and measures, tests and solubilities. Of the supplementary matter, arsenical contamination receives special attention, the section on radiography has been brought up to date, "nutrimenta" are considered in a special chapter, in which the work of Fischer on the structure of the protein molecule and the new nomenclature of protein substances receive notice; and serum and vaccine therapy is fully discussed. The elements of bacteriology, opsonins, and the determination of the opsonic index, references to cerebro-spinal meningitis, trypanosomiasis, the *Treponema pallidum* of syphilis, the transmission of Mediterranean fever by goats' milk, the use of tuberculins, Calmette's ophthalmic reaction in tuberculosis, and organotherapy all are considered.

Chapters on mineral waters, analytical memoranda, including electrical conductivity, and a therapeutic index are included. Glossaries of words and phrases likely to occur as directions in foreign prescriptions are given in several languages, and should prove very useful. The index is very full and complete, and the composition of a number of patent medicines is given. The book is emphatically one which no medical practitioner or pharmacist can do without, and it should find a place in the library of every laboratory, for it contains data that may be of service in almost every branch of science. R. T. H.

The British Journal Photographic Almanac, 1909. Edited by George E. Brown. Pp. 1336. (London: Henry Greenwood and Co., 1908.) Price 1s. net.; cloth 1s. 6d.

As each year begins to draw to an end, so this very excellent friend of the photographer makes its appearance. While the style of the volume remains the same, the text, sandwiched in between a mass of advertisements, will be found most useful material for the worker. Among some of the numerous subjects dealt with may be mentioned the epitome of progress since the last issue, while the recent novelties in apparatus are full of interest. The usual tables, both chemical and optical, together with the numerous formulæ for the principal processes, form, as usual, an important part of this publication, not forgetting the calendar, directory of photographic societies, and particulars of the chief photographic associations which are not included in the above directory.

The frontispiece is a coloured portrait of the late Mr. Thomas R. Dallmeyer, from a painting by Sandys, the three colour blocks having been made and printed by Messrs. Hood and Co., Ltd., Middlesbrough.

The great number of advertisements is quite a unique feature of this publication, and the capital indices render them easy to refer to. The volume should naturally find a place in every studio or laboratory where photography is practised.

The American Annual of Photography, 1909. Vol. xxiii. Edited by John A. Tennant. Pp. xliv+328. (New York: Tennant and Ward; London: Dawbarn and Ward, Ltd., 1908.) Price 5s.

THE twenty-third issue of this annual is a volume which will be welcomed by all photographers. It is bristling with a great number of original articles on many subjects, most of which are admirably illustrated. These are for the most part written in a very clear manner, and summarise in a small space the particular speciality of the individual writers. Thus, Mr. A. Radclyffe Dugmore leads off with "Camera Hunting for Big Game," while Mrs. H. C. Sutherland writes about "Animal Photography." "The Photography of Lightning" is dealt with by Mr. Howden Wilkie, with some interesting photographs, and Mr. W. J. Farthing treats of "The Camera in Natural History Research."

In addition to the many articles mentioned above, the volume includes some excellent reproductions of photographs taken by well-known workers.

At the end are gathered together a typical collection of formulæ and tables, the former being selected from the methods of practical photographers. The strong binding and general character of the book reflect great credit on the editor and his co-workers, and the volume should find a home in every photographic studio.

Beiträge zur Naturdenkmalpflege. Heft i. and ii. Edited by Prof. H. Conwentz. (Berlin: Gebrüder Borntraeger, 1907–8.)

IT will be remembered that Prof. H. Conwentz, editor of the above publication and Prussian Commissioner for "Naturdenkmalpflege," delivered an address on "The Preservation of Natural Monuments" (NATURE, vol. lxxvi., p. 556) before a joint meeting of Sections K, C, D, and E at the Leicester meeting of the British Association. In this address Prof. Conwentz explained what was meant by "Naturdenkmäler," and also the aims and objects of the Prussian State Department for their preservation. The above periodical is the official organ of the department for Naturdenkmalpflege. The first Heft is subdivided into two main parts. The first part deals with the administration of the department. The second part shows the progress which has been made in the care and preservation of natural monuments.

The main object of the department seems to be directed towards getting the public and private landed proprietors interested in the preservation of all things of natural interest which are in any way threatened with extinction or obliteration. Prof. Conwentz, the head of the department, has travelled over the greater part of the State, and held personal interviews with local authorities, heads of departments of public and other bodies, societies and individuals who are at all likely to be interested in the movement, and, further, a great many lectures have been given all over Germany, and, indeed, in several other countries, in order to stir up public interest in the care and preservation of natural monuments, which is probably the most potent factor of all.

An appendix at the end of the Heft contains much useful information in a very concise form, showing the constitution and function of the State Department for Naturdenkmalpflege. This first number covers the year from April 1, 1906, to March 31, 1907. The demand for copies was so great that a new impression was necessary.

Heft ii. of the Beiträge covers the period from April 1, 1907, to March 31, 1908. It is arranged on the same lines as the previous number, but shows by its size and the amount of new matter it contains that great progress has been made. Many Naturdenkmäler have been catalogued, mapped out, and placed under proper care and supervision. Details of these are given, but care is taken that localities or stations where very rare plants or animals occur are not made public, as it would no doubt defeat the object of the department to let collectors and dealers know of such places. The appendix shows what recent legislation has taken place, and gives other useful information, which appears desirable or necessary for every co-worker.

The Beiträge will appear from time to time, but not at definitely stated intervals, and the size and price may also vary with each new issue.

A. W. B.

Die periphere Innervation; Kurze übersichtliche Darstellüng des Ursprungs, Verlaufs und der Ausbreitung der Hirr- und Rückenmarksnerven. By Dr. Emil Villiger. Pp. 110. (Leipzig: W. Engelmann, 1908.) Price 6 marks.

THE manifestations of disease are made so frequently through the nervous system that there can be no doubt of the utility of such a book as this, which seeks to give the clinician a brief and clear description of the anatomy and physiology of nerve paths as a solid basis for diagnostic purposes. It is an elementary book representing well-known facts to serve the purpose of the medical man, its main interest to British neurologists lying in the fact that it represents the modern teaching of German and Swiss medical schools. From a medical point of view the most important part of the nervous system is the sympathetic, by which the viscera are brought into close touch with the central and peripheral nervous system, and by which visceral disease is so frequently reflected, but the sympathetic system is altogether excluded from Dr. Villiger's book. The sensory nerve supply of the body wall, of the pleura and peritoneum is also omitted. The levator palatæ is still described as receiving its nerve supply from the facial nerve. On the other hand, the segmental nerve supply of the muscles of the body and the muscular incoordinations and disturbances which follow lesions of the central nervous system are well described.

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.]*

On the Salinity of the North Sea.

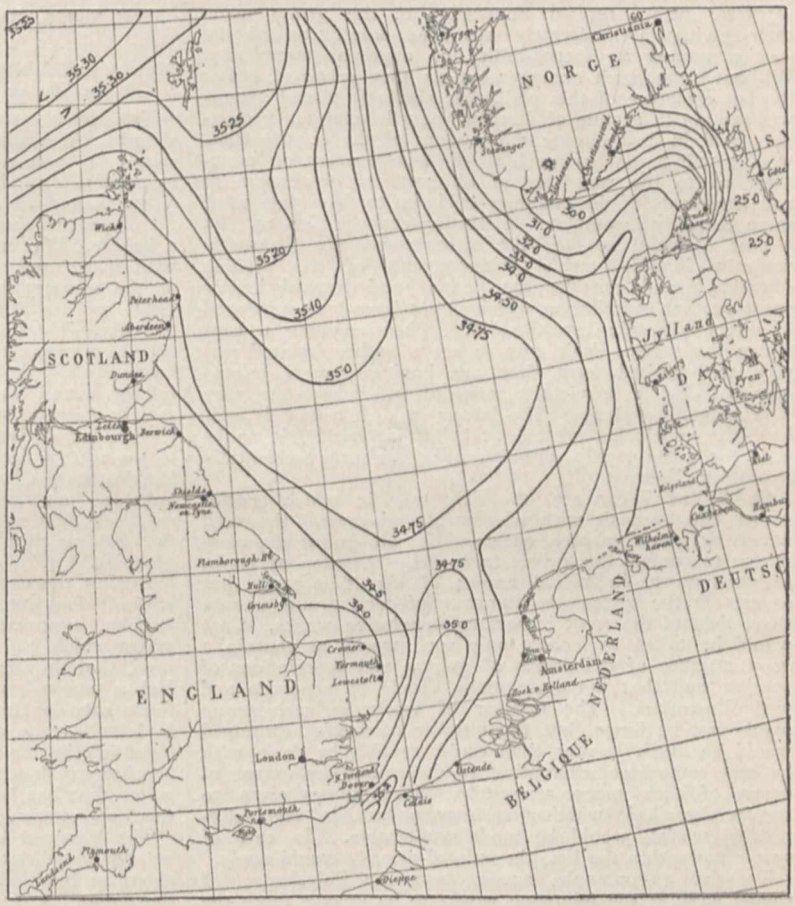
THE accompanying chart of the mean salinity of the surface of the North Sea has been constructed from the international observations made during the years 1903–7. A similar chart has been constructed by Mr. Martin Knudsen (dealing with a somewhat shorter period), and our two charts, independently prepared, agree with and confirm one another in a very close way.

The general features of the chart are extremely simple; the highest salinities are found, first, around the Shetlands, and, secondly, in the neighbourhood of the Straits of Dover, and the values are somewhat higher in the former region than they are in the latter, where the connection with the waters of the ocean is more remote. The salinity falls off rapidly in the Skager Rack, and is, on the whole, low everywhere in the immediate neighbourhood of the coast.

We may the more easily comprehend and describe the form and distribution of the isohalines (or curves of equal salinity) by comparing with them the case of the distribution of temperature or of potential in a bar of metal subjected to a flow of heat or of electricity. In such a bar of metal, heated at one end and cooled at the other (as in Forbes's classical experiments), we obtain a series of isotherms running transversely to the "thermal axis," and arranged in an exponential series at increasing distances as we pass towards the cooler end. If, in the next place, we apply new sources of heat along the edges of the bar, it is obvious that the result will be to bend the isotherms from straight into curved lines, concave towards the cooler end of the thermal axis. Lastly, if we substitute for the straight and elongated bar a square plate, and apply our sources of heat and cold at two of its adjacent sides, then the thermal axis will be bent into a curve, and the isotherms will be crowded together upon its concave, and comparatively remote from one another on its convex, side.

Now, neglecting the phenomena in the Straits of Dover, which are of comparatively small magnitude, we have in the accompanying chart a series of isohaline curves which correspond very closely indeed with the isothermal system just described. Our axis is traceable through the Cattegat and Skager Rack, along a bent course in the middle of the North Sea, to its termination in the Atlantic eastward of Shetland; the isohalines, which are essentially transverse to this axis, are everywhere rendered convex towards the ocean by reason of the influx of fresh water from the shore, and these isohalines, while they are comparatively widely interspaced in the southern part of the North Sea and off the east coast of Great Britain, are crowded together off the coast of Norway, that is to say, on the concave side of the axis. Furthermore, we notice that the whole system of curved isohalines is thrust over much nearer to Shetland than to Norway, firstly, I presume, because it is in the neighbourhood of Shetland that the oblique north-easterly track of the so-called Gulf Stream, with its highly saline water, lies nearest to the North Sea, and, secondly, because the inflow of fresh water from the Norwegian coast predominates greatly over that from the coast of Britain. We may follow the parallel a little further, by noticing that, just as our axis is bent within the North Sea, so it is also bent, but in the opposite direction, as it passes from the Cattegat into the Skager Rack. Accordingly, we find in this latter region a disposition of the isohalines comparable, though on a smaller scale, to that within the North Sea itself, for they are crowded together on the concave side of the bent axis, that is to say, towards the Danish coast, and comparatively widely spaced on the Norwegian; while at the same time the whole system is thrust over towards the Danish side by the greater inflow from the Swedish and Norwegian coasts, to which disposition, no doubt, in this case, the course and direction of the outflowing current from the Baltic contribute.

A chart of the mean annual variation of salinity, which



Mean Surface Salinity of the North Sea, 1903–7.

variation we can show to be, on the whole, regularly periodic, is found to correspond very closely in its contours with the chart of mean salinity, for the regions of highest salinity are subject to the least variation, and those of the lowest mean salinity to the greatest. At the mouth of the Cattegat, where the mean salinity is about 25 $^{0}/_{00}$ (or 25 grams of chlorides in a thousand parts of water), the mean annual variation is nearly 10 $^{0}/_{00}$; at the mouth of the Skager Rack, where the mean salinity is about 31 $^{0}/_{00}$, the mean variation is about 5 $^{0}/_{00}$; in the middle of the North Sea, with a mean salinity of 34·75 $^{0}/_{00}$, the mean variation is only about 0·2 $^{0}/_{00}$; and in the region of our highest salinities off Shetland, of about 35·25 $^{0}/_{00}$, the mean variation is less, and probably very considerably less, than 0·1 $^{0}/_{00}$. A further discussion of this subject, including an account of the distribution of salinities at various depths, and of the phases and other phenomena

connected with the periodic variation, will presently appear in the Scottish Reports of the North Sea Investigation Committee. D'ARCY W. THOMPSON.

University College, Dundee, December 9.

Reform of Zoological Nomenclature.

THE labours of the committee proposed by Mr. Boulenger at the British Association for remedying the abuses of zoological nomenclature will be enormous, even if restricted to the settlement of common generic names. To hope that they should extend to large numbers of species, or to species of the less prominent groups, is, I fear, impossible unless a more wholesale method of dealing with the names be adopted.

The necessity for extending the settlement to a large number of species of such groups as the Polychæta is very pressing, since hundreds of names were given by the earlier workers, whose limited knowledge of the group made their giving a moderately adequate description of the species named an impossibility or apparent superfluity. Without some such arrangement as that proposed below the nomenclature of this and other similarly placed groups will remain in a state of flux for years beyond our generation, and in consequence the labours of the conscientious worker will be not so much to the advancement of knowledge as to the weighing of all sorts of circumstantial and fragments of documentary evidence to determine what some culpably incomplete description really refers to. As a case in point see the list of synonyms for *Aphrodite aculeata* in McIntosh's "Monograph of the British Annelids," and consider the patient and learned labour spent on that compilation which might have been employed in direct scientific investigation. Then compare a case where the species dealt with is not a rather isolated and very well-marked form, but one having several related species living in its vicinity, none of which have any very striking characteristic! The labour in such a case is endless, the conclusion arrived at being always liable to be upset by some purely circumstantial evidence accidentally coming to light.

So far as I can see, the only way in which species names can be dealt with wholesale, and several thousand names be given priority, once and for all, is for the committee to confine themselves to the consideration of books rather than to individual names. I should suggest that experts in the systematic literature of each group prepare short lists of the most important descriptive works. Care would be taken to include only such works as contain a good number of definitions of genera and descriptions of species, and that the descriptions should be adequate and well illustrated. The number of works in each group would not be large, but the number of species contained would be much greater than could possibly be dealt with by any committee attempting to determine the extent of usage of each name separately. The names given to species *described*, whether as new or not in this selection of works, would be made unalterable. In case of synonymy within the list, the rule of priority would apply.

To give an example, again, from the Polychæta. I should suggest the following works to be among those the nomenclature of which should be inviolable:—

(1) Claparède, "Annelides Polychètes du Golfe de Naples" (but possibly not his other work on Polychæta from near the Spanish frontier).

(2) Ehlers, "Die Borstenwurmer," and several recent works on South American collections.

(3) McIntosh, "*Challenger* Reports," vol. xii. The *Challenger* reports would all be reckoned authoritative, I suppose, thus securing an immense number of settled names at once.

(4) McIntosh, "Monograph of the British Annelids."

Some famous works, *e.g.* Kinberg's and Grabe's, even the latter's "Annulata Semperiana" I personally should not include, and some voluminous recent literature certainly should be omitted. I do not mean that such works should be allowed to lose any of the usefulness they have at present, but should be searched rather for their facts than their namings.

My plan will certainly cause some unjust neglect of some few well-made descriptions of species, but can any beneficent and effective legislation, on any subject whatever, be framed to avoid all injustice to small minorities? In comparison with the injustice which gives any easy-going name-giver authority to mar the work of the laborious describer, this is nothing.

It has the advantage of substituting the authority of series of the best works for that of the committee. Cavillers may object to the most authoritative committee of living and possibly interested men, but are less able to object to this reinforcement of the authority of the most eminent workers in each group, many of whom are now beyond all personal interest in the preservation or neglect of their particular systems of nomenclature.

My plan is doubtless full of difficulties, but I believe not more so than any other proposed, while the remedy goes deeper, not, as in other cases, merely touching the surface of this great hindrance to progress and order.

CYRIL CROSSLAND.

Port Sudan, Red Sea, November 13.

Mercury Bubbles and the Formation of Oxide Films by Water containing Oxygen in Solution.

THE formation of mercury air bubbles described by Mr. Wright, Sir William Crookes, Mr. Hare, and Prof. Dixon seems to be a different phenomenon from that described by the late Prof. P. G. Tait in his "Properties of Matter" (1899, p. 257) in the following passage:—

"Even so dense a liquid as mercury can be formed into a bubble. We have merely to shake a glass bottle *filled* with water and clean mercury. The bubbles which form on the mercury (often detached) are full of water. Sometimes we see others coming up from the interior of the mercury. These are water-skins full of mercury."

I have repeated Tait's experiment, using a 250 c.c. bottle containing about 50 c.c. of mercury and filled quite full of water. A short, vigorous shaking fills the bottle with a foam of mercury bubbles, which quickly subsides, leaving some isolated bubbles, which also quickly sink to the bottom and disappear in the mass of mercury. The bubbles formed in this way are therefore mercury *water* bubbles, not mercury *air* bubbles. The addition of sulphuric acid to the water stops the formation of bubbles; the shaking then breaks up the mercury into minute solid globules.

During the experiment an observation was made which, while it does not bear directly on the formation of mercury bubbles, is perhaps of some interest. It was found, when water which had not been freed from dissolved gases was used, that the liquid set free by the bursting of the bubbles had a smoke-brown colour by transmitted light. As the foam subsides into the mercury below, this brown cloud is left floating over the surface of the mercury. The cloud left by the bursting of single bubbles can sometimes be observed floating in the upper part of the liquid. With water that has been freed from dissolved gases by boiling this appearance does not occur.

The browned water, after standing for a few minutes, was decanted into a clean vessel, and was watched for about an hour. During this time no deposit settled from the liquid. A drop of the liquid was then examined under the microscope with illumination by an intense oblique beam of reflected light, and also by transmitted light with a high-power objective. Two kinds of particles were present, minute globules of mercury measuring from 2000 to 6000 $\mu\mu$, and shreds and spicules of oxide film. The latter, which are only visible under the oblique beam, are in constant pedetic movement. They are not spherical aggregates, but minute plates, which appear and disappear as they turn and twist in the unidirectional beam of light. The oxide film which forms on the stretched mercury surfaces has, no doubt, the same microstructure as I have found alike in solid and in liquid films—a kind of lenticular granulation due to surface tension. The sudden collapse of the mercury film sheds the oxide film, and causes it to break up into minute lens-like plates or spicules, which are in pedetic movement. In some cases these plates form aggregates of considerable size round the minute mercury globules. These aggregates are sufficiently massive to be visible by transmitted light. G. T. BEILBY.

Glasgow, December 12.

THE STUDY OF STELLAR EVOLUTION.[1]

WE are becoming so accustomed to fresh proofs of Prof. Hale's versatility and thoroughness that the appearance of this volume hardly strikes us as being so remarkable as it would have done had another written it, but even this fact cannot detract from the feelings of wonder and admiration which are forced upon us as we peruse the contents.

It should be noted that this work is not *a* study, but is an account of *the* study, of stellar evolution, telling us of the methods and apparatus applied in attacking the various problems, and how far such means have already been successful. It was at first intended as a handbook to the Yerkes Observatory, but the removal of the author to the new solar observatory at Mount Wilson, with its new equipment and newer methods, rendered it advisable that the scope of the work should be widened.

Prof. Hale looks upon the evolution of stellar systems, not as an entity, but as a part of the general scheme of evolution which began with the Beginning and at present ends in the social systems which govern man, and it is in this philosophical spirit that he introduces his subject in the first chapter. The great differences between the old and the new astronomy are then pointed out, with reference to the changes introduced by the application of photography to the study of astronomy, and the consequent importance of the methods of reduction which have to be applied to the photographic results.

The sun is then discussed as a typical star, and Prof. Hale answers a question which is continually being asked by persons who are not thoroughly familiar with solar work. Why at a solar observatory, such as Mount Wilson, are time and opportunities spent in studying stars and other masses outside the solar system? Why pay attention to those far-away systems which can never, within comprehensible time, exert any influence on terrestrial conditions? The author expunges all doubt in his reply to these questions. Just as the biologist, by studying the lower forms of life, discovers the laws which regulate the life and being of man, so must the solar physicist appeal to those other stars, of earlier and later birth, in order to comprehend solar phenomena.

Those who heard Prof. Hale's evening lecture at the Royal Astronomical Society in 1905 will recognise the sentiment of the succeeding chapters, in which, while describing various instruments, he insists upon the useful work that may be accomplished with very modest equipments, and shows that, if the worker only gives earnest consideration to the choice of a definite research, he may find that his smaller instruments will prove equally efficient with the larger ones. Among the beautiful full-page illustrations at the end of the volume there are a number illustrating this point.

Chapters dealing with the reflecting telescope and the principles of spectrum analysis, in which the work of Herschel, Fraunhofer, Kirchhoff, Huggins, Secchi, Lockyer, Janssen, and others is briefly described, bring the history of these subjects up to date, and lead to a description of grating spectroscopes, their history and manufacture. In this regard it is gratifying to be assured that Michelson has completed a ruling-machine, with an almost perfect screw, designed to rule 14-inch gratings, and has already completed gratings of ten and twelve inches. By constructing a machine with four screws he further hopes to reduce the ruling errors to one-fourth the amount produced in a single-screw machine.

After discussing the phenomena of the sun's surface and surroundings, and the historical discoveries concerning them, the author proceeds to a description of the evolution of the photo-spectroheliograph, in which he has played so great a part. He also emphasises the point that the explanation of the results offered in this chapter is merely an hypothesis which future researches may modify, and refers to the anomalous-dispersion explanation of Julius as one of the possible alternatives.

The perusal of chapter xii. leaves us with the ardent desire that British authorities and capitalists would see eye-to-eye with their American confrères as to the fundamental necessity of fostering scientific work, for Prof. Hale here describes the foundation, equipment and work of the Yerkes Observatory. Here, as in other parts of the book, the author strongly insists upon the necessity for an equipment capable of undertaking the concurrent study of the correlated solar, stellar, and terrestrial phenomena.

Notwithstanding the dictum of Newton and the experiments of Piazzi Smith and others, the question of the advantage of high altitudes for solar work has only become acute during the last decade or so, and no one is much better qualified than Prof. Hale to discuss this question. It is therefore with interest that we read the chapter dealing with this subject, in which he shows conclusively that altitude alone is not necessarily advantageous. Many of the higher peaks surrounding Mount Wilson have been proved to be unsuitable for solar work, whilst the author's experiences of Mount Etna, in July, 1894, were not of the kind calculated to make him regard it as an ideal site from which to attempt the photography of the corona without waiting for a total eclipse. Mount Hamilton, notwithstanding its glorious night "seeing," is said to be unsuitable for solar work on account of the atmospheric movements, adverse to good solar definition, set up by the intensely heated, bare rock which forms the slopes immediately surrounding the summit.

In chapter xiv. Prof. Hale describes the Mount Wilson site, and, from his experience there, defines five specific requirements for a site to be suitable for the prosecution of solar research and its necessary adjunct, the study of stellar evolution. After describing the Snow telescope and discussing the uses of spectroheliograph plates, the author proceeds to the study of sun-spots, and in this chapter we find one of the strongest arguments possible for the inclusion in a solar physics observatory equipment of the apparatus necessary for the correlated study of terrestrial spectroscopy and similar work. Prof. Hale has just previously described the numerous pieces of apparatus fitted up, ready for instant use, in the spectroscopic laboratory, and, speaking of the powerful magnet used to produce the Zeeman effect, he says:—"It is not a question here of detecting magnetic phenomena in the sun, since most careful study has not revealed any evidence of solar magnetic fields capable of affecting the appearance of spectral lines." Yet quite recently, since the above statement was penned, he has published results (NATURE, August 20, No. 2025, p. 369) which strongly suggest that the Zeeman effect, or something which produces similar phenomena, is *en évidence* in the sun-spot spectrum!

A chapter on stellar temperatures follows, and in describing the apparatus which has been used in the attempts to measure the stellar heat radiation directly, the author gives some interesting data illustrating the extreme delicacy of the apparatus with which Nichols, working at the Yerkes Observatory in 1898 and 1900,

[1] "The Study of Stellar Evolution; an Account of Some Recent Method of Astrophysical Research." By Prof. George Ellery Hale. (The Decennia: Publications, second series, vol. x.) Pp. xi+252; with 104 plates. (Chicago The University of Chicago Press; London: Wm. Wesley and Son, 1908.) Price 16*s.* 6*d.* net.

"Populäre Astrophysik." By Dr. J. Scheiner. Pp. vi+718; 30 plates. Leipzig and Berlin: B. G. Teubner, 1908.) Price 12 marks.

was able to detect the heat radiations received from Arcturus and Vega. The former was found to send us heat equivalent to that given by a candle about six miles away, if there were no absorption by the atmosphere, and Vega less than half that amount.

Following a chapter devoted to the nebular hypothesis we find a discourse on stellar development, and some interesting points are made concerning the various stellar classifications in the light of recent research. For example, Lockyer's temperature classification has been criticised on the ground that the observed changes of intensity of stellar lines might be produced by an indeterminate combination of electrical and temperature action. This has been recognised and reiterated by the author of the classification, who accepts the changes, whatever be their cause, as a basis on which a working hypothesis might be erected. But now we find Prof. Hale writing to the effect that the results obtained in the Mount Wilson laboratory imitation of sun-spot phenomena "seem to favour the view that a temperature classification of the stars, on the basis of the relative intensities of lines, is perfectly possible." In these experiments all electrical phenomena were excluded, but the above statement is not made unreservedly, as shown in the subsequent discussion of the meteoritic hypothesis. The work with the new 60-inch reflector at Mount Wilson, it is hoped, will provide a great deal of information respecting the fainter stars which has hitherto not been obtained.

In dealing with the meteoritic and planetesimal hypotheses, Prof. Hale directs special attention to the outstanding uncertainties respecting the transitional stage, nebula to star, and urges the importance of directing special attention to nebulæ by obtaining photographs of their structures and spectra; this research can only prove fruitful if the persistent prosecution of correlated laboratory experiments is carried out concurrently.

Discussing the question of the variation of the heat received from the sun, the author points out how small an amount of definite measurement has yet been undertaken, and urges that other observatories, in other regions of the earth, should cooperate in the bolographic work.

Kodaikanal, where the dry season corresponds with the wet season in South California, and an Australian station are suggested as localities in which the observations might be profitably inaugurated.

The importance of active cooperation between solar and meteorological observers, such as has of late years been instituted by the International Commission, is also emphasised.

The concluding three chapters (xxiii.–xxv.) are essentially of general interest. In the first the author describes at some length the making of the 60-inch reflector by Ritchey in the Mount Wilson workshops (Pasadena), and illustrations of the process are to be found among the plates. Then some possibilities of new instruments, *e.g.* the 100-inch reflector now under construction, are reviewed, and in the final chapter warm encouragement is given to the amateur observer. This embodies a series of hints on fitting up instruments, and, coming from a master who commenced his far-reaching studies with home-made instruments, they should be especially welcome, as they are essentially practical.

The printing and general get-up of the volume are of the high order one is accustomed to expect from the Chicago University Press, and the 104 full-page reproductions of actual photographs, which are bound up at the end, form by far the finest collection of general astronomical pictures ever yet published in a single volume.

In Prof. Scheiner's book we have a more conventional treatment of the subject of astrophysics, in which, in two parts, the whole subject is discussed under the customary headings and in popular terminology. Thus in the first section of part i. we find simple explanations of the fundamental principles underlying the methods employed, such as those of refraction, reflection, polarisation and dispersion of light, and the capacity and psychophysiological action of the eye considered as the final instrument on which the interpretation of all the phenomena depends to so large an extent.

In the following section the specific instruments are described, and the construction and adjustments of the spectroscope are expounded at length. The determination of absolute wave-lengths introduces us to the principles underlying the employment of the grating, and to the work of Kirchhoff, Doppler, Zeeman, and other pioneers in spectroscopic research.

The discussion of the spectra of elements is interpolated with data, such as the relationships of the spectra to the element's position in the periodic system, which should prove valuable for reference.

Photometry forms the subject of section iv., and the student should find helpful the descriptions and illustrations of the various instruments, and the discussion of the psychophysical actions which have to be accounted for in performing the reductions. The uncertainty which still attaches to the results obtained from attempts to measure the solar heat radiations is discussed in a brief chapter, and is well illustrated by a tabulated statement of the values derived for the solar constant by the various observers from Pouillet in 1837 to the author in 1902; the values range from 1·7 to 3·4 gr. cals., the lowest having been obtained by Vallot in 1896, and the highest by Crova and Hansky in 1897.

The four chapters which bring the first part of the book to a conclusion deal with the application of photography to astronomical work, and so much has already been written about the subject that there is but little new matter for the author to expound; but the instruments are clearly described and their various functions explained, the matter in the text being well illustrated by figures.

In eleven chapters (xviii.–xxviii.), the second part of the book deals with the results obtained from the employment of the instruments and methods previously described. The various solar phenomena, the surface appearance and physical characteristics of the moon and planets, and the results obtained from observations of comets and the zodiacal light are expounded at some length, and are illustrated by drawings and photographs in the text. These figures are generally good, but it is a pity that the drawings of several features, such as the Martian surface and the intensified lines of sun-spot spectra, could not have been supplemented by some of the excellent photographs now obtainable.

Chapter xxiii. deals with the subject of nebulæ, and includes a useful table of nearly eighty N.G.C. nebulæ which have been shown certainly to be gaseous; the equatorial coordinates of these objects for 1900 are given, and a striking feature of the list is the great preponderance of planetary nebulæ. In the description of the physical characters, the distances, motions and extent of these gaseous masses, various tables of data are interpolated, and should facilitate references to the subject. One of exceptional interest is that in which the determined radial-velocities of thirteen nebulæ are shown. Taking mean values, we see that the extremes of approach and recession are −65 and +44 km. per sec., the values obtained for N.G.C. 6543 and 6790 respectively.

The fixed stars and their spectra and variations are next considered, and the various proposals concerning their classification are discussed; but here we cannot but express regret at the lack of scientific spirit which permeates some of the passages. For example, in describing the classifications, presumably to students and general readers, we find the author stating that the classification proposed by Lockyer, having as a fundamental feature the evolution of the heavenly bodies, is, in his opinion, based on such uncertain premises that he neglects entirely any further reference to its foundation and characteristics. Surely a classification which yet remains to be proved inadequate in the explanation of observed phenomena, and which explains so many of the problems of stellar evolution so simply, should not be so summarily dismissed from what is, presumably, intended as a standard work on the subject. How different is Hale's attitude mentioned above. There, whilst making the reservations which he thinks necessary, he discusses the matter in relation to the most recent work, and shows that one, at least, of the fundamental points in the temperature classification is capable of experimental demonstration.

The remainder of the book is devoted to the discussion of radial velocities, novæ, the changes produced in spectra by variation of the conditions under which the light-source is produced, the several types of stars showing extraordinary spectra, and variable stars. In conclusion, there is a chapter (xxviii.) in which the results obtained from celestial photography are discussed, special attention being paid to the photographs of nebulæ and of the Milky Way.

The volume is illustrated by thirty full-page reproductions of photographs and two hundred and ten figures in the text, and should afford German readers a good general view of the study of astrophysics.

WILLIAM E. ROLSTON.

PEKING TO MANDALAY.[1]

THE great development of the facilities for travel in the interior of China that has taken place in recent years is strikingly brought home to us by the narrative of Mr. Johnston, the magistrate of our little port of Weihaiwei, in North China. Since the days of Marco Polo, who himself travelled from the old capital of China to that of Burma, many European travellers, for instance, Baber, Colquhoun, Gill, and Morrison, have passed through much the same localities and mainly by the same route, but none, perhaps, have traversed the greater part of the ground more swiftly than Mr. Johnston. Leaving Peking on January 13, 1906, by the great new inland railway, built by French and Belgian engineers since the Boxer occupation of Peking in 1900–1, he reached Hankow, on the Yangtse, on January 16, a distance of 759 miles, and the journey could have been done in half the time but for the train running only in the daytime, halting overnight and resuming its journey in the morning. From Hankow, shallow-draught steamers owned by British, Chinese, and Japanese companies proceed up the Yangtse thrice weekly to Ichang, at the entrance to the great gorges of the Upper Yangtse, described by Little and others, a thousand miles from the mouth of that river and in the very heart of China. In one of the Japanese steamers our author made this journey in three or four days from Hankow; and ten days more by "red boat" took him 200 miles through the gorges and up the rapids to Wan-hsien, in the rich province of Ssuch'uan beyond the gorges. Here Mr. Johnston proceeded inland to Tachien-lu, visiting by the way the sacred Mount Omei, to the previous descriptions of which by Baber,[1] Little,[2] and others he adds something, though unfortunately he gives no photographs or sketches of the contour of the mountain.

Mount Omei, which the legends associate with the mythical progenitors of the Chinese race, Fu Hsi and Nu Wo, ascribed to the twenty-ninth century B.C., and who have their caves here, early became a centre of the Buddhists. A temple to Buddha is alleged to have been erected here in the reign of Ming Ti (58–75 A.D.), under whom Buddhism is supposed to have been introduced into China. A remarkable feature of this mountain, and one which has evidently contributed to its sacred repute, is the phenomenon of the *anthelia* locally known as the "Glory of Buddha." From the summit of the mountain the awe-struck pilgrim, standing on the edge of a tremendous precipice, which Baber describes as probably the highest in the world, sees, under favourable atmospheric conditions, several thousand feet below him, floating on a bank of cloud, this beautiful iridescent halo in all the brilliant prismatic colours of the rainbow. It is of the same kind as the spectre of the Brocken, and is to be seen under similar conditions in other parts of the Alps and in the Himalayas. The necessary conditions are said on hearsay by our author, who himself was not so fortunate as to see the spectacle, to be a fairly clear sky and a bank of cloud below; but he omits an equally essential condition, namely, that the sun must be on the opposite side of the spectator to the bank of cloud.

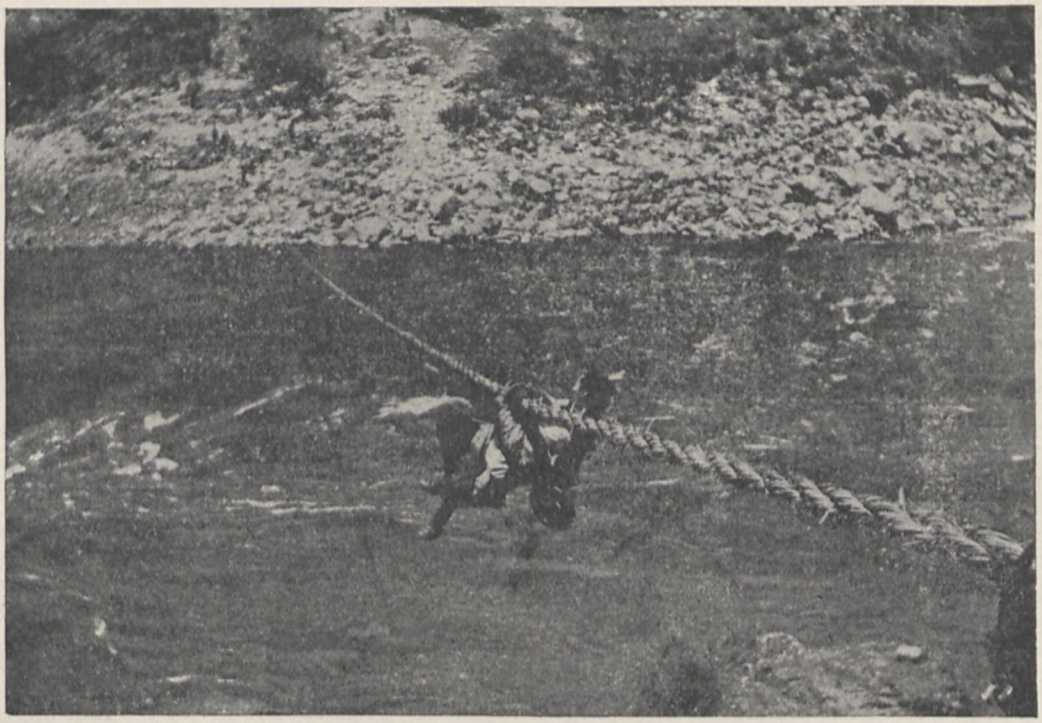
From Mount Omei Mr. Johnston passed to Tachien-lu, the well-known mart and missionary station in western China, and thence down through the wild border country to Burma. The first part of this route lay to the east of the usual track, and led for about a month's march down the valley of the Nya Rong or "Yalung" river to Li-chiang by a road "evidently about the same" as that traversed by M. Bonin in 1895,[3] and by the missionary, Mr. E. Amundsen, in 1898,[4] and crossed by Major H. R. Davies in his exploratory survey of western China. This district and its interesting wild tribes, the Lolo or Man-tzu, and others, are so comparatively unknown that we regret to find so little new about them in this book. The author tells us that his journey "was not undertaken in the special interests of geographical or other science," but to gratify a desire for travel and to acquire some knowledge of the various wild tribes. He gives us, however, little fresh information about the tribes, not even photographs of them that are of any use for ethnological purposes. Indeed, the want of new and more precise observation is the chief defect of the book, and for a travel-book there is far too frequent a tendency to theorise and to inflate the text with discursive and speculative views on the general tenets of Buddhism and on commonplace topics of that religion taken from the well-known works of European writers. So again, when he devotes about ten pages to Mr. Kingsmill's extravagant theory which ascribes to the barbarous Man-tzu tribes of China a descent from "the stock of the Maurya family of north-western India," we think that Mr. Johnston takes too seriously the legends fabricated by Buddhist priests in the countries outside India in order to affiliate themselves to the family of Asoka, the great Buddhist emperor of India. Considerable space, totalling about three pages, is taken up by the introduction of Chinese

[1] "From Peking to Mandalay: A Journey from North China to Burma through Tibetan Ssuch'uan and Yunnan." By R. F. Johnston. Pp. xii+460; with Maps and Illustrations. (London: John Murray, 1908.) Price 15*s.* net.

[1] "Supplementary Papers," Roy. Geog. Soc., vol. i.
[2] "Mount Omi and Beyond." By A. Little.
[3] *Bulletin de la Soc. de Géog.*, 1898, pp. 389 *et seq.*
[4] *Geog. Jour.*, June and November, 1900.

type in footnotes for common names which are already transliterated into English in the text. We have seen the Tibetan cryptic spell written in a variety of ways in travellers' narratives, but we do not remember to have seen it rendered "Om mane padme hom," as it repeatedly appears here. On the other hand, Mr. Johnston tells the story of his journeyings pleasantly and effectively, and with much literary skill; and he gives in appendices three pages of valuable vocabularies in the dialects of five tribes (Yung-ning Liso, Yung-ning Moso, Muli [Njong], Pa-u-rong Hsifan, and Pa-u-rong Lolo); also some statistical and fiscal information translated at first hand from the official records of Mount Omei and the Ssuch'uan provincial chronicles.

He is a believer in the reality of the "Yellow Peril," and picturesquely supports the tragic conjecture that the Western peoples some day may be crushed out of existence and their yellow successors scarcely regret their disappearance any more than we ourselves regret the extinction of the dinotherium or the ichthyosaurus. "Why indeed should they?" he asks. "When we consider how seldom the memory even of our own dead ancestors touches our sympathies or prompts an affectionate thought, it will not seem strange that in days to come the victorious Yellow man may regard the extinct White man with no more emotion than the visitor to a museum now regards the wire-linked bones of a prehistoric monster. No creature that is doomed to failure in the struggle for existence need look to the conquerors for the least sign of pity or sympathy. No less cheerfully warbles the thrush because the great auk will flap his ineffectual wings no more. Even the crocodile refrains from shedding tears over the fossil remains of the Triassic *stagonolepis*. It behoves us to remember that victory in the struggle for existence is not a victory once and for all. The doom of the conqueror in this fight is that he must never sheath his sword. New challengers are ever pressing into the lists, and the challenged must ever go armed and with lance in rest." L. A. W.



Crossing the Yalung River. From "From Peking to Mandalay."

INTERNATIONAL PHYSICS.

RECENT work at the Bureau international des Poids et Mesures is described in the volumes referred to below.[1] The volumes, like their predecessors, are full of interest to the physicist concerned with exact measurements, and are a monument to the services rendered to science by the International Committee of Weights and Measures and the director and staff of the well-known institution at Sèvres. Though twenty-two nations participate in the work of the committee, the total budget of the institution is limited by statute to 4000*l*. a year. This sum is made up by contributions by the different nations on a scale based on their respective populations, the latter being multiplied in each case by an appropriate factor, 1, 2, or 3, according as the metric system is not employed, is permissive, or is obligatory. The United Kingdom recently passed from Class (1) to Class (2), and, paying only on the population of the mother country, contributed, in 1907, 6339 francs, or about one-sixteenth of the total sum required.

After some interesting correspondence between the International Committee and the British Government on the question of the representation of the colonies belonging to this country, Canada has just entered the convention as an autonomous nation having its own delegate.

At the present time Great Britain is in the happy

1 "Procès-verbaux des Séances du Comité international des Poids et Mesures." Deuxième Série. Tome iv.
"Travaux et Mémoires du Bureau international des Poids et Mesures." Tome xiii. (Paris: Gauthier-Villars, 1907.)

position of being the only nation having two representatives on the committee. The circumstances leading to this are detailed in the "Procès-verbaux." The two members are Major MacMahon, F.R.S., and Sir David Gill, K.C.B., F.R.S.

One of the most important pieces of work recently completed at the bureau is the new study of the relation between the metre and the wave-length of the red cadmium line. The classic research of Messrs. Michelson and Benoit fifteen years ago laid the foundation of a whole system of independent controls on the invariability of the prototype. Although the maximum divergence of the three independent determinations made was only one micron (0·001 mm.), and the probable error of the mean considerably less, yet it was felt desirable to repeat the work with the highest possible refinements. This has been done by Messrs. Benoit, Perot, and Fabry, employing a totally different type of interference fringes from those used in the earlier work. By this change and by the use of "invar," the laborious "build-up" process of the older method has been greatly shortened, and the precision of the measurements much enhanced. The results may be stated as follows after all corrections have been applied :—

Mean of older determinations,

$$1 \text{ metre} = 1\,553\,164{\cdot}03\lambda_R \text{ or } \lambda_R = 0\mu{\cdot}643\,847\,00$$

New determinations,

$$1 \text{ metre} = 1\,553\,164{\cdot}13\lambda_R \text{ or } \lambda_R = 0\mu{\cdot}643\,846\,96$$

the measurements being made in dry air at 15° C. and under 760 mm. pressure.

Among many other matters of interest in the "Procès-verbaux" is an appreciation of the spectroscopist Thalén, formerly the representative of Sweden on the International Committee, written by his successor, M. Hasselberg. After the application of certain corrections, the author shows that the agreement of Thalén's measurements of the wave-lengths of the three principal cadmium rays with those of Michelson is extraordinarily close. Rowland's values are higher in each case by about one part in fifty thousand.

An appendix deals with the behaviour of nickel steel standards of length. According to the latest investigations, a metre bar of the alloy invar, annealed in the usual way at 40° C. for many hours, *grows* after this treatment, at first somewhat rapidly for work of the highest precision—a micron in 100 days—and afterwards at a diminishing rate. A curve is given showing that a bar which has been under observation for 4000 days has not yet quite ceased to change. During the whole period, however, its change is less than fifteen microns. There is no need to emphasise the enormous utility of invar for many purposes, though this phenomenon would appear to render it less suitable for absolute standards than was once supposed.

Passing now to the volume of the "Travaux et Mémoires," we find the papers included in it are six in number. Three of these relate to work done some time ago by Dr. Chappuis before his departure from Sèvres, the first being an account of further studies on the gas thermometer. This is followed by full descriptions of his now classic researches on the dilatation of water and of mercury. The first paper, of sixty-six pages, deals with a repetition of the well-known experiments which led to the adoption of the hydrogen scale as the recognised international standard of temperature over ordinary ranges. Using both the original large reservoir of platinum-iridium and one of hard glass, values were obtained for the coefficient of expansion of hydrogen under one metre initial pressure and at constant volume, substantially identical with those found earlier. No perceptible difference of "march" was found between the constant-volume and constant-pressure hydrogen scales between 0° and 100°. Many data are also given for nitrogen and carbonic acid.

An elaborate paper by M. Daniel Berthelot discusses the theory of the gas thermometer and the thermodynamic scale. It is proposed to deal with this paper in a later article on thermometry.

Other papers full of great practical interest deal with the general methods of standardisation of divided scales and of boxes of weights. These give, in a summarised form, all the results of the unrivalled experience of Messrs. Benoit and Guillaume and the Sèvres laboratory on these points. The remarks of Dr. Benoit in the early pages of his paper on the standardisation of weights should be studied by every constructor of weights of precision.

NOTES.

SIR JAMES DEWAR, F.R.S., has been elected an honorary member of the German Chemical Society.

DR. F. W. PAVY, F.R.S., consulting physician to Guy's Hospital, has been awarded the Godard prize of 1000 francs by the Paris Academy of Medicine, for his works on carbohydrates and diabetes.

THE death is announced, at fifty-one years of age, of Dr. Giuseppe Ciscato, professor of theoretical geodesy in the University of Padua.

A SPECIAL general meeting of the Geological Society will be held on Wednesday, February 10, 1909, in order to consider the result of the vote of the fellows on the question of the admission of women into the society.

WE learn from *Science* that Prof. E. B. Poulton, F.R.S., will give the annual address before the Entomological Society of America at its Baltimore meeting on December 31. The title of the address will be "Mimicry in the Butterflies of North America."

DR. H. BRERETON BAKER, F.R.S., Lee's reader in chemistry in the University of Oxford, will deliver the Wilde lecture of the Manchester Literary and Philosophical Society on March 9, the subject being "The Influence of Moisture on the Combination of Gases."

THE Broca prize of 1500 francs for 1908 has been awarded by the Anthropological Society of Paris to Dr. Paul Rivet. The prize was founded in 1881 by Madame Paul Broca, and is awarded for the best memoir on human anatomy, comparative anatomy, or physiology in relation to anthropology. The next award will be made in 1910.

A MOVEMENT, supported by the Linnean Society of New South Wales, is on foot to approach the Australian Government with the object of having Barrow Island, sixty miles off the north-west coast, set apart as a fauna reserve. The island, which is remarkable for its kangaroo, bandicoot, rat, and wren, none of which occurs on the mainland, is likely to be leased for sheep-farming, to the detriment of the fauna. The wise policy of the Crown's retention of islands as sanctuaries for wild life is being amply justified by the experiences of New Zealand and the United States, and the Barrow Island fauna is worth effort to save.

THE Academy of Natural Sciences of Philadelphia has appointed Dr. A. E. Brown as its delegate to the University of Cambridge Darwin memorial celebration.

According to *Science*, although Darwin became a member of the Dresden Academy in 1857, before the publication of the "Origin of Species," it is probable that to the Philadelphia Academy belongs the honour of having been the first foreign society to accord his great work official recognition. He was elected a correspondent on March 27, 1860. To his election Darwin refers appreciatively in a letter to Lyell dated May 8 of that year.

MR. ROOSEVELT will be accompanied on his African expedition by Messrs. Edgar A. Mearns, Edmund Heller, and J. Alden Loring. Mr. Mearns is an army surgeon, who has written an account of the "Mammals of the Mexican Boundary of the United States," as well as numerous papers on zoology and botany. He is the founder of the American Ornithologists' Union. Mr. Heller is a zoologist, formerly on the staff of the Field Columbian Museum at Chicago. He has had some experience of African travel, having been a member of Mr. Carl E. Akeley's exploring party in 1905. Mr. Loring is an authority on the smaller mammals, and is well known in America as a collector.

THE Carnegie Institution has made arrangements for what should prove to be important work in the development of magnetic science. According to a Central News message from New York, a vessel is being built under the auspices of the institution every portion of which is to be absolutely non-magnetic, even the anchors being made of bronze. The ship is to be used for the purpose of studying magnetic conditions in all parts of the world. With funds provided from the same source, Dr. Thomson and Prof. Beattie are, a special correspondent of the *Times* reports, engaging in a Cape-to-Cairo trek with the view of extending the magnetic survey through Africa, on which they have been at work for some ten years, sometimes at their own expense and sometimes assisted by colonial Governments.

EVIDENCES of the growing interest in aëronautics among men of science and others of all nationalities continue to be forthcoming. The Aëronautical Society of Great Britain has just acquired an experimental ground near Dagenham Station, which is about half a mile long and the same distance in width. It includes certain mounds about 50 feet high, which will be useful for testing models. It is expected that the ground will be opened at an early date, and that it will be provided, as soon as funds are available, with a completely equipped scientific establishment. The Paris correspondent of the *Globe* reports that a proposal is to be made in the Chamber of Deputies asking the French Government to arrange an international aëronautical exhibition for 1910, and the United States Secretary of War in his annual report just presented to Congress asks for 100,000*l.* for army aëronautics. It will be remembered that last session a grant of 40,000*l.* was sought unsuccessfully by the Congress War Department.

THE committee of the Research Defence Society has circulated a report dealing with the work accomplished by the society since January last, the month in which it was founded. There are now 1650 members, of whom 160 are ladies. Rules for the society have been approved by the committee, and will be submitted in due course to a general meeting. Branches have been formed, or are being formed, at Birmingham, Bournemouth, Cambridge University, Clifton, Dublin, Edinburgh, Leeds, Liverpool, Manchester, Oxford, and Torquay. Eleven pamphlets of an explanatory kind have already been issued by the committee, and about 500 bound sets of these have been sent to public free libraries and to the libraries of certain scientific and educational institutions. Representatives of the society have spoken at several debates, in London and in the provinces, on the subject of experiments on animals. The report points out that the society will be glad to assist any person who wishes to lecture on the results that have been obtained by the help of research in the prevention and treatment of disease.

THE construction of a new tunnel under the Thames at Rotherhithe, for wheeled traffic and foot passengers, was described in a paper read by Mr. E. H. Tabor before the Institution of Civil Engineers on December 8. The tunnel is 30 feet in diameter, 3 feet more than the Blackwall Tunnel, which it resembles in many ways. It is longer, however, owing to the docks on each side of the river making an oblique crossing necessary. The approaches include about 1000 feet of tunnel, curved to a radius of 800 feet, and special machinery was necessary for facing the cast-iron segments used in the lining of this part. In order to find the nature of the strata as the work progressed, a pilot tunnel was driven in advance of the main one by aid of a shield fitted with a rotary excavator. The work has been carried to a successful issue in four years, or in eighteen months less than was allowed for it, and the actual cost of about one million pounds is somewhat less than the original estimate.

THE *Times* correspondent at Stockholm states that the Nobel prizes awarded for the year by the Swedish academies were distributed on December 10 with the usual ceremonies and commemorative speeches. The award to Prof. Rutherford (chemistry) was made on account of his researches in radio-activity; to Prof. Lippmann (physics), for discoveries in connection with colour-photography; to Prof. Metchnikoff and Paul Ehrlich (medicine), for their researches in the subject of natural and acquired immunity; and to Prof. Rudolph Eucken (literature), for his philosophical works. All the prize-winners, except Prof. Metchnikoff, who was prevented from attending, were present to receive their prizes, consisting of a medal, diploma, and a cheque for 7680*l.*, at the hands of the King. Prof. Metchnikoff's prize was handed, on his behalf, to the Russian Minister, Baron Budberg.

As already announced, the Australasian Association for the Advancement of Science will meet in Brisbane on January 11 next. The association will come of age next year, and the meeting will inaugurate the jubilee year of Queensland, the history of which as a separate State dates from 1859. The new president of the association is Prof. W. H. Bragg, of Adelaide, while the sectional presidents are Prof. Pollock, of Sydney (astronomy, mathematics, and physics); Prof. Easterfield, of Wellington, N.Z. (chemistry); Prof. Skeats, of Melbourne (geology and mineralogy); Mr. Charles Hedley, of Sydney (biology); Mr. A. H. S. Lucas, of Sydney (geography); Mr. A. G. Hamilton, of Wellington, N.Z. (ethnology and anthropology); Mr. G. H. Knibbs, of Melbourne (social and statistical science); Mr. H. W. Potts, of the Hawkesbury College (agriculture); Prof. R. W. Chapman, of Adelaide (engineering and architecture); Dr. J. Mason, of Wellington, N.Z. (sanitary science and hygiene); Mr. Peter Board, of Sydney (mental science and education). The acting permanent secretary, Mr. J. H. Maiden, can be addressed at the office of the association, Royal Society's House, Sydney, and will be glad to give further particulars and to enrol members for New South Wales.

THE new radio-telegraph station, which has been erected for the Post Office at Bolt Head, South Devon, as stated in NATURE of December 10 (p. 166), was opened by Mr.

Sydney Buxton, the Postmaster-General, on December 11. The station will be available for communication with all ships fitted with wireless telegraphy, whatever their nationality and whatever the particular system of radio-telegraphy with which they may be equipped. It will be worked in accordance with the provisions of the International Radio-telegraphic Convention, which was ratified by his Majesty's Government in June last, and came into operation on July 1. The great majority of the liners which call at ports in the English Channel can be communicated with through the station. It will also be available for transmitting, to and from ships, messages originating at or destined for places abroad. The range of the station is 250 miles, but for the most part the station will probably not have occasion to exchange messages with ships beyond 100 miles. The station will also be used for communication with the Channel Islands if there is any interruption in the telegraph cable between England and the islands. In the course of an address at the opening of the station, Mr. Buxton pointed out that the primary use of wireless telegraphy is for communication from ship to shore and from shore to ship. He added that the cost of wireless stations for shore-to-shore communication is far less than that of a cable, and, further, that in mountainous or inaccessible districts, where the erection or maintenance of land lines is impracticable or exceedingly costly, connection by wireless telegraphy may be the most effective means of communication.

DR. CHARLES EDWARD BEEVOR, whose death on December 5, at the early age of fifty-four, we announced with sincere regret last week, was for five-and-twenty years an ardent worker in the rapidly extending field of neurology. His interest was early centred on the action of muscles, and his Croonian lectures, delivered in 1907, contained the fruits of patient observations extending over many years. Recently, he published in the Philosophical Transactions of the Royal Society an extensive monograph on the distribution of the arteries of the brain, illustrated with colour-photographs from his beautiful preparations. This research was the result of enormous industry, for in many instances five cerebral arteries were injected simultaneously with coloured fluids. His Lettsomian lectures, dealing with the diagnosis and localisation of intra-cranial tumours, were the fruit of much careful observation. Owing to his extreme modesty and the unpretentious way in which he worked, the value of his observations was, until recently, known mainly to members of the neurological section of the Royal Society of Medicine, of which he was president at the time of his death; but, within the last few years, neurologists all over the world have recognised the merits of his work, and this summer, by special request, he delivered an address to the American Medical Association. Generous and unassuming to a remarkable degree, he thought little of his own researches compared with those of his colleagues. During the preparation of the Croonian lectures it was difficult to make him understand that what he called "simple facts" were unknown outside the circle of his neurological friends. He belonged to that rare group of men who inspire, not only respect, but affection in all who are brought into contact with them.

DR. OTIS TUFTS MASON, head curator of the division of ethnology of the United States National Museum at Washington, passed away on November 5 at the age of seventy years. Dr. Mason was the great exponent of the technology of the American Indians; the general trend of his studies was embodied in two valuable little books, "The Origins of Invention" (London: Walter Scott, 1895), and "Woman's Share in Primitive Culture" (Macmillan, 1895). Most of his memoirs were published in the Annual Reports of the United States National Museum. The following imperfect list will give some idea of his activity and wide range of interests:—"The Human Beast of Burden" (1887), "Cradles of the American Aborigines" (1887), "The Ulu or Woman's Knife of the Eskimo" (1890), "Influence of Environment upon Human Industries or Arts" (1896), "Pointed Bark Canoes of the Kutenai and Ainu" (1899), "Traps of the American Indians" (1901), "A Primitive Frame for Weaving Narrow Fabrics" (1901), "Aboriginal American Harpoons" (1902). Dr. Mason was a great authority on American basketry, and published several papers on the subject; and in 1904 appeared his memorable work, "Aboriginal American Basketry: Studies in a Textile Art without Machinery," which consists of 377 pages, 212 figures in the text, and 248 plates, which will long remain the standard work on the subject. Dr. Mason arranged some very instructive cases in the museum illustrating the evolution and distribution of various implements, and no one who has had the privilege of being taken round the U.S. National Museum, and especially the grand collection of baskets, by Otis T. Mason will ever forget the erudition and enthusiasm of that lovable man.

THE annual general meeting of the Royal Agricultural Society was held on December 9. The report of the council announces that in recognition of the valuable services rendered by him to the agriculture of Canada, the council has elected, as an honorary member of the society, Dr. William Saunders, C.M.G., Director of Experimental Farms, Department of Agriculture, Ottawa. The Earl of Jersey has been nominated for election as president of the society for the year 1909. The seventieth annual show of the society will be held at Gloucester on June 22–26 of next year, and the show in 1910 will be held at Liverpool. At the Woburn Experimental Station field trials have been begun with the growing of different varieties of lucerne, and on the use of calcium cyanamide on corn and root crops; also, the influence of inoculating methods for lucerne and white clover has been tried. Further work has been done at the pot-culture station on the action of magnesia in soils, and, for the Royal Commission on Sewage Disposal, an additional year's work on the utilisation of sewage sludges has been conducted. In the botanical department of the society a bacterial disease of swede turnip was investigated, which had rendered an entire crop a failure. Black-scab disease of potato, more correctly known as potato canker, made its appearance again in many places. This pest, by its steady increase, threatens to be as serious for potato growers as the potato disease. Various injuries affecting roses, potatoes, beans, peas, turnips, and swedes were reported upon. The zoological department reports that, on the whole, crops appear to have been freer than usual from insect attack during the past year. Much attention has been given to a disease of the pea plant, which, although apparently widespread, has hitherto escaped observation in this country. It is due to the so-called corn thrips, *Thrips cerealium*. The general interest in the external parasites of domestic animals, which has been excited by the discovery of their power to communicate disease, is still on the increase, and numerous ticks and other animals are continually sent to the society for identification from various parts of the world.

A LECTURE on the Danish North-east Greenland Expedition was delivered at a meeting of the Royal Geographical

Society on December 7 by Lieut. A. Trollé, R.D.N. The principal object of the expedition, which was planned by the late L. Mylius Erichsen, was to explore the north-east coast of Greenland from 77° N. lat. to the cairns erected by Peary in 82° N. lat., and the east side of Peary Land in about 83° N. lat. The vessel *Danemark*, a steam barque of 242 tons register, carried a fully equipped expedition, with supplies for three years, and reached Koldeway Island (76° 20′ N. lat., 18° 30′ W. long.) on August 13, 1906, after thirteen days' navigation through 125 miles of drift ice. Winter quarters were ultimately established near Cape Bismarck (76° 46′ N. lat., 18° 37′ W. long.), where meteorological, magnetic, and tidal observations were established, and a number of expeditions went northwards for the purposes of mapping and placing depôts containing stores for subsequent journeys. Towards the end of March, 1907, expeditions set out northwards in four divisions. The fourth and third divisions returned in May with valuable cartographical material; the second returned on June 23, after a remarkable journey of some 1250 miles, having reached Cape Bridgman (83° 30′ N. lat.). The first division, under Erichsen, did not return, and it was only after several fruitless attempts at rescue that a sledge party sent out in the following March definitely ascertained that all the members of this division had perished. The precise value of the scientific results of the expedition is not yet known, but it is certainly exceptionally high. Large collections of ethnographical, geological, zoological, and botanical specimens have been secured, a large area of newly discovered land has been accurately mapped, and a valuable series of meteorological observations, including kite observations of the upper atmosphere, has been recorded.

"THERE is no doubt that the hopes expressed by Prof. Koch and others that atoxyl would prove a general and permanent cure for cases of sleeping sickness must now be abandoned. . . . We have at present no other treatment, apart from atoxyl and its allies, which has shown any signs of successful results whatever." These two not very hopeful statements are the opening and closing sentences in the introduction written by Dr. A. D. P. Hodges to the Quarterly Report on the Progress of Segregation Camps and Medical Treatment of Sleeping Sickness in Uganda, by Captain A. C. H. Gray, published by the Sleeping Sickness Bureau. Captain Gray's report contains a full account of the results obtained by various methods of treatment in the three sleeping-sickness camps in Uganda, and if the outcome is not so encouraging as might be wished, the publication of so much experiment and experience in the treatment of sleeping sickness will be of great value to those engaged in the difficult quest of a remedy for this terrible scourge.

WE have to acknowledge the receipt of vol. ii., No. 70, of the *Anatomical Record*, a serial published at Philadelphia, and largely devoted to reviews of anatomical literature.

THE latest issues of the Proceedings of the U.S. National Museum include the following, viz.:—a revision of certain species of Noctuidæ hitherto included in Homoptera, by Mr. J. B. Smith (No. 1645); new American Palæozoic Ostracoda, by Messrs. Ulrich and Bassler (No. 1646); and descriptions of fossil crabs from California, by Miss Rathbun (No. 1647).

WE are indebted to Mr. A. J. Jukes-Browne for a copy of a paper on the bivalve molluscs of the "Venus" group from the older Tertiary formations of England and France, this paper being extracted from the October issue of the Proceedings of the Malacological Society. In addition to re-defining the genera, the author makes numerous emendations on the nomenclature commonly in use among palæontologists in this country.

THE Horniman Museum and Library at Forest Hill, according to the sixth annual report, continues to make steady progress, both as regards the increase of the collections and in the matter of attracting visitors. The increase during the past year is specially notable in the ethnological department, the additions including implements and other specimens from the French caves, presented by the Christy trustees, and palæolithic implements from Swanscombe, Kent, the gift of Mr. J. Cross.

SPECIAL attention may be directed to a paper by Mr. R. L. Moodie in the October issue (vol. xix., No. 2) of the *Journal of Morphology* on the lateral-line system in extinct amphibians. Out of the five groups into which the stegocephalian amphibians are divided, a lateral-line system is found in all except the Aistopoda. As a rule, the system presents itself in the form of the channels of grooves constituting the "lyra" on the skulls of the typical labyrinthodonts; the smoothness of the bottom of these canals, which is most developed in the Stereospondyli, being apparently a feature distinctive either of age in the individual or of specialisation in the group. While these canals differ to some extent from the slime-canals of certain fishes, such as Amia, yet some degree of homology between the two types of structure can be traced. For these canals on the stegocephalian skull, the author proposes definite names. In the branchiosaurian group the head-canals are lacking, and their place is taken by a true "lateral line" on each side of the tail, similar to that of the modern salamander Necturus. An important corollary to, or rather result of, the investigation is the determination that the bone originally termed the squamosal in the stegocephalian skull is really that element, and not, as it has been attempted to prove, the supratemporal. The paper closes with the determination of the homology of other elements in the stegocephalian skull with the cranial bones of fishes.

WE have received from the author, Dr. W. L. H. Duckworth, an admirable descriptive catalogue of the specimens illustrating the comparative osteology of man and the higher apes contained in the museum of human anatomy at Cambridge. Although intended primarily for university students, this fully illustrated pamphlet of forty pages is well worthy of the best attention of naturalists, since it contains several items of information which it would be difficult, if not impossible, to find elsewhere. As an example we may cite the author's account of the distinctive characteristics of the heads of the gorilla and chimpanzee, which runs as follows:—"In the head of the gorilla the chief points of interest to be noted are the prominent brow-ridges, the flatness of the nose, the remarkable elevations on each side of the nasal aperture, the short but prominent upper lip, and the small ears with inconspicuous lobules. The nuchal region is not depressed as in man, for in the gorilla the great development of the muscles of the back of the head fills up the space between the head and the shoulders. . . . The head of the chimpanzee is smaller and rounder, and though the brow-ridges are very prominent and the upper part of the nose is depressed, yet the physiognomy is very different, owing mainly to the smaller size of the nasal alæ, and the long protruding upper lip. The ears, too, are different, being very large. There is also a slight but distinct nuchal depression."

THE habits of crinoids form the subject of a suggestive paper by Mr. A. H. Clark in the November number of the *American Naturalist*. From the very nature of the case, very little can be actually known with regard to these deep-sea organisms in the living condition, so that we must depend largely upon inference in trying to ascertain their nature. Their food consists, however, of minute pelagic organisms and small crustaceans, and it is obvious that, as a rule, the largest supply of this nutriment will be obtained by those individuals which live in deep water, as not only will they obtain what they can collect by themselves, but they will also receive a rain of carcases from the upper layers. As a corollary of this, it appears that the size of these organisms depends upon the amount of their food-supply, so that the largest individuals ought to occur in the deepest water. On the other hand, where streams of ice-cold water, as on the west coast of Greenland, or still larger quantities of fresh water at a higher temperature, as on some of the coasts of Cuba, Guadeloupe, and Japan, flow into the ocean, they prove fatal to minute organisms, and in such situations the greatly increased food-supply renders it possible for crinoids to flourish and attain a large size in comparatively shallow water. Indeed, in some instances the individuals of various species attain their maximum size in situations of this nature. Crinoids present all colours except blue, and it appears that the smaller stalked forms are invariably yellow, which, as among parrots, may be the equivalent of no colour at all.

A REVISED second edition of the guide to Sowerby's models of British fungi on exhibition in the Natural History Museum at South Kensington has recently been issued. The publication, obtainable at a popular price, provides a fairly ready means of identifying the common larger Basidiomycetes and Ascomycetes. The descriptions in the new edition are still confined to the models, but omitted genera are mentioned. The most observable change is the division of species, formerly grouped under Peziza, under the genera Otidia, Sarcoscypha, Macropodia, Plectonia, and Peziza. A serviceable addition has been furnished in the glossary.

A DESCRIPTION, with maps, of the vertical distribution of plants in the Balkan States is contributed by Prof. L. Adamović to *Petermann's Mittheilungen* (vol. liv., part ix.). The horizons are broadly demarcated as lowland, upland, montane, alpine, and subnival. The wheat fields rise to an altitude of nearly 4000 feet, and about the same elevation one reaches the limit of fruit trees, also of such trees as the walnut, *Corylus coturna*, and the chestnut. The hornbeam, poplar, and birch continue to the middle of the montane region, where they give place to beech, fir, and Scots pine. At the lower limit of the subalpine region, about 6000 feet, woods are no longer formed, and above this altitude the juniper and mountain pine are reduced to bushes.

OF various plant diseases discussed by Mr. E. S. Salmon in his report on economic mycology for the year 1907–8, issued from Wye Agricultural College, the American gooseberry mildew, *Sphaerotheca mors-uvae*, and "warty" disease or "black scab" of potatoes, caused by *Chrysophlyctis endobiotica*, must be classed as extremely noxious pests, and the apple scab, due to the fungus known as *Fusicladium dendriticum* or *Venturia pomi*, should be recognisable by all fruit-growers. With regard to the first-named, Mr. Salmon continues to urge the necessity for more drastic measures, and very rightly foresees in the potato scab another insidious pest that calls for systematic and compulsory eradication. Apple scab is fortunately less dangerous, being amenable to treatment, but growers will be well advised to digest the advice given regarding Bordeaux mixture for controlling this and other fungal pests.

DR. H. MOLISCH describes in the *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften* (Vienna, vol. cxvii., part i.) some experiments upon forcing the resting shoots of woody plants by soaking them in warm water. Twigs of the hazel, bearing male catkins, placed for twelve hours in a bath registering about 30° C. in mid-November, and then removed to a warm house, were hastened into flower in eight days. Flowers of Forsythia similarly treated developed in a fortnight. Lilac, dog-wood, horse-chestnut, and other shrubs or trees were also responsive to treatment. The stimulus is only effectual at a certain period, and appears to be distinctly localised. Staminate buds of hazel could be forced in November, but twigs bearing pistillate flowers could not be stimulated until December. As showing the localised nature of the effect, a photograph of a hazel shoot is given where the branches on one side that had been steeped are fully grown, while the branches on the other side remain quite dormant.

IT is well known that the central regions of Australia are too dry for successful cultivation without irrigation. There exists a vast artesian basin, but unfortunately the water obtained from the bores contains sodium carbonate, and is thereby rendered so alkaline that it cannot be used for irrigation purposes. A suggestion has been put forward that nitric acid should be mixed with the irrigation water in sufficient quantity to convert the carbonate into nitrate, *i.e.* to change the injurious constituent into a valuable fertiliser. The practical difficulties to be overcome are very considerable, but a successful result would be of incalculable benefit, and the scheme is being investigated in the chemical laboratory of the Sydney Department of Agriculture.

IN the Memoirs of the Indian Meteorological Department (vol. xx., part iv.) Mr. R. L. Jones discusses types of weather in the south of the Madras Presidency. The most important types, corresponding to the four seasons, are:—(1) cold-weather type, late December to February; (2) hot-weather type, March to May; (3) south-west monsoon type, June to early October; (4) north-east monsoon type, October to December. Charts showing the 8h. a.m. pressure distribution for each of these have been selected from the published daily weather reports, and explanatory notes are added to each. Abnormal conditions sometimes occur; the change, however, from one type to another takes place gradually as the year advances. In order to appreciate these, Mr. Jones deals with the normal and the most abnormal weather types for each month. The subject is important, and very interesting; it has been a favourite inquiry in various countries, *e.g.* Abercromby's "Principles of Forecasting," published by the Meteorological Council in 1885, deals with the question in considerable detail, so far as relates to the weather of the British Islands.

WHEN we use force to move a body or impede movement we are conscious of our effort exerted. Reasoning from this human experience, Sir John Herschel suggested in his "Outlines of Astronomy" that the movements of falling bodies, or of any matter in space, are "the direct or indirect result of a *consciousness* and a *will* existing *somewhere*, though beyond our power to trace, which force we term *gravity*." Prof. Karl Pearson refers to this animistic view in his "Grammar of Science," and Dr.

O. Z. Bianco, of the Royal University of Turin, now sends us a quotation from Schopenhauer's dissertation "Ueber den Willen in der Natur" to show that the German metaphysician accepted Herschel's speculation as to the cause of motion of inorganic matter under the influence of gravitation. Dr. Bianco deals with the same subject in a paper entitled "Schopenauer e la gravitazione universale," published in the *Rivista Filosofica* in 1906.

THE *Physical Review* for October contains a paper by Prof. E. F. Nichols and Dr. W. S. Day on new groups of residual rays in the long wave spectrum. The substances tested were rock salt, ammonium chloride, witherite (barium carbonate), and strontianite (strontium carbonate). The radiation from a group of Nernst burners was reflected in succession from five plane surfaces of one of these materials, and, after passing through a spectrometer composed of concave silvered mirrors and a wire diffraction grating, fell on a Nicholls radiometer, the deflection of which could be observed. The residual wave-lengths found are:—for rock salt, 52·3; for ammonium chloride, 51·4; for witherite, 46·0; and for strontianite, $43·2 \times 10^{-5}$ centimetre.

A LARGE part of the November number of the *Physikalische Zeitschrift* is devoted to the papers read at the Versammlung deutscher Naturforscher und Aerzte at Cologne in September. Amongst a number of interesting communications, we note one from Dr. J. Classen, of Hamburg, on the value of the quotient electric charge by mass for the kathode rays. His method is that of Kaufmann, in which the velocity of the electron is taken to be that due to its passage through the electric field between kathode and anode, and the effect of a magnetic field on the path of the electron is measured. In Dr. Classen's experiments a Wehnelt kathode is situated a millimetre in front of a large anode with a hole a millimetre diameter at its centre, and the discharge tube is placed in a magnetic field due to two large coils arranged in the Helmholtz manner. The deflections of the rays are determined photographically. The value of the quotient obtained is $1·77 \times 10^7$, *i.e.* considerably less than the $1·86 \times 10^7$ obtained by Kaufmann.

WE have received a copy of the "Guide-annuaire de Madagascar et Dépendances" for the year 1908. This official publication contains a complete list of Government officials in the various provinces of Madagascar, and much valuable statistical information.

WE have received from Messrs. John Wheldon and Co., of Great Queen Street, London, a copy of a catalogue of 800 books and papers on cryptogamic botany which they offer for sale. The books are catalogued alphabetically by authors' names under the headings algæ, fungi, lichens, musci and hepaticæ, filices, and general.

MESSRS. SPOTTISWOODE AND CO. have sent us a copy of the autobiography of the late Sir Edward Frankland, which was edited and concluded by his two daughters, and printed for private circulation in 1902, under the title "Sketches from the Life of Edward Frankland." Copies of this interesting volume may now be obtained from Messrs. Spottiswoode at the price of 3*s.* 6*d.* net.

THE first two numbers have reached us of *Pathologica*, a new bi-monthly journal devoted to pathology, and having a strong editorial committee. The journal includes original articles, abstracts of recent publications, and reviews of books; it is published by Luigi Griffini, Genoa.

OUR ASTRONOMICAL COLUMN.

WATER VAPOUR IN THE ATMOSPHERE OF MARS.—A telegram from Prof. Lowell, published as Circular No. 100 of the Kiel Centralstelle, reads as follows:—"Quantitative measures by Very, with his new spectral comparator, of Slipher's spectrograms Mars mmron (?), show little *a* water vapor band twenty-two per cent. stronger in Mars spectrum than in our own air. Solar lines C equal.—Lowell."

Our readers will remember that early in the present year Mr. Slipher photographed the spectrum of Mars in which the *a* water-vapour band was considerably stronger, relatively, than in a similar spectrum of the moon, both spectra being taken when the objects were at about the same altitude (see NATURE, vol. lxxvii., No. 2002, March 12, p. 442). It is to these photographs, presumably, that the above message refers, the queried word probably meaning "moon."

ACCELERATION OF MATTER IN THE TAIL OF MOREHOUSE'S COMET.—In a paper published in No. 22 of the *Comptes rendus* (November 30, p. 1033), MM. Baldet and Quénisset give further details concerning the accelerating velocities of the agglomerations seen, on their photographs, in the tail of comet 1908*c*.

Between September 17 and November 6 ninety-six photographs were obtained, with six different cameras, at the Juvisy Observatory, and, on examining these, it is quite possible to recognise the same features of the tail on photographs taken at different times on the same night and also on those taken on successive nights.

The photographs taken on October 15 and 16, with an interval of nineteen hours, afford a good example. Measures made on that of October 15 showed that a luminous mass, then some 580,000 km. from the head, was travelling at a velocity of about 14 km. per sec. The same mass was easily recognisable on the photograph of October 16, and the measures showed that it was then about 2,200,000 km. from the head, that is to say, it had travelled 1,600,000 km. during the interval; had 14 km. been maintained as a uniform velocity, the distance covered would have been only 960,000 km. Measures made on two plates taken on October 15, with an interval between the exposures of 1h. 40m., showed that another similar luminous mass was travelling at the velocity of 58 km. per sec.

Other peculiarities in the tail are also noted, and in one of the two photographs which accompany the paper there is a remarkable deflection in the tail, not far from the head, which seems to indicate that the ejected matter had encountered some such obstructing medium as would be provided by meteoritic débris.

The peculiar changes of the comet's appearance are also reviewed by Prof. Barnard in No. 4, vol. xxviii., of the *Astrophysical Journal* (p. 292, November). With three cameras, Prof. Barnard secured 190 negatives, which show very strikingly how rapidly the enormous changes in the comet's appearance took place. Two photographs reproduced with the paper were taken on September 30 and October 1 respectively, the interval between the exposures being barely twenty-four hours; yet the general appearance of the tail was utterly transformed during that interval.

CHARACTERISTICS OF THE SUPERIOR (K_3) LAYER OF THE SUN'S ATMOSPHERE.—In a paper published in No. 22 of the *Comptes rendus* (November 30, p. 1016), M. Deslandres states that by employing a large spectroheliograph of a special type he has succeeded in obtaining photographs with the pure radiation (K_3) of the highest layer of the sun's atmosphere. In previous work the calcium radiation, K_3—the central dark reversal of the calcium K line—has always been mixed with varying proportions of the bright (K_2) reversals which bound it on either side, consequently the photographs have shown the integrated phenomena of the highest layer and the layer immediately below it; but in the new photographs those phenomena peculiar to the upper layer are shown alone. The favourable weather of the last four months has permitted a fine set of such photographs, extending over four rotations of the sun, to be obtained.

The principal characteristic of the K_3 images is the appearance of the long dark lines, which M. Deslandres has called *filaments*, joined up by the less conspicuous and less continuous lines designated *alignements*; these apparently intersect at particular points, three or four of them cutting each other in the same place. Then there are large, dark patches, some of which appear to lie above faculæ, whilst others are either attached to filaments or are independent.

Some of these filaments have been observed to persist in the same heliographic positions for several rotations, just as do spots in the lowest level, and this leads to the suggestion that spots and filaments are simply manifestations of the same cyclonic motions in different parts of the circulation. The analogy to terrestrial cyclonic movements is shown to be very close, and it is suggested that the closer study of the solar may throw valuable light upon the working of the terrestrial *tourbillons*.

LIVERPOOL ASTRONOMICAL SOCIETY.—The report of the Liverpool Astronomical Society for the session 1907–8 contains a number of papers read by various members during the session; amongst them is the president's address, in which Mr. Plummer gave an interesting description of the motion of Halley's comet and the various methods by which it has been investigated. Papers were also read by Mr. Reynolds, describing the large reflector which he has set up at Birmingham and also the one he presented to the Helwân Observatory, and Father Cortie, whose discourse dealt with the maintenance of the sun's heat.

ONE HUNDRED NEW DOUBLE STARS.—Bulletin No. 144 from the Lick Observatory is devoted to a list of 100 new double stars discovered by Dr. R. G. Aitken. This is the thirteenth list of its kind, bringing the total number of "Aitken" doubles to 1900, and it includes closer companions to the previously known doubles Σ 22, Σ 339, OΣ (App.) 41, OΣ 87, S. 461, β 627, and Σ 31.

PRIZE AWARDS OF THE PARIS ACADEMY OF SCIENCES FOR 1908.

AT the annual meeting of the academy, held on December 7, the president announced the prize awards as follows:—

Geometry.—The grand prize of the mathematical sciences is divided in equal parts between Luigi Bianchi and C. Guichard; the Francœur prize is awarded to Émile Lemoine, for his work taken as a whole; the Poncelet prize to Prof. Fredholm, of Stockholm, for his researches on integral equations.

Mechanics.—The Montyon prize (mechanics) is awarded to E. Lebert. No memoir was received by the academy on the subject proposed for the Fourneyron prize (the theoretical or experimental study of steam turbines).

Navigation.—The extraordinary prize for the navy is divided between M. Labeuf (2500 francs), for his work on submarines, M. Dunoyer (2500 francs), for his electromagnetic compass, and M. Dautriche (1000 francs), for his work on the influence of alkaline salts on the power of explosive materials; the Plumey prize is divided between M. Codron (1500 francs), for his work on machine tools, M. Marchis (1500 francs), for his work on the use of poor gas and the production and application of low temperatures, and MM. Fortant and Le Besnerais (1900 francs), for their memoir on the oscillations of water along a vertical wall.

Astronomy.—The Pierre Guzman prize is not awarded. The Lalande prize is divided between W. L. Elkin and F. L. Chase, for their researches on the determination of stellar parallax, M. F. Smith receiving a mention; the Valz prize is awarded to Michel Luizet, for his researches on terrestrial magnetism, atmospheric electricity, and variable stars. No memoir has been received on the subject proposed for the Damoiseau prize (the theory of the minor planet Eros based on known observations). Pierre Puiseux receives the Janssen prize for the whole of his astronomical work.

Geography.—The Gay prize is divided unequally between Louis Gentil, for his topographical and geological work in Morocco, Prosper Larras, Abel Larras, and Marcel Traub, for surveying work in the same country; the Tchihatchef prize is awarded to Lieut.-Colonel Bernard, for his memoir on the delimitation of the Franco-Siamese frontier; the Binoux prize is divided between Paul Heilbronner, for his memoir on the geometrical description of the French Hautes Alpes, and Jules Richard, for his works and book on oceanography. Mentions are attributed to MM. Mazeran and Réne Bossière. The Delalande-Guérineau prize is awarded to Auguste Chevalier, for his researches on the flora and economical resources of tropical Africa.

Physics.—André Blondel receives the Hébert prize, for his researches on the electric arc; Marcel Brillouin the Hughes prize, for his book on the viscosity of liquids and gases.

Chemistry.—The Jecker prize is awarded to Ph. Barbier, for his researches in organic chemistry; the Cahours prize to MM. Gain and Pierre Carré (in equal parts); Montyon prizes (unhealthy trades) to A. Frois, for his work on dust arising in industrial occupations, and Georges Claude, for his practical applications of liquid gases; the Berthelot prize to M. Fosse; the Fontannes prize to M. Pervinquière; the Bordin prize to F. Priem and M. Leriche.

Botany.—The Desmazières prize is not awarded, but M. Hariot and Mlle. Belèze receive honourable mentions; the Montagne prize is awarded to Ernest Pinoy, for his studies in the myxomycetes; the De Coincy prize to Paul Guérin.

Anatomy and Zoology.—For his work on the Coleoptera, Pierre Lesne receives the Savigny prize; Jules Bourgeois the Thore prize, for the whole of his entomological work.

Medicine and Surgery.—Montyon prizes are awarded to MM. Frouin, Tissot, Carré, and Vallée, and MM. Rennes, Chevassu, and Joly are accorded mentions, MM. Georges Rosenthal, Adrien Lippmann, and Soubies citations. The Barbier prize is awarded jointly to MM. Piettre and Vila, for their work on the blood of mammals and birds; the Bréant prize (interest, in equal parts) between MM. Vincent and Remlinger; the Godard prize to MM. Lamy and Mayer jointly, for their studies on the mechanism of urinary secretion; the Baron Larrey prize to Dr. Bonnette, for his memoir on the dangers attending the use of blank cartridge; the Bellion prize to M. Basset, for his book on pathological anatomy, J. Alquier receiving an honourable mention. The Mège prize is not awarded. The Serres prize is accorded to Albert Brachet, for the whole of his work on embryogeny.

Physiology.—The Montyon prize for experimental physiology is divided equally between J. Sellier, for his studies on the comparative physiology of digestion, of muscular contraction, and the special physiology of the encephalus, Henri Pottevin, for his studies on the soluble ferments, and F. X. Lesbre and F. Maignon (jointly), for their contributions to the physiology of the pneumogastric and spinal nerves. The Philipeaux prize is awarded to M. Lafon, for his experimental researches on diabetes and glycogen; the Lallemand prize to G. Pagano, for the whole of his researches on the nervous system; the Martin-Damourette prize to Eugène Collin, for his application of the microscope to the determination of substances of vegetable origin; the Pourat prize to J. Lefèvre, for his studies on the energetics of the animal body.

Statistics.—The Montyon prize is divided between MM. Deniker and Felhoen, MM. Risser and Laurent receiving mentions.

General Prizes.—Berthelot medals are awarded to MM. Barbier, Gain, Pierre Carré, Frois, and Georges Claude. Charles Frémont receives the Tremont prize and J. H. Fabre the Gegner prize. The Lannelongue prize is divided between Mmes. Béclard, Ruck, Cusco, and de Nabias; the Wilde prize between MM. Tikhoff and Charles Nordmann; the Saintour prize between Paul Gaubert and Émile Rivière; the Jérome Ponti prize between Louis Bedel and Adrien Dollfus; the Houllevigue prize between MM. Debierne, Petot, and E. Fabry. The Estrade Delcros prize is awarded to Jacques Hadamard; the prize founded by Mme. la Marquise de Laplace to P. M. E. Lancrenon; and the prize founded by M. Félix Rivot to MM. P. M. E. Lancrenon, G. E. A. Chavanes, and R. D. Blanchet.

METEOROLOGY IN SOUTH VICTORIA LAND.[1]

WHEN the *Discovery* sailed for the Antarctic regions in August, 1901, Captain Scott took out an equipment of meteorological instruments, but the men who were to have used them were not on board. When South Victoria Land was reached, the observations, therefore, had to be made by men who had not been trained for the work. The report on the observations which were made by Lieut. C. W. R. Royds and assistants shows that they are to be congratulated on their success in carrying out arrangements for the exposure of the instruments and their devotion in maintaining the readings during their stay in South Victoria Land.

The first volume of the report contains the observations made at the winter quarters of the *Discovery* at Ross Island, and also those made on sledge journeys from there at various times during 1902 and 1903. These have been examined and tabulated at the Meteorological Office under the direction of Dr. W. N. Shaw, and have been discussed in sections by Commander Campbell Hepworth, Mr. R. H. Curtis, Dr. C. Chree, F.R.S., Mr. W. H. Dines, F.R.S., and Mr. C. T. R. Wilson, F.R.S. The preface is by Dr. W. N. Shaw, and Lieut. Royds has written the introduction, giving details as to the exposure of the instruments.

The *Discovery's* winter quarters were in lat. 77° 50′ 50″ S. and long. 166° 44′ 45″ E., and observations were made every two hours from February 9, 1902, to February 15, 1904. Whilst the *Discovery* was at Ross Island it was remarkable how infrequently did the thermometers register temperatures above freezing point, the maximum reading being only 42° F. The lowest reading was −58°·5 F. Yet it is noted that the ship was in a position much warmer than the regions surrounding.

The fluctuations of the temperature were rapid and violent, and generally associated with a change of wind direction. A south wind often brought a rise of temperature. The alcohol minimum thermometer was read and re-set every two hours, and when the observations were compared with the readings of the adjacent mercury thermometers the fact was brought out that there was a minimum in almost every two-hour period, and the thermograph readings also show this.

The summers were notably cold; the highest mean temperature for any month was 26°·2 F., this being the mean for December, 1903. The coldest month was July, 1903, the mean temperature being −21°·0 F. These are the values given in the preface and in one of the tables, but there are two other tables which give different months and temperatures. During April, 1903, the temperature never exceeded 0° F.

Discussing the readings of the minimum thermometer, it is shown that the lowest readings of the day oftenest occurred within two hours of midnight. A table is given showing the percentage frequency of the occurrence of the minimum of the day in each two-hour period. These values are given monthly and seasonally. On 37 per cent. of days the principal minimum occurred between 10 p.m. and 2 a.m. The values for the winter season show the maximum frequency at this period of the day, and also a secondary maximum between noon and 2 p.m., the minimum occurring at 8 a.m. to 10 a.m. being the principal one.

This table is put forward as very strong evidence that during the Antarctic winter night the temperature is affected by diurnal and semi-diurnal influences. The mean daily variation of temperature amounts only to 3° in summer and 1° in winter.

The sunshine recorder was not set up until September 14, 1902, and there is no record after February 15, 1904. The amount of sunshine recorded is remarkably great. In December, 1903, 490 hours were registered, this being 66 per cent. of the total possible. There were several notable spells of continuous sunshine; thus in December, 1902, there was a period of eighty-seven hours' unbroken sunshine, and in December, 1903, one of seventy hours. During the twelve days December 6–17, 1903, there were only fifteen hours without sunshine.

The amount of cloud was observed and recorded 7890 times. Less than one-tenth of the sky was occupied by clouds in 37·5 per cent. of the cases; 43 per cent. of the observations record that more than eight-tenths of the sky were clouded. The winter months were least cloudy.

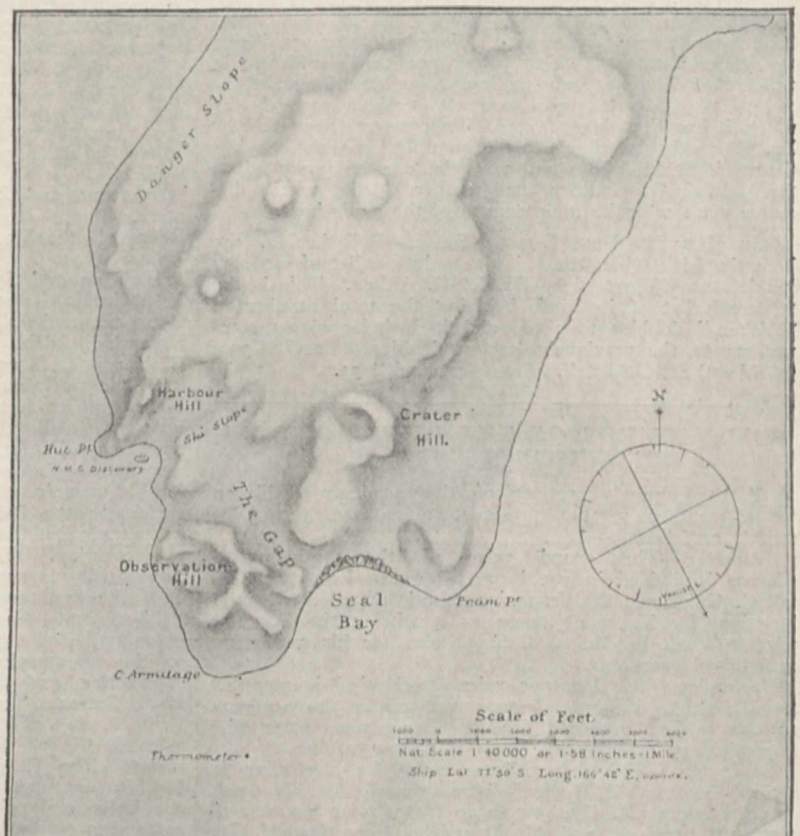


FIG. 1.—Map of south-western extremity of Ross Island, showing winter quarters of H.M.S. *Discovery*.

Although the readings of the wet- and dry-bulb thermometers were recorded, the values for humidity have not been tabulated, as it is the opinion of meteorologists that the relative humidity values obtained from very low thermometer readings are much open to doubt. The data are, however, sufficiently definite to show that the climate of Ross Island is undoubtedly very dry.

Observations with a black-bulb thermometer *in vacuo* gave remarkable results in the form of high readings. Thus for the month of December, 1902, when the mean temperature was 23°·1 F., the average maximum on the black bulb was 123° F., and in January, 1903, only on one day did this thermometer fail to register 100° F. It is argued that the air over the Antarctic regions must be

[1] "National Antarctic Expedition, 1901–4." Meteorology, Part i., Observations at Winter Quarters and on Sledge Journeys, with discussions by various Authors. Pp. xiv+548. (London: Royal Society, 1908.)

very permeable to solar radiations, and that this is due to the small amount of aqueous vapour present.

During the two years under discusison no rain fell on Ross Island. The measures of snowfall are somewhat doubtful, and were obtained by driving stakes into the snow and measuring at intervals the length exposed. The only point that is definite is that the total fall for the two years must have been very small.

Observations on the amount of evaporation were made during the winter by weighing small dishes of ice daily, the ice having been formed in the dish so that the surface was smooth and measurable. Notwithstanding the very low temperatures of the winter months, the evaporation was very great, the mean monthly value being 0·25 inch, which is almost double that for the winter months in London, where the temperature is nearly 50° higher. These observations confirm the opinion expressed as to the low humidity indicated by the wet- and dry-bulb thermometer readings.

The observations on wind direction, when reduced to eight points, show 8 per cent. of north winds, 5 per cent. of south winds, 61 per cent. between north and south on the east side, and 3 per cent. on the west side; 23 per cent. of the observations recorded "calms." The observations at Cape Armitage, 3000 yards away, agree with this.

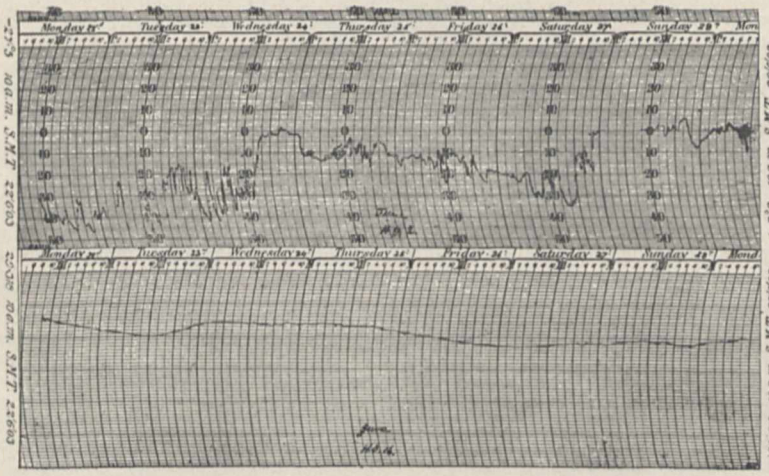


FIG. 2.—Reproductions of traces of the self-recording instruments at winter quarters, representing rapid fluctuations of temperature and an associated barometric trace. (1) Thermograph record of temperatures between −50° F. and 5° F., June 22 to 28, 1903. (2) Barograph record for comparison showing the absence of any noteworthy change of pressure to correspond with changes of temperature.

On the sledge journey made by Lieut. Royds and party to the south-east, across the Great Ice Barrier, observations of wind direction were made, but the rough notebook does not say whether the directions entered are "true" or "magnetic." Lieut. Royds afterwards wrote that they are "true" bearings, and indicate south-west winds. In the discussion by Mr. Curtis they are treated as doubtful, and as possibly easterly winds. The records of other sledge journeys often show southerly or south-westerly winds.

The direction of movement of lower clouds was in 47 per cent. cases between south-east and south-west; of Mount Erebus smoke, 76 per cent. cases between south and west; of upper clouds, 64 per cent. cases between south-west and north-west.

The mean barometric pressure during the period February, 1902, to January, 1904, was 29·29 inches, and comparing this with the observations made on other expeditions, and bearing in mind the prevalence of easterly winds at the ship's station, it is deduced that the barometric pressure should be relatively higher over the regions towards the Pole.

In this connection the observations made on the various sledge journeys become important, though in the discussions of them Mr. Curtis and Commander Hepworth reach different conclusions.

Mr. Curtis, discussing the observations of pressure made by Lieut. Royds on his journey across the Barrier in November, 1903, plotted them on a distance scale, reading to and from the ship, and apart from the general fall on the outward journey and the rise on returning, recognises points which seem to indicate fairly definitely changes in altitude. The reading taken at the furthest point of the journey (170 miles) was about 0·25 inch lower than that taken on the ship at the same time. If this gradient was real, then the winds experienced on the journey should have been stronger than were recorded. If the gradient was not real, then the difference was most probably due to change of altitude. Assuming a rise of 2 feet per mile (an amount apparently warranted by the evidence of ice pressure and the northerly movement of the ice barrier), and reducing the barometer readings accordingly, the pressure at the last station on the journey would then be read as one-tenth of an inch greater than at the ship. Mr. Curtis concludes, therefore, that the pressure rises to the south.

Commander Hepworth, in his memoir on the climatology of South Victoria Land, makes a long and careful comparison of the observations made by all the Antarctic expeditions and on excursions from Ross Island. Attention is often directed to pronounced differences between the weather experienced by the sledge parties and that prevailing at the *Discovery*. Wind, temperature, and pressure all differ, and Commander Hepworth finds sufficient justification for accepting Lieut. Royds's statement that the winds on his journey across the Barrier were south-westerly.

Captain Scott in his book, "The Voyage of the *Discovery*," says, of another excursion, "on comparing notes with this party we realised for the first time what a difference there might be in the weather conditions within easy reach of the ship. It was not only in the matter of temperature—as I have already described—but also in the force and direction of the wind. . . . Already we had learnt that the prevalent wind at our winter quarters blew from the south-east through the Gap, and that this wind was usually local and frequently ceased within a mile or two from the ship."

Commander Hepworth says that in correcting the observations of pressure made on sledge journeys he has assumed a mean altitude, whilst "it is recognised at the same time that the assumption of a mean altitude is scarcely admissible, as the whole mechanism of ice distribution implies some gradual elevation southwards—how much is an open question."

By this method of correction "the results show that the mean pressure to the south differs but little from the mean pressure at the winter quarters."

"It seems not improbable that indeed from Cape Adare to Mount Longstaff and even still further to the south, the distribution of pressure conforms largely to the configuration of the high land, and that an area of relatively high pressure lies over the land to the westward of the coast ranges and relatively low over the Ross Sea, giving gradients for southerly winds during the greater portion of the year."

The existence of the Antarctic anticyclone is not yet proved, though many facts point towards it.

Some of the differences between the results arrived at by those who have discussed the observations are certainly due, to some extent, to imperfections, some of them inevitable, in the observations themselves, but it seems probable that if the statements made by certain members of the expedition had been accepted, as they should have been, some of these differences might have disappeared.

M.

THE PERCY SLADEN TRUST EXPEDITION TO THE INDIAN OCEAN. FURTHER EXPLORATIONS.[1]

TO complete the work of the above expedition I left in June last for the Seychelles, accompanied by Mr. H. Scott and Mr. J. C. F. Fryer as naturalists. We arrived there on July 10, but were unfortunately detained on Long Island, the quarantine station, for ten days. The time, however, was by no means wasted, as the island was fairly representative of low-country coco nut cultivation, and contained a fairly rich insect fauna, mainly of introduced species. We had boats also, and were thus enabled to examine the reefs in its vicinity, collecting particularly the sedentary organisms.

On July 23 I sent Mr. Fryer to examine Bird and Dennis, two islands seventy miles to the north of Mahé, on the edge of the Seychelles Bank. He remained a fortnight on each, examining them in all their aspects. The former was barren, with a vast number of sea birds breeding upon it, while the latter was planted in coco nuts. Both proved to be formed entirely of coral material, rock and sand, and both were found to be gradually washing away into the sea. The surface reefs around them are insignificant, and they gave the impression of being the remains of reefs once widely extending along the north edge of the whole bank. On his return Mr. Fryer at once started down to visit the islands of Aldabra, Assumption, Cosmoledo, and Astove, among which he is to work for four months. These islands lie to the north-west of Madagascar, and due west of Farquhar Atoll, visited by the *Sealark* in 1905. Assumption and Aldabra form the most western group, the former being a crescent-shaped bank, 3½ miles long, and the latter a ring-shaped atoll, 19 miles long by 7 miles across, almost completely surrounded by land, with a shallow lagoon.

Astove and Cosmoledo form a second group, the former a ring-shaped atoll, 2 miles long, completely surrounded by land save for one passage to the south, and the latter an atoll, 9½ miles by 7 miles, lagoon 4 fathoms, ring much broken up, with eight main islands. Aldabra is well known as the home of gigantic land tortoises. Some rock from it in my possession contains *abundant* silica, a fact which makes the accompanying abstracts from Mr. Fryer's preliminary report on its adjacent islands of peculiar interest.

On July 24, accompanied by Mr. Scott, I went to Silhouette, the second highest island in the Seychelles, 2467 feet. We settled at 1600 feet, within the indigenous jungle, of which a square mile still exists. Here Mr. Scott remained until October 1, obtaining a rich collection of its insect fauna, which, allowing for the difference in the size and position of the islands, appeared to be to a large degree comparable in its nature to that of the Sandwich Islands. The island itself is about 12 square miles in extent, with rugged granite hills, and two bays with flats covered with coco nuts. These owe their existence to former fringing reefs, the level of the island having changed to the extent of at least 30 feet within comparatively recent times. The coco nut is grown up to 1200 feet, but the trees, as is also the case in Mahé, are infested with a fungoid disease, and do not bear well.

After a month in Silhouette I returned to Mahé, every part of which I visited in the ensuing seven weeks. For the most part I was occupied in examining its geographical features, rocks, reefs, and jungles, and in collecting its plants, of which I obtained upwards of 2000 sheets. I have little of general interest to add to my report in NATURE, January 25, 1906. Mahé showed the same change of level as Silhouette, and my former impression, that there might have been a more ancient elevation of about 200 feet, proved to be erroneous. Only about 2½ square miles of the indigenous jungle are now left, and that is being gradually affected by the reckless destruction of its larger trees. Mr. Scott is to collect its insects during the next four months, but it can scarcely be supposed that more than a small percentage of its indigenous fauna still manages to survive. This jungle area lies in the centre of the island, the north and south thirds of which, being almost completely deforested, have become physiologically dry, to the almost complete destruction of their indigenous flora and fauna. Much of the land, too, has been destroyed by cassava planting, which is followed on the steep hill-sides by the washing away of the soil, converting them into bare glacis.

J. STANLEY GARDINER.

Astove, where we arrived first, is an atoll about 2 miles long by 1½ miles broad; so far as I could tell it is entirely composed of elevated coral as a basis, with sand distributed in various places. The seaward beach in most parts is formed of sand, but in places coral rock forms small cliffs, showing very evident washing away. There is only one pass. This is narrow, and from the present rate of washing away must be of fairly recent date. On the westward side of the pass are "coral rock" cliffs, while on the east a good deal of piling up of big blocks has occurred. These blocks are all of coral rock, not dead corals. They appeared to have come partly from the present land (washed out) and partly from the reef, which, so far as I could see, was composed of coral rock only, and was not ordinary dead reef such as I saw at Bird Island, to the north of the Seychelles. The coral rock interested me very much. In places one could see regular fields of coral with all the corals in their natural positions, while here and there are small holes, 5 feet to 6 feet deep, with sides all encrusted with corals exactly as they grew. There was absolutely no question of piling up. The whole place is evidently exactly as it was underneath the sea. In parts of the island the corals have been more "metamorphosed" into rock (not retaining their original structure), but I could trace no correlation between the occurrence of this rock and its position on the island. In the north of the island there are some dunes about 50 feet high, purely of wind formation. I dug a hole on the landward side of one, and found guano underneath with a sort of shingle below. I think the north-west monsoon must have been much stronger once, or cyclones more frequent, to have driven this shingle inland.

The lagoon is very shallow: bottom of fine coral (?) mud, which makes the whole lagoon white, and forms a froth all round the shore. There are one or two small islands near the pass. There will probably be two more "passes" formed soon, one to the N.N.E. and another to the S.E. The reef to the west is sandy, with little living coral. It falls directly to "no bottom" without any slope, so that a ship cannot anchor, but is moored by lines to the reef. I searched the reef opposite the pass, but found no living corals, only a piece or two of recently killed coral thrown up. As I have said before, it is rock, and not reef. In one place it drops to the sea in terraces, forming small waterfalls as the tide goes out.

The next island we went to, Cosmoledo, represents a further stage in the Astove condition. There are only a few islands left. The settlement is on Menai, with a fishing station on Wizard. The rock is the same as at Astove, but naturally there is very much more sand. All round the reef the remains of islands stick up like rock mushrooms. On Menai Island there is a mangrove swamp on the lagoon side, trees mostly small, as the larger have been cut for their bark, used for tanning. There is a sand-dune, with some very old Casuarina. Everything was very dead and burnt up, and not nearly so attractive as at Astove. I went also to Wizard, Goëlette, and North-East Islands. Wizard is very sandy, but has the distinction of having three good wells. I got a positive measure as to the rate of erosion, 15 yards having gone in the last fifteen years (measured by Spur's old house, which is now in the sea). Goëlette is of no interest except as containing some guano; North-East Island I only stayed on for a short time; all the guano has been dug, and is now being taken to the Cape. I caught a large lizard there, which occurs on none of the other islands, but it seems to me to be only a variety of the universal small one. We had wretched weather, very squally, and I seem to have spent most of my time in a whale-boat trying to get to somewhere.

The next island, Assumption, is the most interesting of the three; it is not an atoll, and the settlement is a new one, so that everything is untouched. The rock is

[1] For earlier reports see NATURE, April 13, August 10, October 5, November 9, December 21, 1905, and January 25, 1906.

the same as at the other islands, but is more changed, and possibly contains some mineral other than calcium. The most interesting feature was the presence of big pits, some very deep, all over the island. The rock seems to be honeycombed with holes, sometimes covered in and sometimes open through the falling in of the superficial layer. Further, in three of these pits I found mangroves growing, all of very great age. Two contain Brugiera and one Ceriops. I thoroughly explored all these holes, digging where possible. In one mangrove hole the bottom was guano; I dug 18 inches, but water came in so quickly that we could go no further. The water was salt. The crowbar showed at least 5 feet more "guano mud." The hole was about 8 feet deep, and so there must have been at least 13 feet altogether. There was plenty of mangrove (Brugiera) seed, but very few young trees. This hole was on the eastward side of the island, near the sea. In another hole, just west of the centre of the island, the trees were also Brugiera. This hole was very deep (25 feet to 30 feet), with pools of brackish water (undoubtedly from the sea). Digging again was hopeless, and the crowbar found no bottom. I found some shells in the mangroves, most of which were dead. In another hole (north of the island) there were Ceriops trees. The hole was 12 feet deep, the bottom wet and muddy, salt water standing on one side (and fluctuating with the tide). We tried digging here with more success, the water coming in from the sides, and not the bottom. We got down two holes 15 feet, and then found a great lump of coral, which the crowbar broke off. The water got so high that I could not tell whether this was a coral lump tumbled off the walls and fallen by chance in a natural position, or whether it was the bottom of the hole. So I dug another hole, and at a depth of 6 feet came to a soft, white ooze rock; how much of it there was I do not know, as we could only grovel for bits broken off by the crowbar in 4 feet of mud and water. How the mangroves got into these pits I cannot imagine. There is certainly nothing more than a free percolation from the sea. The only suggestion I have is that there have been two elevations, and that after the first the island was only a foot or two out of the water, possibly with protecting sand round the edge, and that it was covered with mangroves.

In one hole I found the remains of land tortoises, which are certainly extinct now. Is there any historical evidence?[1] I send all I could find to try and ascertain the species, or rather to see if it is the same as the Aldabra one. I also send some things found by the manager in the guano which look like eggs of these tortoises. I heard that the same had been found also at Cosmoledo.

The deepest hole was 45 feet deep, and contained 23 feet of water, which in all cases was salt. I tried to think if a lagoon formation could take place this way, but do not quite see it yet. The holes are certainly increasing in size owing to erosion and weathering, but must at the same time get shallower. There are some high dunes, 70 feet, at the south-east; wherever there is sand on the east of an island a dune is formed; as a rule, however, this side is bare rock, as the sea is very heavy, and keeps it clear of sand.

The vegetation of Assumption differs slightly from that of the other islands in that there are numbers of tanghain (*Euphorbia abbotti*) and la fouche (Ficus) trees, which give the land a different appearance. Of animals, I caught two species of bat, from which I got some Nycterobia.

J. C. F. FRYER.

THE ORIGIN OF THE POTATO.

IT is a curious fact that the origin of the potato of commerce, *Solanum tuberosum*, that is, the wild species from whence it was derived by selective cultivation, has hitherto baffled research, none of the many wild species of that genus agreeing sufficiently closely in character to be identified with any of the innumerable varieties existing. This in itself might have been of little importance had not the outbreak of the potato disease in the last century suggested the wisdom of finding the original wild species, and by crossing it with the cultivated forms, of infusing fresh vigour into the latter, and thus to some extent fortify them against that destructive plague. To this end Mr. A. W. Sutton, of Reading, collected as many of the wild species as he could from the native habitats in Chili and Peru, and also from outside sources in North America and elsewhere, but none of these could be accepted as the parental form of the potato of commerce, and though many experiments were made in the way of hybridisation, the results were entirely negative so far as obtaining an improved strain was concerned, and the trials consequently ceased.

A fresh impulse was given to Mr. Sutton's researches by the alleged appearance in France of a "sport" from a wild species known as *Solanum commersonii*, which "sport" was declared to be fully equal to good varieties of the potato of commerce, though it had arisen, as the presumed raiser asserted, from a tuber of the wild species named. Not only, however, did this "sport" resemble closely a cultivated potato in all its characters, but investigation proved to all practical potato growers and experts that it was identical with a well-known variety, and that, in point of fact, it must have originated from a tuber or part of a tuber of that variety which had accidentally been in the soil in association with the wild tubers. The renewed research to establish this fact had, however, the result of re-directing Mr. Sutton's attention to another wild species called *S. etuberosum*, which had been grown in Mr. Sutton's ground for some twenty years, but which until 1906 had not been observed to produce any seed-berries, and had consequently not lent itself to seminal culture, but during that period its tubers, originally small and about the size of marbles, but white and edible, had increased to 2 inches to 3 inches in diameter, and when cooked resembled closely an ordinary potato. In 1906, however, one seedberry was observed, and the opportunity of sowing was immediately seized upon. Hitherto all the recognised wild species when sown yielded true offspring, that is, no variation at all was observed, and Mr. Sutton's surprise may therefore be judged when the twenty plants produced from this seedberry were not only of very varied character in foliage, flowers, and tubers, these last being of many colours and shapes, but they were diverse on precisely the lines of a batch of seedlings of the common potato, from which, indeed, they could not be discriminated even by an expert. The idea consequently arose that this might be due to cross-fertilisation with one of the ordinary potatoes in the vicinity, and though Mr. Sutton's experience led him to doubt this, he proceeded to check these results by a second sowing in 1908 from several seed-berries which had been successfully self-fertilised by hand, and were consequently free from suspicion. The resulting plants, however, were equally diverse, and on the same lines. A second suggestion was then made that the parent plant, *S. etuberosum*, was not really a wild species, but an escape from cultivation; but here, apart from the original smallness of the tubers, the botanist steps in, for all the wild species examined have pollen grains of a symmetrically oval or elliptical shape, and *S. etuberosum* has them of same form, while all pollen grains examined of cultivated potatoes are extremely irregular in size and shape, and no true elliptical ones are seen. The true specific character of *S. etuberosum* is thus established, while the identity of its offspring with that of the commercial potato equally establishes the fact of its being the original wild species.

Finally, a most important economical fact remains to be mentioned. For more than twenty years *S. etuberosum* has entirely defied the potato disease in the Reading grounds, though year after year subjected to infection by closely adjacent plants. The result originally aimed at when the experiments commenced is thus more than achieved, since there is no necessity for cross-fertilising with the ordinary potato, which is susceptible to disease, and consequently we have all the vigour of the wild type without any taint whatever in the new strain of disease-proof or disease-resisting potatoes which, it is hoped, has now appeared.

CHAS. T. DRUERY.

[1] No.—J. S. G.

RADIO-ACTIVE CHANGES IN THE EARTH.[1]

I WISH particularly to refer to manifestations of radio-activity which are observed, not in artificially prepared materials like radium, but in the rocks and minerals of the earth's crust, as we find them in nature. Let us consider, in the first place, the most conspicuous cases of this kind. The source from which radium is obtained is the mineral pitchblende. This mineral occurs in veins, like the majority of the useful metals; I may refer particularly to the mineral veins of Cornwall, so long famous as a source of tin. These veins are of the nature of cracks, running through the granite and through the slate which adjoins it. The cracks have been filled up by the various metallic ores which have been introduced by precipitation or sublimation, the exact nature of the process being somewhat obscure.

I will now show you an experiment, due to Sir W. Crookes, which illustrates the radio-activity of pitchblende in a very beautiful manner. A flat polished slab of pitchblende intergrown with a variety of other material which is not radio-active was laid face to face with a photographic plate, which was developed after the lapse of about a week of contact. The radium and other radio-active substances contained in the pitchblende have acted photographically upon the plate, while, of course, those portions of the material which are not radio-active have exerted no such action. Thus pitchblende has, as it were, taken its own portrait, which I now show you on the screen.

Pitchblende, the principal radium ore, contains, as you know, only an infinitesimal percentage of radium, the bulk of the substance being made up of oxide of uranium. Uranium is commonly spoken of as a rare metal; but terms of this kind are comparative only, and in contrast with radium, which is more than a million times scarcer, it seems common enough. Now I wish to speak for a little about this association of uranium and radium in pitchblende. Is it accidental, or has it some special significance? I hope to be able to convince you that it has.

In the early days of radium it was common to hear the difficulty emphasised that while there was no reason for doubting that the radium which was found in the earth had been there as long as other metals, a substance that was continually giving out energy in this way was obviously defying the greatest physical generalisation of the nineteenth century—the law of the conservation of energy. We cannot, however, afford to sacrifice this law so easily, and a ready mode of escape offers itself if we suppose that a continual waste of radium is occurring. In that case it becomes necessary to suppose, also, that the supply is in some way replenished, for otherwise all the radium would have wasted long ago. From what material are the fresh supplies of radium derived? They must be derived from some other substance contained in the mineral where the radium is found, and there is now reason to feel sure that uranium is the substance in question.

We have convincing proof of this in the fact that the amount of radium found in the mineral is always in direct proportion to the quantity of uranium which it contains. I should perhaps say, to avoid misconception, that there is good reason for believing that several transitional stages exist through which uranium passes on its road to become radium. It is not necessary, however, to take into account the existence of these intermediate products in order to form a clear idea of the process by which the supply of radium is kept up. Uranium changes spontaneously, though very slowly, into radium, and the amount of radium produced per annum, for example, will be proportionate to the amount of uranium present. On the other hand, a certain fraction of the total amount of radium present decays per annum, and the balance of this account of profit and loss will represent the amount of radium found in the mineral at any time that we examine it. There will be no difficulty in seeing that on this theory the amount of the radium in the mineral should be proportionate to the amount of uranium, and experiment fully confirms the theory by showing that such is in fact the case. We have here a clear and distinct case of the transmutation of metals, so long unsuccessfully searched for.

Let us now come back to the pitchblende.

What was the source of metalliferous ores found in mineral veins is a very much vexed question, and no solution of it which has yet been proposed can be said to be altogether free from difficulty. One of the most plausible theories, however, supposes that the metals have been derived from the rocks by which the veins are traversed. We are not here concerned with metalliferous ores in general, but only with those which carry radio-active material. In deciding whether the granite of Cornwall can be supposed to furnish the uranium of pitchblende, it is, of course, fundamental to know whether any uranium is present in the rock. It should be said, by way of preface, that the quantity must, at best, be very small, and certainly too small for detection by the methods of chemical analysis as ordinarily applied. We have seen that uranium in nature is invariably accompanied by a proportionate quantity of radium, and as it is in practice much easier to detect minute quantities of radium than to detect the corresponding quantities of uranium, it is best to look for the former only, and to be content to infer the presence of the latter.

I have made a large number of experiments to find out how much radium there may be, not only in Cornish granite, but in a large variety of other rocks. In every case the presence of radium has been established, though only to the extent of about one-millionth part of what is found in pitchblende, and even that, it will be remembered, is not much. If we take into account the very large bulk of the granite and the very small bulk of the pitchblende veins running through it, there is no difficulty in admitting that the granite was capable of supplying the radio-active material of the pitchblende.

Granite, of course, consists of a variety of different minerals, which give it its mottled appearance. These minerals, there is no reason to doubt, have been formed in the successive stages of crystallisation of an originally molten mass. There is a mineral called zircon, of which the jacinths sometimes set by jewellers are a variety, which is present in very minute crystals in granite. These minute crystals of zircon have a very characteristic geometrical shape; a square prism terminated at each end by a pyramid. The fact that they have this perfect shape is a proof that they have been perfectly free to assume their natural form, and have not been hampered for want of space by other minerals surrounding them. The inference is plain that zircon has been one of the first minerals to crystallise in the consolidation of granite.

I have found that this zircon is very much richer in radium than the granite generally, though, on the other hand, it is poor compared with pitchblende. It seems clear that the minerals which crystallise first take an unfair share of the radio-active elements, leaving the rest of the magma impoverished.

In the light of this observation, Prof. Joly, of Dublin, has been enabled to explain a curious appearance which is seen when a section of the granite thin enough to be transparent is examined under the microscope. This appearance is seen in one of Prof. Joly's photographs of a minute crystal of zircon, which is embedded in a large crystal of mica. You will observe that the material surrounding the zircon for a definite distance outwards has become darkened in colour. The altered region round the speck of zircon is practically circular, and is reminiscent of a spot of grease on cloth.

Prof. Joly has pointed out that this alteration in the surrounding materials must be due to the radio-activity of the zircon. That radio-active materials are capable of producing such colorations has been known from the early days of radium. You see, for instance, projected on the screen, the image of a glass bottle, in which a radium preparation has been kept. Though originally of colourless glass, it has been stained a deep purple by long-continued action of radium.

It may, perhaps, be thought that this idea, though plausible, is no more than a guess. It is, however, much more than that. We know, from the investigations of Prof. Bragg and Mr. Kleeman, that the α particles of

[1] Discourse delivered at the Royal Institution by the Hon. R. J. Strutt, F.R.S.

radium, which constitute the most important feature of radio-active emission, are only able to penetrate a limited and definite distance into solid materials. They then lose their characteristic properties, if, indeed, they are not altogether stopped. This distance has been measured experimentally, and Prof. Joly has shown that the distance is just the same as that to which the alteration round the zircon crystals extends. Thus we have full quantitative confirmation of the theory which attributes it to radio-activity.

I will now pass from the discussion of a very minute phenomenon to the discussion of a large-scale one. It will be familiar to many of you that, in the opinion of some, at least there is reason for changing the views which have been held for two generations concerning the earth's internal heat. We know that there is, at any rate, some radium in the earth, and that radium gives out heat. Thus it cannot be disputed that some part of the earth's internal heat must be due to this cause; the only question which remains is whether this part is large or small, whether, in fact, the earth's internal heat is chiefly to be accounted for as a small remnant of the much greater internal heat which it once possessed, or whether there is enough radio-active material in the earth to supply most of the annual loss by conduction through the crust and radiation into space.

As I mentioned before, I have made a large number of determinations of the quantity of radium in the rocks of which the superficial portions of the earth are constituted. These are found to be so rich in radium that the difficulty is not so much to account for the internal heat of the earth, as determined by underground observations of temperature, but rather to understand why it is not much hotter. I have suggested, as an explanation, that this general distribution of radio-active material, which pervades the outer parts of the earth, is in reality superficial, extending only to some moderate number of miles in depth, though no doubt much deeper than the deepest mines. I am not wholly satisfied, however, of the sufficiency of this explanation. Radium, and the series of products of which it is one, are not the only radio-active materials in the earth; there is another series, of which thorium is a member, and there is good reason to suppose that thorium is present in rocks in such quantity as to add appreciably to the evolution of heat. Taking this into account, we should probably find, if we had exact data for calculation, that the thickness of rock containing radio-active material was so small that the material of the interior would somewhere have exuded, in the course of the violent dislocations and earth movements which geology reveals to us. No material, however, appears anywhere at the earth's surface which can plausibly be regarded as representative of the unknown interior if the suggested hypothesis is accepted. It cannot be denied that the subject is at present obscure. Possibly an explanation may be found by supposing that the activity of uranium may be arrested at high temperatures. We have at present no adequate experimental evidence on the subject. It is known that there is very little effect of this kind on radium. If, however, the activity of uranium were arrested at a high temperature, the supply of radium and all the other members of the series would fall off, and thus the aggregate heat production of the whole series might be greatly diminished.

I shall now pass to another branch of the subject. The investigations of Sir William Ramsay and Mr. Soddy have proved that there is continuous evolution of helium from the radium emanation. We have good reasons, into which, however, I do not propose to enter, for considering that the same is true of radio-active changes in general, at all events those in which there is an emission of radiation. Helium is probably evolved at each stage of the transformation of uranium, and at each stage of the transformation of thorium; and it results that the natural minerals and ores in which these elements are found contain a store of helium, which has accumulated in them and remains locked up in their pores.

As already mentioned, I have succeeded in determining the presence of radium in granite. Thus it becomes natural to inquire whether the corresponding amount of helium is to be found there too. Nothing of the kind had ever come under observation before, and it was, therefore, with some interest that I made the experiment. You see before you a vacuum tube of helium prepared from ordinary granite. The characteristic yellow glow will satisfy anyone acquainted with the appearance of a helium discharge of the presence of the gas.

The facility with which helium was detected in granite suggested further experimental problems. The undoubtedly radio-active elements are at present confined to uranium and thorium, and their respective families of descendants. Evidence has been produced, by myself among others, which suggests that lead and some other elements possess a feeble radio-activity of their own; but this evidence is somewhat equivocal. It seemed highly desirable to attack the question in a new way, and the idea suggested itself of looking for helium in the naturally occurring ores of all the elements, common and rare. This had indeed been done, to some extent, from quite a different point of view, by Sir William Ramsay and his coadjutors, in their first investigations on helium; but their observations were directed to finding a practical source of the gas, and were not carried out with anything approaching the minuteness required for the present purpose.

The upshot has been to prove the presence of helium in almost every mineral examined, and even in such unpromising materials as rock crystal, or common quartz sand. The quantity found in the various cases has varied very widely. In fact, minerals may be found having any helium content, from thorianite, which contains 10 cubic centimetres per gram, down to rock crystal, which contains about a ten-millionth part of that quantity.

I have here a small tube of helium obtained from clear, colourless rock crystal, and you will have no difficulty in seeing the characteristic yellow glow as before.

Are we to regard the helium in common minerals as due to a feeble radio-activity of the common elements? No doubt such an hypothesis is tempting, but it must be rejected. Radium is present everywhere in traces, and these traces are in general sufficient to account for the minute quantities of helium. This is illustrated in the table below, which gives in round numbers the actual amount of helium extracted from various minerals by heat, and the amount of helium reckoned relatively to the radium.

	Mineral	Helium present, c.mm. per kil	Helium ratio, *i.e.* ratio of helium to radium. Arbitrary scale.
Normal	Samarskite	1,500,000 ...	... 14
	Hæmatite	700 ...	... 9
	Galena	2 ...	... 17
	Quartz	2 ...	... 10
Abnormal	Beryl	33,000 ...	... 954

There is reason to think, as already mentioned, that the presence of thorium would constitute another source of helium; but it is believed that this complication does not produce any appreciable effect in these cases. You will see that minerals like quartz, though they contain actually only an infinitesimal quantity of either substance, still show about the same proportion of helium to radium as the minerals which are rich in both. We may conclude that helium is connected with radium in the poor minerals as in the rich ones.

I have, however, encountered an interesting exception to this rule in the mineral beryl. Beryl is, in all essentials, the same as emerald; the latter name is kept for stones which are of a clear, deep green colour; but scientifically the distinction is of no importance. Some beryls contain enormously more helium than can be accounted for by the small traces of radium in them. Nor do they contain any appreciable quantity of other radio-active material. What view, then, can we take of the presence of helium in this mineral? It is, to me at least, difficult to believe that the gas can have been introduced from without. If not, can it have been generated from radium formerly existing in the beryl, but now exhausted? This, too, seems unlikely, for it would imply that beryls are older

than other minerals, and there is no plausibility in such a theory from the geological standpoint. My own opinion is that, in all probability, an element hitherto unknown exists in the mineral, from which the helium is generated. It may be objected that, in that case, the mineral ought to be radio-active. If, however, the radiation were emitted with less than the critical velocity, we should not be able to detect it, and nothing is known to make such an hypothesis improbable.

In conclusion, I shall be well content if I have convinced you that there is still something to be learnt from careful examination of the most commonplace materials. If there is nothing new under the sun, there are, at least, unsuspected things going on inside the earth, where the sun cannot penetrate.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

GLASGOW.—Dr. C. H. Desch, of University College, London, has been appointed university lecturer in metallurgical chemistry in the place of Dr. C. E. Fawsitt, the new professor of chemistry in the University of Sydney, New South Wales.

OXFORD.—Dr. Arthur J. Evans, F.R.S., has handed over as a free gift to the Ashmolean Museum the collection of Anglo-Saxon jewellery and other relics bequeathed to him by his father, the late Sir John Evans. With it is also a comparative series illustrating the early Teutonic art of the Continent, including specimens of Scandinavian, Frankish, Lombard, and Gothic work.

WE learn from *Science* that Colonel Oliver H. Payne, of New York, has given 10,000*l.* to the endowment fund of the University of Virginia.

WE have received a copy of the December issue of *The Record*, the magazine of the South-Western Polytechnic Institute, Chelsea. In addition to items of news about the work and play of students of the institution, the magazine contains short articles from members of the teaching staff and from students.

THE draft charter of incorporation of the University of Bristol has been issued. The following are to be the first chief officers of the new university:—Chancellor, Mr. H. O. Wills; pro-Chancellors, the Bishop of Hereford, the Right Hon. Lewis Fry, and the Right Hon. Henry Hobhouse; Vice-Chancellor, Prof. C. Lloyd Morgan, F.R.S.; and treasurer, Mr. G. A. Wills. Women are to be eligible for any office in the University and for membership of any of its constituent bodies, and all degrees and courses of study in the University are to be open to them. It has been announced that the authorities of the Bristol University College have purchased the blind asylum and its land which adjoin University College. The site thus secured will be used for the erection of part of the new university.

AN appeal is being made on behalf of the Bethnal Green Free Library Institute, which was founded thirty years ago. The institute has no endowment and no State or rate aid, but is entirely maintained by voluntary gifts. There is a lending library, a reading room, and a large reference library. Classes for instruction in various subjects are held, and lectures by Sir Robert Ball, F.R.S., Dr. Andrew Wilson, Dr. W. H. Dallinger, F.R.S., and others, have been provided. The library is entirely free. There is a debt of 250*l.* on the general fund, which the committee is anxious to clear off before the end of the year. Contributions may be sent to the treasurer, Mr. F. A. Bevan, 54 Lombard Street, E.C.

ON Wednesday of last week, December 9, the first annual dinner of old students of the Royal College of Science was held at the Criterion Restaurant, and was attended by more than a hundred old students, in addition to past and present members of the staff and members of the governing body of the Imperial College of Science and Technology, of which the college now forms a part. The chair was taken by Mr. H. G. Wells, who was a student of the college during 1884–7. The toast of the Royal College of Science was proposed by the Right Hon. A. H. D. Acland, who, after making some happy allusions to the descriptions of college life in one of Mr. Wells's books, went on to say that the governing body of the Imperial College intends to do something to foster corporate life among the students by the erection of a suitable building for a students' club. He also made an important statement as to the future of the college, indicating that the governors are fully alive to its great traditions, and that the associateship will still continue to be given as the diploma in science, just as that of the School of Mines is to be the diploma in mining. Mr. A. E. Briscoe, who responded to the toast on behalf of the old students, said that students of the college have gone all over the world, and have had much to do in bringing about that efficient teaching of scientific method which has been so marked a feature of recent educational progress. Many of the old students have made great names for themselves, and he attributed their success to the thoroughness of their training, and especially to the laboratory training they received. He hoped that under the new régime research will be the main work of the college. Subsequent speakers included Dr. H. A. Miers, principal of the University of London, who referred to the imperial character of the work of the college as a valuable feature of modern university life, and Prof. W. P. Wynne, who spoke of the debt owed by many old students to that much-abused body, the Department of Science and Art. At the conclusion of the dinner the old students present proceeded to elect a provisional committee to draw up rules for an old students' association to be submitted to a special meeting at an early date. Mr. T. L. Humberstone, 3 Selwood Place, South Kensington, will act as secretary; all old students who are desirous of becoming members are requested to communicate with him.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 19.—"On the Refraction and Dispersion of Krypton and Xenon, and their Relation to those of Helium and Argon." By C. **Cuthbertson** and M. **Cuthbertson**. Communicated by Prof. F. T. Trouton, F.R.S.

The authors have determined the refraction and dispersion of krypton and xenon with larger quantities of gas than were available at the time of their first isolation. The gases were prepared in the laboratory of Sir W. Ramsay by Prof. R. B. Moore. The atomic refractive index of krypton is found to be

$$\mu = 1 + 0{\cdot}0008378\left(1 + \frac{6{\cdot}97}{\lambda^2 10^{11}}\right),$$

and that of xenon

$$\mu = 1 + 0{\cdot}0013646\left(1 + \frac{10{\cdot}14}{\lambda^2 10^{11}}\right).$$

On comparing these figures with the refractive indices of helium and argon, as determined by W. Burton, it is shown that the refractivities for infinite wave-lengths are even more nearly in the ratios of whole numbers than the earlier values. Taking the value found for argon as the standard, the divergence from integral ratios is, for krypton, 0·0 per cent.; for helium, 0·34 per cent.; and for xenon, 2·25 per cent.

If the refractive indices are expressed by means of Cauchy's formula, $\mu - 1 = a(1 + b/\lambda^2)$, it is found that, plotting a against b for the four gases examined, the relation is linear.

Owing to the untrustworthiness of the existing determinations of the dispersion of oxygen, nitrogen, and hydrogen, comparison cannot be made with other groups of elements.

Physical Society, November 27.—Dr. C. Chree, F.R.S., president, in the chair.—A graphic method of dealing with refracting surfaces: H. S. **Allen**. A graphic method is given for finding the cardinal points for combinations of coaxial refracting surfaces. The method may be applied to such cases as that of two thin lenses a finite distance apart, two refracting surfaces forming a thick lens, or to the general case of the combination of two lens systems.—An accurate method of measuring moments of inertia:

the late Prof. W. **Cassie.** In this method use is made of the periods of small oscillations of a balance-beam. The method consists in taking as standard moment of inertia a known mass hung from the knife-edge of a balance and comparing others with it. The time of swing is taken with the standard mass in one pan and a counterpoise in the other. The body the moment of inertia of which is required is attached to the beam in such a manner that the coefficient of the directive couple is unaltered, and the time of swing is determined without weights in the pans. From these times, with a knowledge of the length of the beam and the masses used, the moment of inertia required is easily calculated.—The diffusion of actinium and thorium emanations: S. **Russ.** Experiments were described in which the emanation of actinium was allowed to diffuse into the following gases:—air, hydrogen, carbon dioxide, sulphur dioxide, and argon. The diffusion coefficients of the emanation in these gases agree in general with those calculated by means of Graham's law, making use of the diffusion coefficient in air. The variation with pressure of the diffusion coefficient of the actinium emanation in air was shown to be quite in accordance with the ordinary gas laws, down to a few centimetres pressure, the product of the pressure and diffusion coefficient remaining practically constant. Experiments under identical experimental conditions with thorium emanation over a similar range of pressure also yield nearly a constant value for the product of pressure and diffusion coefficient. The ratio of the two constants thus obtained leads directly to a ratio of the molecular weights of the two emanations, the result being that thorium emanation appears to have about 1·4 times the molecular weight of actinium emanation.—The elliptic polarisation produced by the direct transmission of a plane polarised stream through a plate of quartz, cut in the direction oblique to the optic axis, with a method of determining the error of a plate supposed to be perpendicular to the axis: J. **Walker.**—An experimental investigation of Gibbs's theory of surface-concentration regarded as the basis of adsorption: W. C. M. **Lewis.**

Geological Society, December 2.—Prof. W. J. Sollas, F.R.S., president, in the chair.—The geological interpretation of the earth-movements associated with the Californian earthquake of April 18, 1906: R. D. **Oldham.** At the time of the San Francisco earthquake movement took place along a fault, known as the San Andreas fault, which can be traced for a distance of about 200 miles. A re-measurement of the primary triangulation in the region shaken by the earthquake revealed considerable displacements, increasing in amount as the fault is neared, and of such nature that places to the east of the fault were shifted southwards, while those to the west of it were shifted northwards. The extent and peculiar distribution of these displacements negative the supposition that the fault was the cause—it must rather be regarded as a consequence of, or an incident in, the earthquake, this word being used to denote the disturbance in its entirety. The author considers that the displacements cannot be explained in a satisfactory manner on the supposition that they are the result of strains affecting the crust of the earth as a whole, but may be explained by the difference in character and behaviour of the materials composing the greater part of it, where pressures are great enough to produce the phenomena of solid flow, and of those in the outer skin, where the pressures are not great enough to produce any material difference in the behaviour of rocks from that which we associate with solidity, as experienced at the surface of the earth. The surface-displacements constituting the earthquake, as ordinarily understood, arise from disturbances in the outer skin; but in great earthquakes, like the one dealt with in the paper, these may be the result of more deep-seated disturbances affecting the whole crust of the earth.

Linnean Society. December 3.—Dr. D. H. Scott, F.R.S., president, in the chair.—Biscayan plankton: a memoir on the Ostracoda captured during the 1900 cruise of H.M.S. *Research*: Dr. G. Herbert **Fowler.** More than 7000 specimens had been identified, and in the case of more than 3000 the sex had been determined and the lengths of the shells measured. As the result of these measurements, the writer was enabled to formulate provisionally a new law of growth in Crustacea:—"During early growth each stage increases at each moult by a percentage of its length, which is constant for the species and sex." For this the name of Brooks's law was suggested, Prof. W. K. Brooks having made the first observations which led to it; it had been checked to some extent by observations on lobsters (Herrick) and crabs (Waddington).—Mimicry in spiders: R. Innes **Pocock.**—Note on *Juniperus taxifolia*, Hook. and Arn.: Bunzō **Hayata.** This species had been described from specimens from the Bonin Islands, but had also been recorded from the province of Hupeh, China; further examination shows that the Chinese plant is specifically distinct from that occurring in the Bonin Islands.

Mathematical Society, December 10.—Sir W. D. Niven, president, in the chair.—The theory of waves propagated vertically in the atmosphere: Prof. H. **Lamb.** Two cases are considered. In one the undisturbed atmosphere is taken to be at a uniform temperature. In the second the temperature gradient is taken to be uniform, the temperature diminishing upwards. In both, the variations of pressure and density involved in the propagation of the waves are taken to follow the adiabatic law. Even when viscosity is taken into account, it appears that the amplitude of the waves, due to arbitrary initial disturbances, tends to increase indefinitely as the waves travel upwards. One unexpected result is that an unlimited atmosphere may possess a definite natural period of vibration in the sense that an impressed local periodic force, of this, but of no other, period, would generate an oscillation of continuously increasing amplitude.—The representation of a function by series of Bessel's functions: Dr. E. W. **Hobson.** The question considered is that of the convergence of a series of the kind that arises in the problem of the vibrations of a membrane or the two-dimensional vibrations of gas in a circular cylinder. It is shown that the series converges and its sum represents the function which it is meant to represent, in the same way as Fourier's series represents a function, provided that the function is integrable according to Lebesgue's extended definition, and that if the function is infinite at the origin, the infinity is not of too high an order. The order in question must be less than —Theory of Cauchy's principal values (fourth paper): G. H. **Hardy.** The paper deals with the possibility of interchanging the order of integrations in repeated infinite integrals which have finite principal values. A number of results bearing on the problem of the inversion of a definite integral are obtained.—Differentials: Dr. W. H. **Young.** It is shown that in the case of any number of variables the differentials take precisely the place in expansion theorems which are occupied by the successive differential coefficients in the case of functions of one variable.—The solution of the homogeneous linear difference equation of the second order: G. N. **Watson.** The problem is that of determining a function of the complex variable x which satisfies the equation

$$A(x)f(x+1)-B(x)f(x)+C(x)f(x-1)=0,$$

wherein $A(x)$, $B(x)$, $C(x)$ are known uniform functions. It is shown that the required function can be determined provided the functions A, B, C satisfy restrictive conditions which are satisfied by wide classes of functions.—Four systems of three quaternary quadrics that can be expressed by means of five squares: Prof. A. C. **Dixon.** —(1) The reduction of a quaternary cubic from the sum of six cubes to the sum of five; (2) addition to a paper on the eliminant of three quantics in two independent variables: A. L. **Dixon.**—Note on a continued fraction equivalent to the remainder after n terms of Taylor's series: Prof. L. J. **Rogers.**—Solid angles and potentials of plane discs: **Balak Ram.**—A method of solving the problem of Mersenne's numbers: Dr. T. **Stuart.**

EDINBURGH.

Royal Society, November 16.—Dr. Burgess, vice-president, in the chair.—An investigation of the seiches of Loch Earn by the Scottish Lake Survey, parts iii.–v.: Prof. **Chrystal.** The part of this memoir communicated bore specially upon the endeavour, by critical examination of seiche records, chiefly on Loch Earn, to come to some definite conclusion as to the origin of the seiche.

Seven different causes might be assigned, namely, progression of the isobars, wind denivellation, rapid flooding, partial rainfall, squalls, impact of wind gusts, and periodic minor fluctuations of the atmospheric pressure. Lantern-slides were shown giving simultaneous microbarograms, anemograms, and limnograms taken on Loch Earn, and from these it appeared that the most frequent causes of seiches were squalls and periodic minor fluctuations of atmospheric pressure. The well-known embroideries which appear on limnograms during windy or unsettled weather were found to be due, in many cases, to solitary waves or groups of waves which are raised by small squalls. In some cases these wave-groups travel faster than the squall which produces them, so that the lake vibration at certain places precedes the wind disturbance which has caused it but is following after it. A particularly good instance was observed of an atmospheric-pressure fluctuation which was steadily periodic for several complete periods, and which was immediately responded to by a seiche of marked periodicity. An account of the mathematical theory was reserved for the next meeting.—Notes on hydrodynamics, chiefly on vortex motion: Prof. Andrew **Gray**. These depended upon a novel transformation of the usual hydrodynamical equations, leading to specially neat forms of solution of certain types of problem.

December 7.—Dr. Horne, F.R.S., vice-president, in the chair.—A monograph on the general morphology of the myxinoid fishes, based on a study of Myxine, part iii.: Prof. F. J. **Cole**. The chief interest of this continuation of previous papers on the same subject lay in the illustrations, which had been carefully and elaborately drawn.—An investigation of the seiches of Loch Earn by the Scottish Lake Survey, parts iii.–v.: Prof. **Chrystal**. The memoir concluded with a mathematical appendix on the effect of pressure disturbances upon the seiches in a uniform parabolic lake. Rayleigh's method of normal coordinates was made use of with great advantage. The first problem solved was the effect of a uniform excess of pressure over a part of a lake, the excess being assumed to last for a definite time, usually the half-period of one of the seiches, the uninodal, binodal, or trinodal, as the case might be. The amplitudes of the seiches generated were calculated, and found to be of the same order of quantity as the pressure disturbance when estimated in terms of the water barometer. The disturbance caused by a suddenly generated distribution of pressure, expressible in a series of zonal harmonics, was then found, and this led, by use of the principle of superposition, to the calculation of the effect of a pressure disturbance varying both in space and time. The special case of a sudden rise of pressure, propagated with uniform velocity from one end of the lake to the other, was worked out in detail for a lake of parabolic bottom contour six miles long and 270 feet in depth. It was proved that the uninodal seiche was most affected when the disturbance was propagated with a speed of thirty-seven miles per hour.

MANCHESTER.

Literary and Philosophical Society, December 1.—Prof. H. B. Dixon, F.R.S., president, in the chair.—The dawn of human intention: an experimental and comparative study of eoliths: Prof. A. **Schwartz** and Sir Hugh R. **Beevor**. The term "eolith" was first used to designate certain flint chippings found by Mr. Benjamin Harrison in the chalk plateau in Kent, which bore traces that led him to suggest that they were really primitive tools of early man. This view, though receiving the support of De Barri Crawshay and Prestwich, was not generally accepted, and evoked much controversy. The authors now sought to show that the existence of eoliths as the work of man was a fact which was capable of demonstration. They found from anatomical and mechanical considerations that the fundamental processes in which primitive man would need the aid of tools were:—(1) striking; (2) cutting; (3) scraping; (4) piercing; and (5) the production of fire. Then, selecting suitable fragments of flint, they performed with them the simple operations involved in these processes, carefully noting the effects of such use, and of the secondary work of resharpening, on the flints themselves. In this way they were able to establish certain definite characters for each hypothetical class of tools. A comparison of eoliths, collected in considerable numbers from different sources, with the artificially produced tools showed a very close agreement in respect of their characters.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 17.

LINNEAN SOCIETY, at 8.—The Anomura of the Red Sea: W. Riddell.—Forms of Flowers in *Valeriana dioica*: R. P. Gregory.—Études sur les Cirrhipèdes du Cambridge Museum: Prof. A. Gruvel.—Rhynchota from the *Sealark* Expedition: W. L. Distant.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Electric Discharge and the Production of Nitric Acid: W. Cramp and B. Hoyle.

INSTITUTION OF MINING AND METALLURGY, at 8.—A Visit to the Mineral Districts of Canada: W. Frecheville and H. F. Marriott.—Notes on Plant in the Mining Districts of Canada: R. E. Commans.

FRIDAY, DECEMBER 18.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Type-casting and Composing Machinery: L. A. Legros.

INSTITUTION OF CIVIL ENGINEERS, at 8.—High-power Water-turbines on Moderate Falls: R. Wolfenden.

MONDAY, DECEMBER 21.

FARADAY SOCIETY, at 8.—The Influence of Cheap Electricity on Electrolytic and Electrothermal Industries: E. A. Ashcroft.

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INSTITUTION OF CIVIL ENGINEERS, at 8.—Investigation of the Heat-losses in an Electric Power-station: F. H. Corson.

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