THURSDAY, AUGUST 30, 1906.

## THE LATE DUKE OF ARGYLL.

*George Douglas, Eighth Duke of Argyll, K.G., K.T.* (1823–1900). Autobiography and Memoirs. Edited by the Dowager Duchess of Argyll. Vol. i., pp. xi+602; Vol. ii., pp. vii+635. (London: John Murray, 1906.) Price 36*s.* net.

THE last Duke of Argyll was unquestionably one of the most conspicuous and interesting men of his time. Inheritor of an ancient peerage, chief of a great Highland clan, head of an illustrious house that had played a prominent part in the history of his country, possessor of wide estates and surrounded by a numerous and thriving tenantry, he had every advantage which worldly position and hereditary distinction could confer. That he owed much to these gifts of fortune he himself was well aware, and fitly acknowledged. Yet even without them his strong character and vigorous intellect would have assuredly made him a prominent figure in any walk of life that he might have chosen. It will be for ever recorded to his honour that he turned his social advantages to the highest uses. The most accomplished orator of his day in the House of Lords, he held successively various posts as Cabinet Minister, took an active share in the political life of the country, both inside and outside of Parliament, and gained the respect and esteem of all parties in the State. Possessing literary tastes, he became the personal friend of many of the best writers of his time, and having, as he says of himself, "an inborn tendency to write," he showed by the vigour and elegance of his style that he had solid claims to literary eminence. From early youth he was an attentive observer of nature, so that he was led to follow with the keenest interest the developments of modern science, and having ample self-confidence he did not hesitate to take part in the scientific discussions of his day. Whether on public platforms, in periodical literature, or in separate volumes, his tongue and his pen were always busy, either in trenchantly denouncing assertions which he believed to be erroneous or in standing up stoutly for opinions and interests which he felt sure were just and true. But he was ever the high-bred gentleman, who, though a keen controversialist, did not lose sight of the dignity of his order.

The biography of such a man could not fail to be full of interest. It has been edited by his widow, the Dowager Duchess of Argyll, and is comprised in two volumes, whereof the first and about a sixth part of the second consist of an autobiographical fragment. Only begun so late as 1897, this autobiography occupied the writer's leisure hours during the last three years of his life. At his death in 1900, he had brought his narrative no farther than the close of 1857, when he was thirty-four years of age, so that the story of the longest and most active part of his career remained untold. The great blank thus remaining has been to some extent supplied by means of extracts from his speeches, letters, and published writings, but these naturally lack much of the personal revelation which gives a charm to the Duke's own tale. The extracts, as well as a large part of the later chapters of the autobiography, deal in great measure with politics, any reference to which would be out of place here. We shall therefore confine this notice of the book to the scientific side of the Duke's career.

No parts of the autobiography are more delightful than those wherein the writer reveals the intensity of his love of nature. Even to those readers who have had most acquaintance with his published writings, but who never came into personal contact with him, this revelation may perhaps be a surprise. His childhood and youth were spent amid country surroundings on the shores of the Firth of Clyde, and being much alone he was brought face to face with birds and trees and flowers, and the ever-changing aspects of sea and sky and mountain. All through life he was delighted to escape from the din and turmoil of politics to find rest and refreshment among his own Highland hills and glens, the ever varying mood of which under sunshine or cloud, from hour to hour, and from season to season, he watched with the most ardent devotion. Nor did he confine himself to the manifold attractions of his environment at Inveraray. For many years he spent a part of each summer yachting among the Western Isles, with most of the rocks and bays of which he became familiar, and over the endless beauties of form and colour of which he lingered with enthusiastic admiration. He had a keen artistic sense, which found expression in many a coloured sketch of the scenes that fascinated him, and has manifested itself in many passages of vivid description in his autobiography. His poetic temperament likewise received constant stimulus from the same marvellous panorama of sea and sky, mountain, islet, and cliff. He had steeped his mind first in the poetry of Wordsworth and then in that of Tennyson, and from time to time the exuberance of his feelings found relief in verse.

From his earliest years the Duke was passionately fond of birds, watching them in their haunts, noting their habits, and in this way acquiring an intimate knowledge of the bird-life of his native country. As an instance of the hold which this pursuit had upon him, he tells how, when he first looked out for a house of his own in London, he went to see one on Campden Hill, with some four acres of land about it. There were various objections to the place, but when he saw a flock of starlings on the lawn, nuthatches climbing the trees, fly-catchers and warblers darting around, "all doubts and difficulties vanished; the birds settled everything"; and he returned to town to instruct his agent to make the purchase. In this way he chose the charming residence which became his London home up to the end of his life. Besides observing the forms and ways of birds, he specially studied their various kinds of flight as a scientific



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problem to which he often directed attention in his writings.

Within the domain of science his chief interest, however, lay in geology. Many of the questions with which geology deals relate to familiar aspects of the outer world, and do not require much technical knowledge for their comprehension, though in spite of their apparent simplicity they may demand much knowledge of that nature for their adequate solution. Amid the surroundings of the Duke's boyhood and youth there were many features to attract the notice of anyone with a geological bent. He does not appear, however, to have seriously considered the subject until he was seven-and-twenty years of age. In 1850, when on one of his usual visits to his estates in Mull, he received from a villager at Bunessan some specimens of fossil leaves which had been broken off from the face of a neighbouring sea-cliff. He ascertained that these leaves, evidently of a terrestrial vegetation, came from a stratum intercalated between the sheets of basaltic lava which cover so much of that region. His curiosity being thus thoroughly roused, he sent specimens to the Jermyn Street Museum for examination. Eventually he was encouraged by De la Beche to give an account of the discovery in a paper to the Geological Society, while at the same time Edward Forbes described the leaves, which proved to be of Tertiary age. These papers, published in the summer of 1851, showed for the first time the comparatively late date of the basalt plateau in the west of Mull, and thus fixed an important epoch in the volcanic chronology of this country. So auspicious a beginning might have been expected to become the starting-point of a successful geological career. But the Duke never followed it up. So far as the numerous calls on his time and thought allowed, he tried to keep himself in touch with the progress of research in some of the wider branches of geology, and from time to time, as the result of such intervals of leisure, he wrote articles or gave lectures on the subject. But these efforts of his could hardly be regarded as fresh and solid contributions to the advance of the science.

The Duke of Argyll's interest in facts seemed always to be limited by the extent to which he perceived, or thought he could perceive, their meaning, connection, and causes. Fundamentally, he lacked the patience and restraint that characterise the true man of science. His lively imagination was apt to see in the facts what he expected or wished to see, and he was tempted to group and explain them in accordance with some conception he had formed regarding them, and to leave out of sight as irrelevant those other facts which did not fit in with his interpretation. Thus, in regard to geological theory, he had early in life adopted the belief of the old Catastrophist school that the inequalities on the surface of the land have been mainly determined by gigantic earth-movements, and, shutting his eyes to all the arguments of those who pointed to the proofs of the enormous share taken by denudation in the shaping of that surface, he continued to maintain the same belief up to the last. Again, having in his younger days adopted what was long the prevalent opinion that some of the latest touches to the landscapes of this country were given by icebergs and floes during a time of submergence, he stoutly adhered to this doctrine, and lost no opportunity of ridiculing the conclusions of those who maintained that the phenomena in question could only be explained by the observed action of land-ice. But ridicule was not argument. Neither on this subject nor on that of the origin of scenery does the Duke appear ever to have studied the detailed evidence on the ground and grappled with it in a careful and candid examination of the facts. To use one of his own phrases, which he applies to some ecclesiastical tendencies of Gladstone, there was "a fundamental indelibility in his opinions" on scientific problems regarding which he had once made up his mind.

The Duke began his public career by a series of pamphlets and other writings on the ecclesiastical matters which at that time were agitating Scotland. In these publications he showed that he possessed no small share of the logical and metaphysical habit of mind so common among his fellow-countrymen. In his writings on scientific subjects, wherein he was often rather the keen critic than the sympathetic advocate, he found scope for the manifestation of the same mental characteristic. His three volumes, "The Reign of Law," "The Unity of Nature," and "The Philosophy of Belief," may be particularly cited as illustrations of his treatment of scientific questions. A period of thirty years intervened between the appearance of the first and that of the last of these books, which, in their author's words, represented his opinions on "the greatest of all subjects—the philosophy of religion in its relations with the philosophy of science." Even where scientific men differed most widely from him in his dealing with the problems which he discussed, they could not but recognise the intense earnestness and obvious loftiness of his purpose, the vigour with which he plied his arguments, and the fearless and sometimes acute criticism to which he subjected some of the generally accepted opinions of the evolutional school of the day.

Nevertheless, it must be admitted that the general impression made on the minds of the Duke's opponents by his declamation in these controversies was that he hardly ever had a doubt about any statement which he propounded. Scientific readers of his articles and books would express their amusement at what they styled his cocksureness, even in questions of difficult research regarding which he had no direct and first-hand knowledge. Such readers when they turn to his Autobiography may well rub their eyes when they meet there with the following statement:—

"I have never had any tendency to a dogmatic temperament. On the contrary, I have always had an ingrained liability to doubt."

He affirms that it was only where he had reached

"the most assured convictions" that he deemed it "not only justifiable but a positive duty to express such convictions with all the certainty that is felt." The "certainty," however, extended to so many subjects that he might well remark that "some, perhaps many, of my contemporaries in my later years have thought me very confident in my opinions, and very aggressive in my expression of them." He complained of Huxley's aggressive style of writing, but when he penned his strongly-worded articles and letters he seems to have been unconscious that the same complaint might not seldom be brought against himself.

There is no intimation in these volumes to what, if any, extent the author of the Autobiography had journals or letters to rely upon in writing it. The preface states that "memory was invoked to bring back from the storehouse of the past all that had specially impressed him." That he had a tenacious memory can well be believed, but it has undoubtedly played him false in a number of instances, some of which are to be regretted. Thus he misdates certain transactions by a whole year. He refers to Lady Lyell, whom he intimately knew and admired, as "a sister of Leonard Horner, a man of whom much had been expected by his college friends, from his eminent abilities." Lady Lyell, however, was the daughter, not the sister, of Leonard Horner, and the Duke confounds two brothers. It was Francis Horner who passed away comparatively young; Leonard, who wrote an excellent memoir of his brother, lived until 1864, when he died in the seventy-ninth year of his age.

A more extraordinary mistake occurs on p. 289 of the Autobiography in the following sentence:—

"It does seem a marvellous fact that no knowledge of the wonders of Staffa had ever reached the world till it had been visited and described by a scientific Englishman, Sir Stamford Raffles."

Now Staffa, though not belonging to the Duke of Argyll, lies near to his favourite island of Iona, and opposite to his estates in Mull. He had been intimately familiar with it during many cruises among the isles, and must be supposed to have been acquainted with that classic of Scottish geographical description, Pennant's second "Tour in Scotland," in which so much of the scenery, natural history, and antiquities of the kingdom was for the first time described and figured. That volume was published in 1774, and one of its distinguishing features was the appearance in it of the earliest account of the wonders of Staffa, communicated to the author by no less a personage than Joseph Banks, afterwards the distinguished president of the Royal Society, who likewise contributed a number of excellent drawings of the cliffs and caves of the island, which were reproduced by Pennant, and form some of the best plates in his book. Sir Stamford Raffles, who spent his life in the East, was not born until 1781, seven years after the account of Staffa had been given to the world. He and Banks were both "scientific Englishmen" and great travellers, though how the Duke came to confound the one with the other is difficult to understand.

Another error, more serious than a mere lapse of memory, is to be found on p. 350, where it is gravely asserted that

"Smith of Jordanhill was the real founder of the Glacial Theory, which has played so great a part in recent geology. It is commonly assigned to Agassiz, but he did not visit this country till 1840."

No one would for a moment wish to disparage the importance of the discovery made by James Smith in 1839, when he found among the extinct shells of the Clyde basin a number of northern forms, and concluded from them that "it seems probable that the climate of Europe was colder during the newest Tertiary than during the Recent period." But he did not venture to propound a "theory" of any kind, nor did he refer to ice in any form. Agassiz, however, though he did not visit this country until 1840, had already spent some years in the study of glacial phenomena among the Alps, and as far back as 1837 had announced his opinions as to the former greater extension of the ice of central Europe and of the northern hemisphere. When he came to Britain he was able to demonstrate the existence here of the same types of glaciation as are found in Switzerland, and he thus produced further overwhelming evidence in favour of the views which he had already published. The Duke has here suffered his antagonism to these views to blind him to the historical facts of the case, and the same spirit of opposition has led him to conclude his reference to the subject with a characteristically sarcastic allusion to the "fads and faddists" that have followed in the track of the great Swiss naturalist.

It is in many ways a misfortune that the Duke of Argyll did not live to carry his Autobiography down through the central and later parts of his life, and to review in the calm of his old age the controversies, scientific and other, in which he had been engaged. The din of conflict had long ceased, and many of those with whom he had crossed swords had passed away. It would have been interesting and instructive to learn from his own pen how the questions in debate looked to him after the long lapse of years; to discover whether time had modified the confident assurance with which he used to do battle, or had left him in the same convinced and defiant frame of mind in which he fought. Up to their close, his chapters reveal not the slightest symptom of the mental enfeeblement of old age. Indeed, he never wrote more vigorously or with more apparently voluble ease than in this Autobiography. It contains many passages which might be collected as examples of an admirable style of composition, and among his varied contributions to literature it will not be surprising if this latest effort of his pen shall outlast in general acceptance any of his previous writings.

The chapters which follow the Autobiography give a most inadequate picture of what the Duke was in his prime and of what he did. The chapter on his

science is particularly disappointing. It consists almost wholly of disconnected excerpts from letters to or from correspondents, interesting enough in themselves, but embodying no connected review of his relations to science, and leaving the reader very much in the dark as to what these relations really were. The truth is that, what with politics on the one side and the management of his estates on the other, the Duke had but little time for other occupations. Science was to him not so much a serious study as a refreshing relaxation. Even had he undergone the training and possessed the special mental gifts which go to make the successful man of science, he could hardly have found room for their exercise in his busy life. His mind, however, was so active, that such intervals of leisure as he could secure sufficed to enable him to keep himself informed of what was being done in various important lines of investigation. And it was this course of interrupted reading and the thoughtful reflection that accompanied and followed it, rather than any original inquiry of his own, that blossomed out into the lectures, addresses, articles, and books which came in such a crowded procession from his pen. His death left a blank in society which has been filled by no one of his contemporaries. Few men of his class were endowed with so remarkable a mental versatility and took such an eager interest in all kinds of intellectual pursuits. He will be remembered as an illustrious example of a type too rare among us, wherein the *grand seigneur*, the statesman, the man of letters, and the lover of nature and of science are blended in one noble character.

## CHEMISTRY AND THE DETECTION OF CRIME.

*Lehrbuch der gerichtlichen Chemie.* Zweite gänzlich umgearbeitete Auflage, bearbeitet von Dr. Georg Baumert, Dr. M. Dennstedt, und Dr. F. Voigtländer. Vol. ii. Pp. x+248. (Brunswick: F. Vieweg and Son, 1906.) Price 9 marks.

IN addition to cases of alleged poisoning, there exist a number of crimes in the detection of which chemical and physical science can render special aid to the dispensation of justice. Thus, in proving the falsification of documents, in demonstrating a forgery, in the identification of blood-stains or other body-secretions, and in the discovery of evidence confirming a charge of incendiarism, the results of a capable scientific examination will often furnish a direct proof, where otherwise the verdict would depend upon a mere balancing of probabilities.

The second part of Dr. Baumert's "Lehrbuch" deals exhaustively with the foregoing problems. Particular attention is devoted to the photography involved, and in the investigations described much use is made of this adjunct. In fact, the expert in criminological chemistry, if he is to render all the assistance possible, must be not merely a chemist, but a combination of photographer, microscopist, and detective as well.

About three-fifths of the volume is devoted to the methods of discovering and demonstrating fraudulent alterations of documents. The treatment is very complete, embracing as it does not only the microscopical examination of the written characters, the chemical testing of the ink and paper, and the indications of erased or altered letters brought out by photographic enlargement, but also the consideration of pencil marks and "secret" inks.

Some fifty pages are assigned to the examination of blood-stains, and include a careful description of the conditions which should be employed in carrying out the "biological" test for the characterisation of human blood. The authors think, in opposition to Uhlenhuth, that, given the requisite knowledge of bacteriology and physiology, the analyst rather than the medical man should be entrusted with this experiment. A good plate shows the absorption spectra of hæmoglobin and its congeners, and, indeed, a word of praise is due to the excellent photographic reproductions with which the book generally is furnished. Next follows a short chapter on the examination of suspected articles for the presence of human spermatozoa, whilst the last thirty pages deal with the evidence of incendiary origin which the chemist may find on closely scrutinising such objects as may have been left undestroyed where a fire has broken out.

Throughout the book careful directions are given for conducting the various operations, and numerous pitfalls which beset the unwary are indicated. As is befitting where serious charges are concerned, clear distinctions are drawn between the results which constitute proof and those which, however strongly confirmatory, are not in themselves decisive. The general impression left by a perusal of the volume is that in the solution of the crime-problems dealt with the guidance afforded is admirably practical and safe. C. S.

## NERVOUS DISEASE.

*The Management of a Nerve Patient.* By Dr. A. T. Schofield. Pp. ix+267. (London: J. and A. Churchill, 1906.) Price 5*s.* net.

WE cannot congratulate Dr. Schofield on the title he has selected, for a book written, as the author tells us, for the use of students and practitioners requires no such popular designation as "The Treatment of a Nerve Patient." Further, the writer does himself an injustice, for many medical men would not trouble to read a book the title of which suggests some words of advice for a nurse or layman.

Now we consider this little manual well worthy of a careful perusal, for although we do not agree by any means with all that the writer tells us, nevertheless it is a book full of valuable suggestions and advice. We agree with the statement that "many physicians do not sufficiently recognise the influence of mind over body," but Dr. Schofield, in his desire

to emphasise his point, is apt at times to state his case too strongly.

We cannot by taking thought dispel disease; the influence of the patient's mind over his body is powerful, but is it "almost all-powerful"? The consumptive patient is usually full of hopefulness to the last, but unless other means are taken to promote recovery his light-heartedness is of little avail. The writer later greatly modifies his original statement regarding the influence of mind over body by stating (p. 29) that "there are many diseases not cured by the mind alone"; in fact, he might add that quite few maladies can be so treated. Nevertheless, we agree with the statement that "in every case of disease the condition of the mind is an important factor."

We cannot concur with the writer's distinction between "madness" and "hysteria" (p. 21). Hysteria is a disease with definite physical symptoms, and, in addition, the patient exhibits some mental aberration. Now if this mental disturbance becomes more marked, the patient is usually considered to have passed from the realm of physical disease into a state commonly spoken of as "madness," and yet the disease is the same in both cases, only in one instance the physical symptoms are the more prominent and in the other the psychical. Dr. Schofield writes that "a person whose conscious mind is unsound is suffering from madness: one whose unconscious mind alone has gone astray suffers from neuromimesis or hysteria; and the distinction is good." Now a few pages previously the writer tells us that "there is but one mind." Clearly, then, the mind is either sound or unsound, for the whole cannot be what a part of it is not. Further, we are told that "the recovery of the patient from disease depends more upon the efficiency of the *vis medicatrix naturae*, in other words, unconscious mind, than upon any other agent." Therefore it would appear that in hysteria the apparatus which is all-powerful in cure is itself diseased; thus if this statement is true it is a factor which must greatly influence the prospect of recovery.

Dr. Schofield speaks in no uncertain manner concerning the tendency of some persons of the present day to mix up a "very exaggerated psycho-therapy with a pseudo-Christianity." We entirely agree with his remarks, and consider that he has stated the case none too strongly. In the chapter entitled "The Diagnosis," we would specially commend to the student the advice the writer gives of the "importance of cultivating tact." There is probably no attribute of greater value to a physician, and no opportunity should be lost for developing it. The writer makes some very sound remarks concerning the personality of the "doctor." Some persons may consider that too much detail is given, and that some advice is almost too trivial to be recorded; but with this view we should disagree, for undoubtedly the strength of this book lies in the attention which is bestowed on detail.

This book supplies a want, and certainly deserves a place on the bookshelf of the young physician.

## OUR BOOK SHELF.

*Traité d'Exploitation commerciale des Bois.* By A. Mathey. Tome i. Pp. xviii+488. (Paris: Lucien Lavens, 1906.) Price 15 francs.

THIS volume will rank high among the many excellent Continental books which deal with forest utilisation. The author gives a great amount of important and practical information concerning the commercial exploitation of timber from every possible point of view. The work is profusely illustrated by well drawn and excellently reproduced figures, numbering no fewer than 377, and to these must be added eight beautiful chromo-lithographic plates. The volume is divided into five parts.

Part i. deals with the general properties of wood. The anatomical features are also described. The macroscopic characteristics of the various home and exotic deciduous and coniferous species are gone into, and the diagnostic features are brought out very clearly by an excellent series of figures, which show specimen blocks of the various woods cut in transverse and longitudinal sections. The numerous chemical and physical properties of timber are treated in detail. This part finishes with an excellent account of the effect of soil and climate on the growth and texture of the wood.

Part ii. deals principally with defects in timber, such as abnormality of growth, knots and wounds of all kinds, which may be caused by physical agencies. The different kinds of rot arising from the attack of fungi are exhaustively dealt with. This part is extremely well illustrated by means of the coloured plates already referred to, which should greatly facilitate the recognition of these maladies that are only too frequently ignored in this country. The various forms of white and red rot being due to specific organisms greatly increases the danger of sound timber being contaminated by diseased timber; hence the importance of recognising those diseases in order, if possible, to prevent their future occurrence and spread.

Part iii. of the work deals fully with the important subject of seasoning and storing timber, and the different artificial methods of rendering wood antiseptic by means of immersion in, and injection with, the various kinds of preservatives. The artificial methods of seasoning and preserving timber are now receiving considerable attention as the price of wood increases and the supply diminishes, so that this part of the book should be of the greatest interest to all concerned in the production and use of wood.

In part iv. the felling and conversion of timber is adequately considered. The different instruments used are also fully described and figured. In the last part is given an exhaustive account of almost every possible means of timber carriage and transport. On the whole, the author is to be congratulated on the production of this excellent work.

*Illustrations of British Blood-sucking Flies.* With Notes by Ernest Edward Austen, Assistant, Department of Zoology, British Museum (N.H.). Pp. 74; 34 plates. (Printed by Order of the Trustees, 1906.) Price 25*s*.

GNATS and other blood-sucking flies have always been a great pest in most countries, but it is only within the last few years that their active agency in the dissemination of many of the most serious diseases which afflict both men and the higher animals has been fully recognised. In England, however, modern drainage and sanitary regulations have so far diminished their numbers that whenever gnats are exceptionally troublesome many people jump to the conclusion that there has been an invasion of "mos-

quitoes" (not knowing that the terms gnats and mosquitoes are applied indiscriminately to any biting species of Culicidæ), and, what is more important, the gnats belonging to the genus Anophéles, though far from extinct in England, have ceased to disseminate ague as formerly.

Mr. Austen informs us that there are practically only six families of blood-sucking flies in England, Chironomidæ (midges), Culicidæ (gnats or mosquitoes), Simulidæ, Tabanidæ (horse-flies), Muscidæ, and Hippoboscidæ. In Chironomidæ and Muscidæ the habit is exceptional, occurring in a few species only, and, except in the Muscidæ (and perhaps the Hippoboscidæ), the habit is confined to the females. Mosquitoes, however, are also capable of subsisting on the juices of plants.

The illustrations in the present work are considerably enlarged, and with few exceptions represent only females. The originals have been prepared for exhibition in the north hall of the Natural History Museum. The letterpress consists of a brief general account of each family, and a notice of the chief characteristics, habits, and localities of the various species figured, technical descriptions, however, being omitted. Little has been done in England to popularise the study of Diptera, and there are very few illustrations of the species; so we welcome this excellently arranged and illustrated book as a useful contribution to our knowledge of the British Diptera.

W. F. K.

*Gehirn und Rückenmark. Leitfaden für das Studium der Morphologie und des Faserverlaufs.* By Dr. Emil Villiger. Pp. vii+187; illustrated. (Leipzig: W. Engelmann, 1905.) Price 9 marks.

THERE is no department of medical science in which greater advances have been made within the last twenty-five years than in that of diseases of the central nervous system. This is mainly a result of increasing precision in our knowledge of the complicated labyrinth of the various groups of nerve-cells and nerve-fibres which compose the essential mechanism of the nervous system. The complexity of the subject renders it a task of some difficulty to the medical student, whether he be undergraduate or post-graduate, who is desirous of acquiring that thorough grasp of nervous anatomy on which the successful solution of diagnostic problems must of necessity depend. To such students as are able to read German we can cordially recommend Dr. Villiger's book. Within the compass of 177 pages the author discusses in lucid style the main facts of the morphology of the brain and spinal cord, and describes all the more important tracts of nerve-fibres. An excellent series of illustrations, many of them original, illuminate the text, whilst we are glad to observe that the author evidently describes the gross anatomy as if demonstrating the actual brain, using the diagrams as accessories. In this way the practical value of the book is undoubtedly enhanced.

Commencing with an account of the embryological development of the nervous system, the author proceeds to discuss in detail the naked-eye anatomy of the brain and spinal cord, with their surrounding membranes. An interesting historical account is given of the successive stages in the methods of neuro-histology, but we are surprised to find no reference to Marchi's well-known osmic acid method of staining recently-degenerated nerve-fibres, a method which since its introduction more than ten years ago has done more than any other to clear up our knowledge of nerve-tracts. Nor is any reference made to the still more recent methods of Cajal and of Bielschowsky for the staining of neurofibrils. Doubtless these omissions will be rectified in a future edition.

An excellent description is given of the microscopic characters of the various regions of the cerebral cortex, the basal ganglia, the cerebellum, pons, medulla, and spinal cord. The cranial nerves are discussed with remarkable clearness, the diagrams illustrating this part of the book being particularly good. Finally, there is a concise account of the main sensory, motor, and association systems of fibres in the central nervous organ. The book is well indexed.

Dr. Villiger is to be congratulated on having produced an excellent book. Not only does it amply fulfil its avowed scope of serving as an introductory guide to the student, but it will be read with pleasure and profit by many neurologists.

*Naturkonstanten in alphabetischer Anordnung.* By Prof. Dr. H. Erdmann and Dr. P. Köthner. Pp. 192. (Berlin: Julius Springer, 1905.) Price 6 marks.

THIS handy little work is a book of constants intended for the use of chemists and physicists. It differs from others of its kind chiefly in the fact that the information in it is arranged alphabetically, with a marginal thumb index for rapid reference.

The work of the compilers has on the whole been very well done. Only one value of each constant is given, and usually no reference is made to the source or author. The work of the last ten years has, however, been incorporated to a much greater extent than is usual in books of this kind, and even data only published during the past twelve months are included. The plan adopted by the compilers should conduce to a considerable saving of time in looking up information. We think the book should be of especial value to chemists, as the data necessary in quantitative analysis are dealt with in a specially complete manner. There are also tables giving for each element and its most important compounds the atomic or molecular weight, density, melting point, boiling point, thermochemical constants, &c., together with a five-figure logarithm table for computation purposes. Details as to the most important spectroscopic features of each substance are given in a very handy form, the conditions as to the particular spectrum being clearly specified. Another very useful table containing data not often easily accessible is that of the electrochemical equivalents of the metals.

It is difficult in the time possible for a reviewer to spend on a book of this kind to detect many of the errors nearly inevitable in a first edition. The plan adopted by the writer has been to put the work for a while on his reference shelf, and turn to it frequently when looking up constants, verifying from other sources the data thus obtained.

Obvious slips are the value of $\frac{1}{4}\pi$, given on p. 114 ten times too small, the E.M.F. of the Clark cell, given on p. 40 as 0·60735 volt, and several misprints among the tables of English weights and measures, where the gallon is included under measures of surface.

Other inaccuracies are the value for the melting point of palladium, given as 1950° C. instead of 1525° C. ± 25, of nickel, given as 1500° C. instead of 1427° C., and of wrought iron, given as 1600° C. instead of 1500° C.

One rather unfortunate tendency of the work is to deal in a multiplicity of units. There is, for example, no need to speak of "hektowatts," and it is certain that some of the subdivisions of the millimetre dealt with in the chapter on units are only confusing and rarely met with in practical work. Then, also, the units other than metric given in the book as at pre-

sent in use in various countries are not always those ordinarily adopted. In Japan, for example, the present standard of mass is the "Kwan," prototypes of which were recently standardised at Sèvres.

We can, however, cordially recommend the book, which should prove very useful. J. A. H.

## LETTERS TO THE EDITOR.

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### Thermodynamic Reasoning.

IN the address delivered by Principal Griffiths at York, which is printed in your issue of August 9, I read: "Prof. Armstrong remarks that it is unfair to 'cloak the inquiry by restricting it to thermodynamic reasoning, a favourite manœuvre with the mathematically minded.' He adds that such a course may satisfy the physicist but 'is repulsive to the chemist.' The inquiry, 'Why is the application of thermodynamic reasoning repulsive to the chemist?' naturally suggests itself."

This statement shows a strange misapprehension of my position. I have taken exception *to the restriction of the inquiry* to thermodynamic reasoning, not in any way to the mere application of thermodynamic reasoning. My objection was to formula worship. I still and shall ever object to it, for it is the bane of progress. As I said at York, physicists too nearly resemble the visitors to London who walk along the Strand and Shaftesbury Avenue and are content to look at the theatres from outside; they resemble those who admire the British Museum building but have no desire to examine the treasures within it.

If I did not misunderstand him, Mr. Whetham implied at York that it was enough for him that a certain thermodynamic expression was valid: what the condition termed osmotic pressure really is—whether a true pressure or whether, as I suggested, a negative pressure or thirst—mattered not a jot. A certain mathematical thermodynamic picture being painted, no other artist need apply. This does not seem to me to be the attitude a scientific inquirer should adopt. Whether I represent the opinion of chemists matters little: personally I am not willing to remain outside the Museum: I shall go inside, if possible, trusting that in some faint degree I may be able to appreciate the wonders within it.

At present, progress is not a little hampered by the fact that chemists and physicists cannot wander through the museums of nature looking eye to eye in complete sympathy with one another: surely we are destined to be the closest of friends; more should be done to cultivate an understanding; a confusion of tongues has arisen which keeps us apart: we must both strive to speak a simpler language. Together

> "Let us inspect the lyre and weigh the stress
> Of every chord and see what may be gain'd
> By ear industrious and attention meet."

HENRY E. ARMSTRONG.

IT is the strength and weakness of thermodynamical reasoning that it connects different phenomena without the aid of theories about the mechanism by which the connection is effected.

In the discussion at York, Prof. Armstrong put forward certain arguments in favour of the view that solution is a chemical phenomenon, and osmotic pressure due to an attraction of the nature of chemical affinity. He used these arguments in an attempt to invalidate van 't Hoff's thermodynamic theory, which shows that, from the observed solubility phenomena of volatile substances, it follows that the ideal osmotic pressure of a number of particles of such substances in a dilute solution must be equivalent to the pressure which the same number of particles would exert as a gas occupying the same space.

In my reply to Prof. Armstrong I pointed out that the thermodynamic theory is quite independent of the particular view we may adopt as to the fundamental nature of solution, and the *modus operandi* of osmotic pressure. Osmotic pressure may, as van 't Hoff himself supposed, be due to the impacts of the dissolved molecules; it may, as Prof. Armstrong believes, be caused by chemical affinity; it may be produced by some other undiscovered cause. The thermodynamic reasoning avoids all such hypotheses, and connects directly the experimental facts of the solubility of gases with the osmotic pressure they would exert against a perfect semipermeable membrane in dilute solution.

I have never suggested that the ultimate nature of solution was a matter of no interest. It is the question of most supreme importance now outstanding in these subjects; but let us clear the issue before attacking it. We must recognise clearly that the relations indicated by thermodynamics and confirmed abundantly by experiment are among the established facts to be explained by a theory of the nature of solution.

It is for this recognition of the true position of the problem that I contend. The thermodynamic reasoning which connects the ideal osmotic pressure with experimental phenomena is not in question. That reasoning is confirmed by measurements of actual osmotic pressures and of freezing points. It can only be invalidated by a general attack on thermodynamic theory, such as that which was foreshadowed in Mr. Campbell's recent reconnaisance-in-force. I do not think any such attack has much chance of success. Osmotic phenomena seem to me to be entrenched in the strongest part of the vast lines occupied by the science of thermodynamics.

Cannot Prof. Armstrong agree to accept the thermodynamic reasoning as confirmed by experiment, and pass on to the further problem? Personally, I think that the evidence at present available is on the whole in favour of the chemical theory of solution and osmotic pressure—the theory which Prof. Armstrong supports; but there is work to be done before such a conclusion can be taken as established. May we not agree that it is better both for physicists and chemists to do such work than to waste their energies in attacking with inadequate artillery the well-fortified citadel of thermodynamics?

W. C. D. WHETHAM.

High Borrans, Westmorland, August 21.

### The Iron Arc.

WHILE carrying on some experiments with the electric arc between iron electrodes, one of my students, Mr. H. D. Arnold, noticed that there was a certain critical P.D. at which an abrupt change took place in the conditions of the arc. Subsequent investigation has shown that the effect is closely analogous to the "hissing point" of the carbon arc. How close the analogy is may be seen from the following remarks. If the iron arc is started with a large external resistance and maintained at such a length that the current is well below one ampere, it burns with little or no sound, and its appearance in the neighbourhood of the anode is very diffuse and ill-defined. As the external resistance is gradually decreased, the P.D. falls and the current rises until a certain critical value, depending on the length of arc and size of electrodes, is reached. At this point a very small decrease in external resistance suffices to cause a sudden increase in current and drop in P.D., precisely as with the carbon arc. At the same time the arc contracts, a bright spot appears on the anode, and a characteristic hissing sound begins. Further increase of current is accompanied by a *continued decrease* in P.D. The hissing stage, in fact, begins at quite a different point on the P.D.-current diagram from that in the case of the carbon arc. If the experiment is carried out in the reverse order, starting with a large current, the discontinuity is encountered again, but not until the current has been diminished beyond the value that it had at the beginning of the hissing stage. Indeed, with arcs of 6 mm. and more, the current on the hissing stage can with care be decreased until it is smaller than its previous largest value on the quiet stage. Thus there are two possible values of P.D. for the same current and length of arc, one corresponding to the quiet, the other to the hissing stage.

How closely the physical cause of this discontinuity resembles that in the case of a carbon arc is still in doubt, though investigations bearing on this question are under way. With the iron arc there seems to be no sharply defined crater, for each electrode terminates in a viscous, incandescent globule of what seems to be magnetic oxide of iron, from which the discharge takes place. Thus we have to do, properly speaking, not with an arc between iron electrodes, but with one between electrodes of $Fe_3O_4$. Even when the arc is hissing strongly, the discharge seems to take place from only a small area on the surface of the globule. Moreover, a large increase in diameter of electrodes is accompanied by only a small increase in the value of the critical current, which varies between 0·8 ampere and 1·5 ampere over a wide range of values of length of arc and thickness of electrodes. On the other hand, I have found no positive evidence that the discontinuity is not due to the presence of oxygen around the anode. A test with an exploring electrode showed that the effect is confined mainly, if not entirely, to the anode. Given an arc burning on the quiet stage in the neighbourhood of the hissing point, the hissing can be precipitated by shortening the arc, just as in the case of the carbon arc.

After the current has been increased somewhat beyond the hissing point, the arc begins to rotate rapidly, so that on the anode a ring instead of a spot of light appears. This is accompanied by a high-pitched squeak or whistle, which, as the current is still further increased, degenerates into a sputter, and this in turn into a steady, strong hiss, the ring meanwhile having disappeared. At the beginning of the "whistling stage" the arc has a curious tendency to jump back into the quiet stage, so that for an instant the hissing ceases, the current falls abruptly, and the P.D. rises several volts. If one begins to diminish the current immediately after one of these abrupt changes, the quiet stage can sometimes be maintained steadily, even though the current is far greater than that at which hissing normally occurs. It is not impossible that slight irregularities in the supply E.M.F. may in certain circumstances serve to precipitate the change from the one stage to the other, even though the current be not that at which the change normally takes place.

In conclusion, the question may be raised whether Lecher's observation of the discontinuous nature of the arc discharge between iron electrodes was not made on the hissing stage alone, and whether, as with the carbon arc, the discharge may not be perfectly continuous when the current is made sufficiently small. It is planned to repeat Lecher's experiment, making tests on both the quiet and the hissing stages of the iron arc.

Middletown, Conn., August 9. W. G. CADY.

### Volcanoes and Radio-activity.

IN the *Popular Science Monthly* for June Major Dutton has an interesting article on the above subject, which was noticed in a recent issue of NATURE. Having been occupied lately with the study of volcanoes in connection with a more general inquiry into the cause of earthquakes, it occurs to me to point out that Major Dutton has overlooked the recognised distribution of volcanoes about the sea coast, which seems completely to invalidate his theory. If radium, which the researches of the Hon. R. J. Strutt have shown to be so abundant in typical rocks of the earth's crust, such as granite, were an exciting cause of volcanic activity, we should expect to find an abundance of active volcanoes in the interior of continents, such as the United States, Europe, Asia, Africa, Australia, and Brazil, which is contrary to observation.

T. J. J. SEE.

Naval Observatory, Mare Island, California, August 10.

### The Radio-activity of the Chemical Elements.

IN connection with the emission, from the radio-active elements, of corpuscles with velocities below the critical velocity necessary for the ionisation of gases, it has occurred to me that such a form of radiation is possibly a fairly general property of the chemical elements. It is, I think, usually accepted that "$\gamma$" radiation always accompanies the projection of "$\beta$" particles, and the extreme penetration of the "$\gamma$" rays seems to be directly due to the very high velocity of the average "$\beta$" particle. As the efficiency of the "X" rays is due to the sudden negative acceleration of the unit electrical charges (*i.e.* the corpuscles) as they strike the anti-kathode, it appears quite possible that corpuscles, moving with comparatively low velocities, may yet be capable of causing a form of "$\gamma$" radiation of feeble penetrating power. The fact that the kathode stream, which can hardly penetrate the glass of the tube, is still able to set up very penetrating X radiation when given a sudden negative acceleration by impact with the platinum anti-kathode may perhaps be given as an instance in support of this idea. It seems probable that the photographic action of a beam of corpuscles (deviated away from the "$\gamma$" radiation by a magnetic field) may be chiefly due to a form of "$\gamma$" ray set up on contact with the plate itself. The several mysterious instances of the fogging of photographic plates left in certain conditions for considerable periods may be caused by a very feeble form of "$\gamma$" radiation set up by the impact of slow-moving corpuscles on the surrounding matter. Such evidence of these slow-moving corpuscles may be somewhat meagre and doubtful, but I think that, so far as the ordinary chemical elements are concerned, the emission of such corpuscles may be very much greater than the measured activities would lead us to suppose.

C. W. RAFFETY.

Streatham Common, August 25.

## *THE OXIDATION OF ATMOSPHERIC NITROGEN IN THE ELECTRIC ARC.*

IN the year 1775 Priestley published his "Experiments and Observations on Various Kinds of Air," in which he showed that when a series of sparks was passed through air, the air became acid. The experiment was carried out by means of a glass tube, having one end closed with wax through which a wire was fixed, the open end being placed over a solution of blue litmus. Sparks were passed between the solution and the wire, and in a short time the blue litmus turned red. He further noticed the important fact that the water gradually rose up towards the wire. The observations of Priestley were shortly afterwards substantiated by Cavendish, and in 1893 Lord Rayleigh, with better apparatus and appliances, repeated the experiments which ultimately led him to the discovery of argon. Priestley attributed the acidity to the formation of carbon dioxide, but Cavendish, on repeating the work, proved it to be due to the formation of nitric and nitrous acids.

After the successful experimental work of Lord Rayleigh, attention was turned towards the production of nitric acid from atmospheric nitrogen. But it was undoubtedly due to Sir William Crookes, who as president of the British Association in 1898 directed attention to the gradual depletion of the world's store of nitrogenous products, that the importance of the fixation of atmospheric nitrogen was recognised by the scientific and commercial world. At the present time about 1·5 million tons of Chili saltpetre are annually exported, but those who have studied the question consider that at this rate of exportation the Chilian beds will be, at the latest, depleted by 1940. But as the population of the world increases, the quantity of nitrogenous material required for fertilising purposes advances in equal ratio. Sir William Crookes pointed out in 1898 that the world's growth of wheat was about 163,000,000 acres, which at the average of 12·7 bushels per acre gave 2,070,000,000 bushels. "But thirty years hence the demand will be 3,260,000,000 bushels. . . . By increasing the present yield per acre to twenty bushels, we should with our present acreage secure a crop of the requisite

amount." In order to give this increase, about 1·5 cwt. of nitrate of soda would be required to be applied annually to each acre, that is to say, 12,000,000 tons would be needed. As at present situated the world is not in a position to supply this vast amount of nitrogenous product. Since Crookes sounded this note of warning many attempts have been made to oxidise atmospheric nitrogen on a commercial scale, but until within the last fifteen months no process based upon electrical oxidation has been an actual commercial success. It yet remains to see whether the process of Drs. Caro and Frank, which depends upon the formation of calcium cyanamide, will be able to compete in the first place with natural nitrates and ammoniacal products, and, secondly, with the electric process of Birkeland and Eyde, which, as we will shortly show, appears to have solved the problem of the fixation of atmospheric nitrogen. Drs. Caro and Frank found that by passing nitrogen over heated barium carbide barium cyanide was produced thus,

$$BaC_2 + N_2 = Ba(CN)_2,$$

but that when calcium carbide was employed calcium cyanamide and not calcium cyanide is formed,

$$CaC_2 + N_2 = CaCN_2 + C.$$

When the cyanamide is heated with water under pressure it is decomposed with formation of ammonia and calcium carbonate,

$$CaCN_2 + 3H_2O = CaCO_3 + 2NH_3.$$

This process is stated to take place slowly when the cyanamide is distributed on the soil. Although the manufacturers state that cyanamide is stable and does not deteriorate on keeping, some at least of the users say it is unstable and deteriorates considerably as a fertiliser when kept.

An electrical process—that of Bradley and Lovejoy—which was almost a success, was worked for about eighteen months at Niagara. They employed a continuous current with a potential of 10,000 volts. As it is very difficult to keep steady discharges at this high voltage, a slowly rotating framework with projecting electrodes was employed. As it rotated, the electrodes, which were of platinum, approached other projecting electrodes; discharges were thus provoked, but immediately interrupted. In an apparatus of only 5 kilowatts as many as 414,000 arcs were produced per minute. The working of such an apparatus on a technical scale was, as might be supposed, of great difficulty, and although considerable quantities of nitric acid were produced per kilowatt year, it did not prove commercially successful.

In May, 1905, a factory was started at Notodden, in Norway, for the manufacture of calcium nitrate from air and limestone by means of the electric arc flames. A photograph of the factory as it is at present is shown in Fig. 1. In the Birkeland-Eyde process, which is worked at Notodden, a high-tension arc flame is produced between two pointed copper electrodes. The electrodes are attached to a high-tension alternator, and are placed equatorially between the poles of a powerful electromagnet, so that the terminals of the electrodes are in the middle of the magnetic field. An electric disc flame is thus produced which is shown diagrammatically in Fig. 2, and a photograph of the actual flame in Fig. 3. The photographed flame, which represented about 250 h.p., was produced between water-cooled electrodes made of copper tubing.

The working potential employed is 5000 volts, the current is an alternating one of 50 periods per second, and the distance of the terminals apart is about 8 mm. As already mentioned, the electrodes are copper tubes which are water-cooled, and are in the form of a narrow, elongated U; even with flames of 750 kilowatts at 5000 volts the same form of electrode can be employed. By cooling the electrodes, about 7·5 per

FIG. 1.—View of nitric acid factory at Notodden.

cent. of the electric energy employed between the electrodes is removed as heat by the water.

Prof. Birkeland explains the formation of the disc-flames in the following way:—"At the terminals of the closely adjacent electrodes, a short arc is formed, establishing an easily movable and ductile current conductor in a strong and extensive magnetic field, *i.e.* from 4000 to 5000 lines of force per sq. cm. in the centre. The arc then moves in a direction perpendicular to the lines of force, at first with an enormous velocity which subsequently diminishes; and the extremities of the arc retire from the terminals of the electrodes. As the length of the arc increases, its electrical resistance also increases, so that the tension is increased until it becomes sufficient to create a new arc at the points of the electrodes. The resistance of this short arc is very small, the tension of the electrodes therefore sinks suddenly, with the consequence that the outer long arc is extinguished. . . . In an

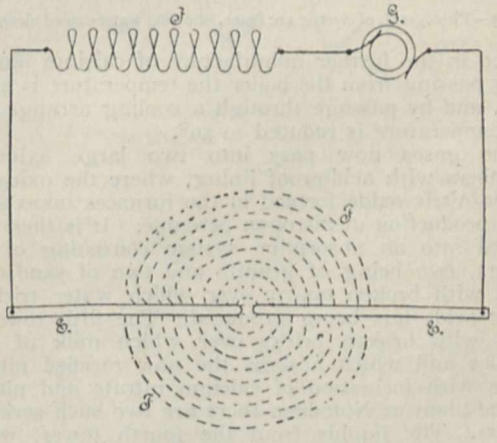

FIG. 2.—Diagram of electric arc flame.

alternating current all the arcs with a positive direction of current run one way, while all with a negative direction run the opposite way (see Fig. 2), presupposing the magnetising being effected by direct currents. In this manner a complete luminous circular disc is presented to the eye."

It is interesting to note that the flame, considering its high electrical power, is not particularly luminous, as it is quite possible to look directly at it with the naked eye at a distance of about 1 yard, and it is not easy to snapshot it.

The alternating-current disc flame is enclosed in special furnaces which are lined with firebrick and enclosed with metal casing. The fire-chamber of the furnace is narrow in the direction of the lines of force—from 5 cm. to 15 cm. wide—and made partly of perforated firebrick, the air being conveyed to the flame in an evenly distributed supply through the walls. The magnetic system is composed of two powerful electromagnets, the extremities of which are turned in towards the fire-chamber. The air is driven into the central region on both sides of the flame by gentle pressure from a Roots blower; it must not be blown too rapidly, otherwise the flame is extinguished. Fig. 4 shows three of the furnaces, each furnace taking 500 kilowatts. The volume of air at present treated is 75,000 litres per minute, which after passing through the furnace contains about 1 per cent. of nitric oxide. The gases leave the furnace at a temperature of 600° to 700° C., and are first passed through a steam boiler, the steam from which is em-

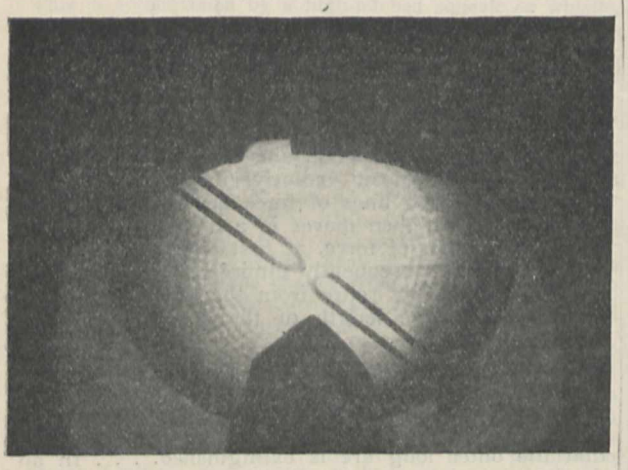

FIG. 3.—Photograph of electric arc flame, showing water-cooled electrodes.

ployed in the further manufacture of calcium nitrate. After passing from the boiler the temperature is about 200°, and by passage through a cooling arrangement the temperature is reduced to 50°.

The gases now pass into two large oxidising chambers with acid-proof lining, where the oxidation of the nitric oxide formed in the furnaces takes place with production of nitrogen peroxide. It is then conducted into an absorption system consisting of five towers, two being of granite and two of sandstone, filled with broken quartz over which water trickles, nitric acid thus being produced. The fifth tower is filled with broken bricks over which milk of lime trickles and which absorbs the now rarefied nitrous gases with formation of calcium nitrate and nitrite. In the plant at Notodden there are two such series of towers. The liquids from the fourth tower, which consist of 5 per cent. nitric acid, are raised to the top of the third tower by compressed air, those from the third to the second, and from the second to the first. The acid, on leaving the third tower, is of 15 per cent. strength, on leaving the second 25 per cent., and it leaves the fourth tower with a strength of 50 per cent.

Some of the acid produced is used to decompose the calcium nitrite obtained from the fifth tower and to convert unchanged lime into nitrate. The oxides of nitrogen produced by the decomposition of the nitrite are carried back to the system of towers. The solution resulting is run, together with the rest of the stored-up acid, into another series of granite tanks, where it reacts with limestone, thus producing neutral calcium nitrate. This solution is evaporated down until the temperature rises to 145°, answering to a concentration of 75 to 80 per cent. of calcium nitrate. The solution is then run into 200-litre drums, where it solidifies, and it appears on the market in this form. It is, however, found that for fertilising purposes it is better to use the basic nitrate owing to the extremely hygroscopic properties of the neutral salt. The ground-up basic nitrate can, as it is not hygroscopic, be readily scattered with a sowing machine.

Numerous manuring experiments have been made with calcium nitrate at different agricultural institutes. The results show that lime saltpetre is quite as good as Chili saltpetre, and on a sandy soil is even superior.

The yield of anhydrous nitric acid by the Birkeland-Eyde process is between 500 and 600 kilograms per kilowatt year. The cost of calcium nitrate containing 13·2 per cent. of nitrogen is about 4*l.* per ton,

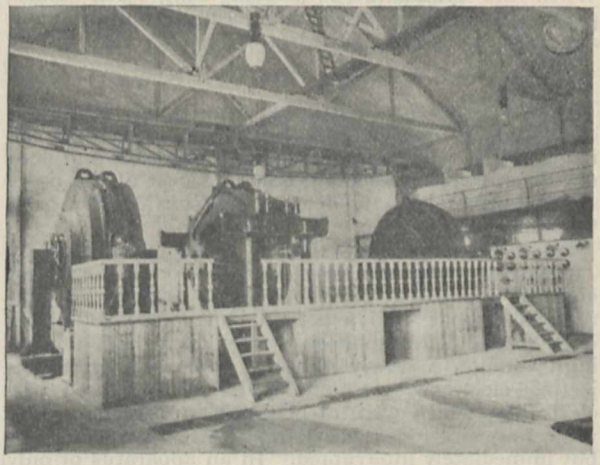

FIG. 4.—Photograph of three 500-kilowatt furnaces at Notodden.

and the selling price about 8*l.* per ton. New works of 30,000 h.p. are now nearly completed, and it is hoped that the new factory will be very shortly in active operation. To an Englishman it is of interest to notice that *all* the pioneer work was carried out in this country. In this connection it should be remarked that even if the final stage—the application of the flame electric arc—had been tried in this country, it could not have been a commercial success. To be a commercial success it is *absolutely* essential that very cheap power should be at the disposal of the manufacturers. At present we have not this cheap power, and it is very improbable that we shall have it in the near future; unless, indeed, some engineer can show us how to harness the tides. But if we cannot manufacture nitric acid from the atmosphere there is a problem, probably a very difficult problem, the elucidation of which would be of almost untold value, and that is the fixation or utilisation of the nitrogen in sewage, which at present is almost entirely thrown with happy abandonment into the sea. As a consequence, the mouths of rivers are polluted, fish are destroyed, and, what is perhaps more serious, disease is often disseminated.

F. MOLLWO PERKIN.

## THE ELECTRICAL SIGNS OF LIFE AND THEIR ABOLITION BY CHLOROFORM.[1]

AS it was not possible to show the actual experiments, Dr. Waller illustrated his lecture by diagrams, and introduced his method of presenting them on the screen by placing in the lantern smoked plates on which he sketched in view of the audience diagrams of the apparatus (battery, induction coil, electrodes, galvanometer) employed in the experiments, and showed the methods by which the photographic records were obtained.

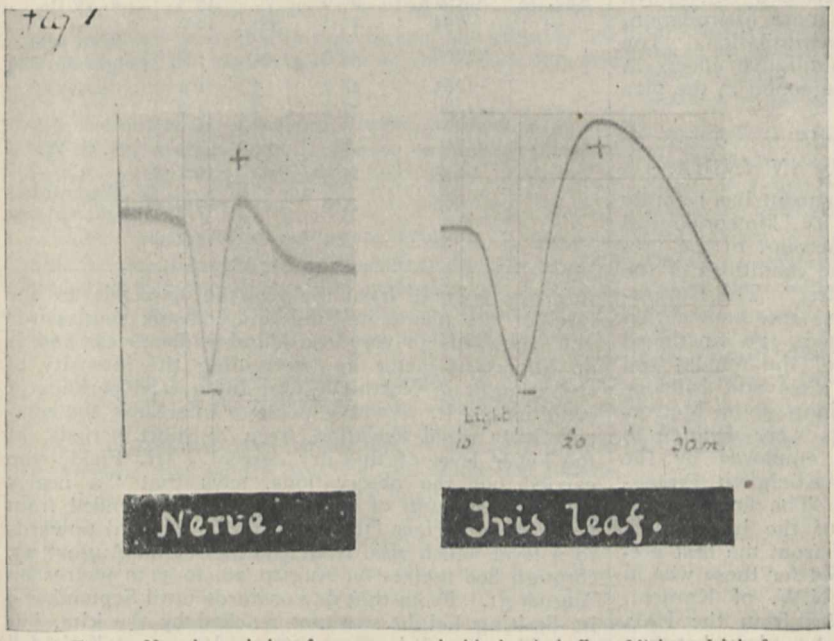


FIG. 1.—Negative variation of nerve compared with electrical effect of light on Iris leaf.

The physiologist is engaged in the task of learning how plants and animals absorb, transform, distribute, and dispense the energy stored in food and manifested in each act of life—in a word, of studying the signs of life; and in the electrical change which accompanies all chemical change we have the most delicate means of addressing two questions to living matter: Are you alive? How much are you alive?

Tissues survive the death of the animal or plant. Six objects were chosen as representative examples of living matter—muscle, nerve, retina of the eyeball, a green leaf, a flower petal, and a seed. The characteristic of life is perpetual change, metabolism—building up and breaking down—anabolism, and katabolism. From the records shown of the electrical responses to excitation of muscle and nerve, it was deduced that isolated nerve, by reason of its showing no fatigue, but giving perfectly regular responses, is a favourable symbol of living matter on which to study the effect of drugs and reagents. From these experiments was proved the fact that chloroform is eight times more powerful than ether, and that 2 per cent. vapour of chloroform is the safe dose. Dr. Waller attributed deaths from overdose of chloroform to inattention to the great scientific principle of measurement.

Records were shown of the electrical effects produced by a series of illuminations of the eyeball, and of similar effects produced by pressure on the eyeball and by electrical excitation; Dr. Waller at first thought these latter effects were the same as those produced by light on the retina, and called them "blaze currents," but afterwards found they were characteristic of all living tissues. The petal of a flower and living seeds give blaze currents.

Dr. Waller described his records of the electrical effects of light on a green leaf; sunlight and the arc light were used; it seemed natural that the vegetable retina should be sensitive to light; the response is a double one, first negative then positive, dissimilation then assimilation; the carbonic acid function of the green leaf is probably attended by electrical effects; positive or assimilative effect is far more pronounced in vegetable than in animal protoplasm (see Fig. 1). A leaf of Nicotiana was illuminated for five minutes at intervals of ten minutes, and gave a deviation of the magnet of

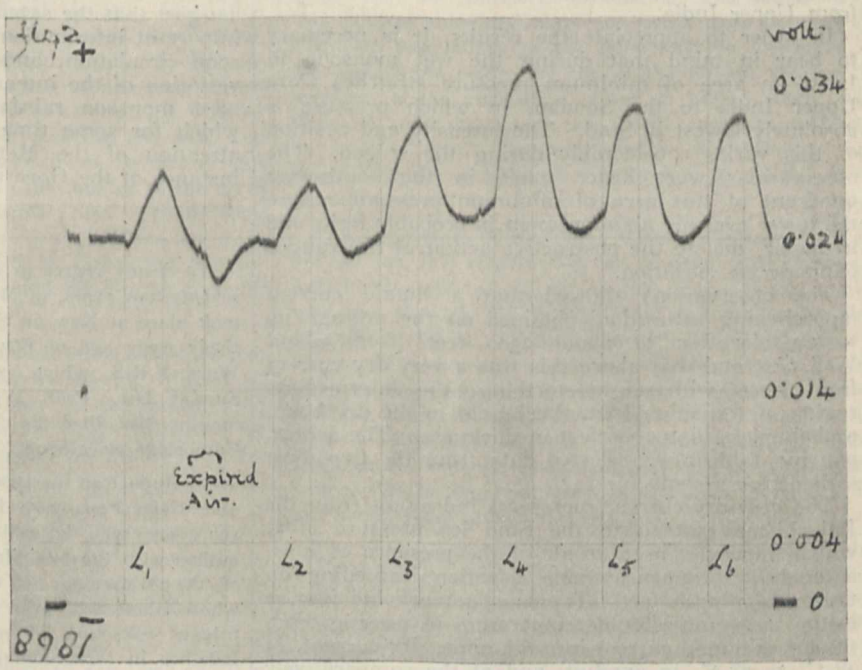


FIG. 2.—Increase of the electrical effects of light on leaf of Nicotiana caused by 4 per cent. $CO_2$.

[1] Abstract of lecture delivered by Dr. Augustus D. Waller, F.R.S., to the members of the British Association at York.

the galvanometer amounting to −2/100 volt, followed by a deviation of +2/100 volt; it was then subjected to an excess of $CO_2$, which caused temporary intoxication, from which it afterwards recovered. Small quantities of $CO_2$, such as 4 per cent., exhibited to the leaf cause increased electrical effects, which are a galvanometric expression of increased chlorophyll action (see Fig. 2); that is, the more assimilation, the more the electrical sign of assimilation. The photographic records indicate dissimilative effects in the minus direction and assimilative action in the plus direction.

## METEOROLOGICAL KITES IN INDIA.

THE India Meteorological Department has recently given in a number of its Meteorological Memoirs (vol. xx., part i.) "an account of the preparations made for determining the conditions of the upper air in India by means of kites." The Government of India, acting on a strong recommendation by the Royal Society, about three years ago sanctioned the inclusion of the exploration of the middle and higher atmosphere by means of kites and balloons as a part of the scheme of operations of the Meteorological Department. Two officers were deputed to Germany to study the methods employed by the Aeronautische Observatorium des Königlich Preussischen Meteorologischen Instituts. The first part of the memoir gives a description of the instruments employed, and the results obtained from the first preliminary ascents. The place selected for these was in Lower Sind, about six miles W.N.W. of Karachi, a mile from the sea and ten miles from the Hala Range on the west, forming the boundary between Lower Sind and Baluchistan.

The ascents were made in the last week of August and first fortnight of September, 1905, shortly before the withdrawal of the south-west monsoon current from Upper India.

In order to appreciate the results, it is necessary to bear in mind that during the wet monsoon in India an area of minimum pressure stretches from Upper India to the Soudan, in which pressure is absolutely lowest in Sind. The intensity and position of this varies considerably during the season. The observations were hence made in the south-west quadrant of this area of minimum pressure, where the lower cyclonic air movement is probably light and irregular, due to the obstructive action of hill ranges of moderate elevation.

The observations showed that a humid current (approaching saturation) obtained on the average up to an elevation of about 2500 feet (from about W.S.W.), and that above this was a very dry current from west with slight northing, the intermediate region of transition from the humid to the dry being probably less than 1000 feet in thickness. The accompanying table gives selected data from the two most satisfactory ascents.

| Date of ascent | Elevation, metres | Temperature, C. | Humidity: Rel. | Humidity: Absolute. Grams per cub. m. | Wind direction |
|---|---|---|---|---|---|
| Aug. 28 | Surface | 28·6 | 70 | 19·5 | S. 70 N. |
| — | 795 | 21·1 | 100 | 18·2 | ,, |
| — | 1000 | 25·9 | 24 | 5·8 | West with slight northing |
| — | 1285 | 28·7 | 5 | 1·4 | ,, |
| — | 1380 | 27·3 | 6 | 1·6 | ,, |
| Sept. 12 | Surface | 28·1 | 85 | 23·0 | S. 60 W. |
| — | 635 | 21·9 | 100 | 19·1 | ,, |
| — | 900 | 25·6 | 42 | 9·9 | West with slight northing |
| — | 1015 | 25·4 | 19 | 4·4 | ,, |

The very dry current represents indraught from the Baluchistan plateau to the Sind low-pressure area, which, however, as a result of the presence of hills, entered it at a considerable elevation, exceeding on the average 2500 feet. The most remarkable feature is the large increase of temperature in passing from the lower humid current into the upper dry current, of 4° C. to 7° C. in amount, and of the comparatively slow rate of decrease for some distance above that plane of transition. Almost equally remarkable is the sudden and comparatively abrupt change of the relative humidity from saturation to values of 5 and 6 only. Mr. Blanford many years ago established that in drought years in North-Western India this dry current from Baluchistan descends to the level of the plains in Sind and extends southwards and eastwards to very considerable distances, and is an important factor in determining the intensity of the drought in North-Western India, and perhaps of conditioning it. Another point of interest is the comparatively rapid variation, even in short periods, of the lower level of this dry current. Mr. Field, who carried out the observations, says that "a nearly saturated stratum of air from the sea extended from the ground surface (10 metres above the sea) upwards to a level which rose from 500 metres on August 27, through 800 metres on August 28, to 1130 metres on August 31. From that day onwards until September 9 its limiting height was not reached by the kite, but probably exceeded 1000 metres. Its upper limit fell again to 600 metres on September 12."

The observations give valuable and interesting information of what may perhaps be termed an outlying portion of the south-west monsoon current. They suggest that the extension of the work will give most important information respecting the south-west monsoon circulation, and perhaps on the causes of the variation of the intensity and extension of the south-west monsoon rainfall, one of the great problems which for some time past has engaged the earnest attention of the Meteorological Department at the instance of the Government of India.

## NOTES.

WE deeply regret to announce the death, at the age of seventy-four years, of Mr. C. Baron Clarke, F.R.S., which took place at Kew on Saturday last, and, at the comparatively early age of fifty-two years, of Prof. H. Marshall Ward, F.R.S., which occurred at Babbacombe, Torquay, on Sunday last. Prof. Ward, who had been ill for some months, had filled the chair of botany at the University of Cambridge since 1895.

ON August 20 there passed away at his beautiful country seat, Coles Park, near Buntingford, Herts, in his eightieth year, one who is well known to mineralogists as joint author with the late Mr. W. G. Lettsom of the "Manual of the Mineralogy of Great Britain and Ireland," and whose name will ever be linked with perhaps the finest private collection of minerals which was ever brought together in this country. Mr. Robert Philips Greg as a young man took great interest in the fine collection which his father, a noted economist and antiquary, had purchased from the executors of its previous owner, Mr. Thomas Allan, F.R.S., and spent considerable sums of money in acquiring new specimens and bringing the collection up to date. After the publication of his "Manual" in 1858 he

appeared to take little active interest in minerals, and two years later, in 1860, the Allan-Greg collection was purchased by the trustees of the British Museum. For many years afterwards he still devoted himself to the study of meteorites, from both the astronomical and mineralogical points of view, until paralysis of the legs rendered it difficult for him to move about. The "Manual" referred to was published nearly half a century ago, and probably few mineralogists will realise that one of the authors has died so recently.

THE death of M. Alexandre Herzen, professor of physiology in the University of Lausanne, and author of many books dealing with physiology and allied subjects, is announced in the *Temps*.

*Science* announces the death of Prof. S. L. Penfield, head of the department of mineralogy in the Sheffield School of Yale University; also of Mr. G. W. Lehmann, chemist of the United States Government since 1878, and chief chemist of the Baltimore Board of Health since 1896.

THE death is announced from Tangier of M. Georges Salmon, leader of the French scientific mission to Morocco.

A MOVEMENT has been set on foot in Germany to raise a memorial fund for the benefit of the widow and children of the late Dr. Schaudinn, and an English committee consisting of Prof. Clifford Allbutt, F.R.S., Sir Michael Foster, F.R.S., Mr. Jonathan Hutchinson, F.R.S., Prof. Ray Lankester, F.R.S., Sir Patrick Manson, F.R.S., Prof. Osler, F.R.S., Mr. John Tweedy, and Prof. Sims Woodhead has been formed to cooperate with the German promoters of the scheme. Subscriptions may be paid to Mr. Adam Sedgwick, F.R.S., treasurer of the fund, New Museums, Cambridge, or direct to the Schaudinn Memorial Fund at Messrs. Barclay and Co.'s Bank, Cambridge.

A CONFERENCE of the International Geodetic Association will be held in Budapest on September 20 next, when, according to the *Temps*, the principal topics to be considered will be the accurate surveying of mountain chains subject to earthquake, with a view to ascertaining whether these chains are stable or whether they rise and sink, and the taking of measures of gravity so as to throw light upon the distribution of masses in the interior of the earth and upon the rigidity of the earth's crust. The drawing up of preliminary reports on these two questions has, says our contemporary, been entrusted to M. Lallemand, director of the general survey in France, and Sir George Darwin, K.C.B., F.R.S.

THE King of the Belgians has shown his practical interest in the study of sleeping sickness by offering a prize of 8000*l*. for the discovery of a remedy for the malady, and by placing a credit of 12,000*l*. in the Congo Estimates for the purpose of prophylactic research; he also recently received representatives of the Liverpool School of Tropical Medicine, and having heard their views as to the necessity of preventing the further spread of the disease, asked the school to submit to him a scheme of preventive measures. The King bestowed the Order of Leopold upon Prof. Ronald Ross, C.B., F.R.S., Prof. Boyce, F.R.S., and Dr. J. L. Todd.

FURTHER slight shocks of earthquake are reported from Valparaiso and Santiago; slight shocks have also been felt at Carcoar, twenty-five miles from Bathurst, New South Wales.

AN earthquake shock is stated to have been felt at 5.55 a.m. on Monday last at Matlock and other parts of Derbyshire. The shock, which was very slight, was accompanied by a sound like distant thunder, and lasted three or four seconds.

THE Wellman Polar Expedition has been abandoned for the present, its leader having decided not to attempt the voyage northward this year on account of defects in the mechanical equipment of his airship. Mr. Wellman is to return to Europe in the middle of next month, and will leave a small party of men behind to guard the headquarters of the expedition.

A ROYAL Commission has been appointed to inquire into the lighthouse administration of the United Kingdom. The terms of reference are:—"To inquire into the existing system of management of the lights, buoys, and beacons on the coast of the United Kingdom by the three general lighthouse authorities, and as to the constitution and working of these authorities, and to report what changes, if any, are desirable in the present arrangements."

A HEALTH, Electrical, and Gas Exhibition is to be held at Portsmouth from November 5–27 next.

THE Latin-American Medical Congress will be held at Monte Video in January next.

THE fourth Portuguese Congress for the Prevention of Tuberculosis will be held at Oporto from April 4–9 of next year.

ACCORDING to the *Electrical Review*, an international competition has been organised by the Association des Industriels de France for the invention of a primary cell and a storage cell satisfying certain conditions. Both cells are to develop the maximum power or contain the maximum energy possible per unit of weight and bulk, and they must be free from risk of every description to the users, easy of transport, installation, and maintenance. The samples submitted must not weigh more than 20 kg. Complete descriptions of the cells must be forwarded by the competitors before the end of the present year to the president of the association, 3 rue de Lutèce, Paris, with drawings, and the actual cells must reach the examiners by April 1, 1907. The prize money, amounting to 8000 francs, may be awarded as a lump sum or divided at the discretion of the association.

THE Legislature of the Berne Canton has sanctioned the project for the construction of a new trunk line—the Lötschberg—with electricity as the motive power, which will pass through the Bernese Alps and connect at Brig with the Simplon. The new line will be 56 kilometres in length, of which 13½ kilometres will be tunnel. It will serve as the most direct means of communication between northern Italy and the district lying to the north and north-west of Switzerland, shorten the approach to the Simplon, and compete with the Gothard tunnel railroad. The work, which is to be begun at once, is estimated to require five and a half years to complete.

THE Australian correspondent of the *Lancet* states that the Federal Government has issued a proclamation prohibiting the importation of the microbe of hæmorrhagic septicæmia, by which it was proposed to destroy the rabbit pest, except upon the condition that the packages containing the microbes be handed unopened to the State bacteriologist of New South Wales, and retained by him unused until the Minister gives permission to use them. Under the Noxious Microbes Act of 1900 of New South Wales it will also be necessary for the State Government to pass a regulation sanctioning experiments before anything can be

done in the way of rabbit extermination. In the meantime only laboratory experiments will be carried on.

WE have received a copy of the meteorological observations made at forty-four secondary stations in the Philippine Islands during 1903. The observations are published for four-hourly intervals from 2h. a.m., and occupy 1128 large octavo pages; the records have been carefully examined under the superintendence of Father Algué. He points out that the Philippines are preeminently agricultural, and that most of the inhabitants are engaged in tilling the soil; consequently temperature, sunshine, and rain are the chief factors to be considered. Rain is the most important element, as sunshine and temperature are generally quite uniform and favourable. 1903 was a bad year for agriculture; drought was prevalent during the first half, while there was considerable rainfall during what is usually considered the dry season. Owing to the drought, the havoc wrought by locusts was terrible; time after time swarms swept over the land devouring the standing crops, and leaving the country-side bare and dreary.

WE have received a copy of the meteorological chart of the Indian Ocean and Red Sea, issued by the Meteorological Office, for September. This valuable publication gives important information for seamen, including the routes recommended, under steam and sail respectively, between several of the principal ports. The wind roses, which are drawn generally for areas of 5° of latitude by 5° of longitude, show the average conditions for the month from records extending over a period of fifty years, and the direction and rate of the ocean currents are indicated in the usual way, from the results of observations obtained during a period of sixty-five years. In addition, any facts of recent date likely to be of interest are made known, among which we may mention a telegram from the Indian Meteorological Office, dated August 10, with reference to the south-west monsoon between Aden and Bombay, and to the unusually quiet weather conditions in the Bay of Bengal.

WE learn from an article in the August number of the *Popular Science Monthly* that the Government of the United States intends to repeat so much of the triangulation of the coast and geodetic survey as lies within the area affected by the earthquake of April 18 last, and to carry the work far enough eastward to connect the re-determined points with stations that may safely be regarded as quite beyond the effect of the recent disturbance.

THE flora of New Zealand presents many exceptional features, and it has been Dr. Cockayne's service to describe various strange vegetable productions of these and adjacent islands in his charming and graphic writings. In a series of ten articles that were printed in the *Lyttelton Times* during May he has provided a general account forming an epitomised survey of the ecology of New Zealand. Discussing the history of the plants, he adduces evidence obtained from the distribution of such plants as *Veronica elliptica* in favour of a former land connection with South America. Referring to the forests, he enumerates several types, of which the filmy ferns and epiphytic lilies are extraordinary. On the shore is found the tiny buttercup *Ranunculus acaulis*, bearing only three small, succulent leaves and its small yellow flower above the sand. The arborescent speedwells and species of Sophora showing peculiar juvenile forms are noteworthy among the shrubs. In the mountain meadows a striking feature is the prevalence of white and yellow rather than blue flowers. *Phormium tenax*, the plant furnishing the valuable fibre known as New Zealand flax, grows in the swamps. Finally, there are numerous plants eminently suitable for cultivation, to mention only the Veronicas, Senecios, and Olearias.

IN choosing bamboos for the garden it is necessary to take into consideration the power of resistance offered by different varieties to frosts. In *Le Bambou* (July) the editor, M. Lehaie, contributes some notes on the subject, quoting from his experience in Belgium. Among the hardiest varieties he places *Henonis, Quilioi, viridiglaucescens, pubescens*, and *aurea*, all species of Phyllostachys, *Sasa paniculata*, and *Arundinaria Japonica*. He also provides a list of bamboos cultivated in Europe during 1906, with their synonyms. An interesting communication by Prof. F. A. Forel points to the identity of *Phyllostachys Henonis* with *Phyllostachys puberula*. Among the economic uses of bamboos, M. J. Noguès makes special reference to the pulp for the manufacture of paper.

ANOTHER pamphlet on the rubber-tree *Ficus elastica*, compiled by Mr. E. M. Coventry, of the Indian Forest Department, was recently published as Forest Bulletin No. 4 of the Government of India. The chief factor determining the distribution of the tree is said to be excessive humidity of the atmosphere. For propagation, cuttings and gooties have been given up in the plantations to which reference is made. New plants are obtained from seedlings raised in seed-beds and transferred to a forest nursery that requires to be surrounded with a stockade to keep out deer. Tapping is effected by making horizontal cuts about half round the tree with a V-shaped gouge. The excess of rubber is allowed to fall on mats placed on the ground; this and the rubber collected from the cuts and bark form three grades. Results tend to show that trees should only be tapped every second or third year.

BY an Act passed in 1903, the New Zealand Institute and the Colonial Museum were placed on a new footing. In the Colonial Museum Bulletin, of which the first number has just appeared, a sketch of the history and present position of the museum is found which contains much information as to the progress made in forming a collection of Maori antiquities; it is worthy of note that the natives themselves are deeply interested in the scheme, and have made valuable donations. The number also contains an important article on the marine mollusca of New Zealand, and an excellent series of photographs of carvings and weapons recently acquired by the museum. It is unfortunate that in the mother country we are too parsimonious to spread abroad in this way the knowledge of our national treasures.

THE *Ceylon National Review*, No. 2, contains an illustrated article by Ethel M. Coomaraswamy on old Sinhalese embroidery, illustrated by a collotype plate and sketches of the different kinds of stitches employed. Nowadays specimens are rare; formerly many objects were thus decorated, especially betel bags, which have been preserved in fair numbers. The colours employed were three, red, blue, and the undyed thread; the designs were geometrical, or taken from plants or animals. Most of the work was done with the chain stitch, and the knowledge of it is now confined to the old men in out-of-the-way villages.

IN *Biologisches Centralblatt* for August 15 Dr. J. Gross concludes his paper on the relationships between heredity and variation. According to the author, there may be two lines of development, fluctuation and mutation, the three stages of the former resulting respectively in the production

of races, species, and genera, while the first stage of the latter corresponds to De Vries's and the second to Mendel's mutation. The Rev. E. Wasmann, in the second article, discusses the comparatively recent development of new species of "commensural" beetles of the family Staphilinidæ in the nests of ants and termites. In the black and red beetles of the genus Dinarda, for example, there are races or species corresponding to the various races or species of ant with which they are associated, and as the differentiation of the ants appears to be comparatively recent, that of the beetles must, *a fortiori*, be still more so. In the third article Maria Countess von Linden describes certain very remarkable variations in the shape and colour of the wing-scales of the swallow-tail butterfly *Papilio podalirius* during the pupa-stage as the effect of external influences. It is noticeable that the scales on the orange spot differ from those of the rest of the wing. The basilar membrane in the ear of parrots, in connection with Helmholtz's resonance-theory, forms the subject of the concluding article, by Mr. A. Denker.

THE contents of Nos. 1 and 2 of vol. xxviii. of Notes from the Leyden Museum are largely devoted to the description of new genera and species, a number of these being described by Mr. G. Ulmer in a paper on non-European trichopterous insects. Of more general interest is the description, by Dr. E. D. van Oort, of a new bird-of-paradise (*Neoparadisea ruysi*) from New Guinea, representing a generic type by itself, and also Dr. Jentink's separation of the large duiker antelope of Rhodesia from the West African *Cephalophus sylvicultor*, under the name of *C. coxi*.

THE New Zealand fern-bird (*Sphenoeacus punctatus*) forms the subject of the first article, by Mr. J. C. M'Lean, in the July issue of the *Emu*, while in the second paper Mr. H. S. Dove gives notes on a number of New Zealand birds, inclusive of introduced species. In a later communication Mr. E. Scott contributes some interesting information with regard to Dampier's observations on Australian birds made during the voyage of 1689. Mystery attaches to the meaning of the term "gladdens," which the great navigator employed to designate certain birds associated with oyster-catchers and cormorants.

THE whole of vol. xxvii. of Notes from the Leyden Museum is occupied by Miss C. M. L. Popta's description of the fishes collected during Prof. Nieuwenhuis's expeditions to central Borneo in 1898 and 1900. The collection contained a large number of new forms, which have, however, for the most part been named in previous communications. The more important species are illustrated by photographs from original specimens.

SEASIDE natural history, illustrated with a number of excellent photographic plates (in some cases reproduced from Johnston) of zoophytes, &c., occupies a prominent position in the July issue of the *Museum Gazette*. The addition of a large education museum to the "garden city" at Letchworth is strongly advocated.

IN its report for 1905, published in the August issue of *Nature Notes*, the Selborne Society takes occasion to refer to the necessity for more active workers and larger funds if its objects are to be fully and efficiently carried out. The enclosure at Ealing for the protection of birds is reported to have been a marked success during the nesting season.

A PAPER by Mr. David Heron "On the Relation of Fertility in Man to Social Status, and on the Changes in this Relation that have taken place during the last Fifty Years" has been published in the series of Drapers' Company Research Memoirs (Studies in National Deterioration). Mr. Heron takes as his starting point the legitimate birth-rate for the different districts in London for the years 1851 and 1901, and proceeds to calculate for each year the correlation between this and various measures of their social and economic conditions. By this method he shows conclusively that in both these years a low birth-rate is associated with satisfactory conditions and a high one with poverty and improvidence, but that in 1901 this coincidence is far more strongly marked than in 1851, and that whereas in the middle of the last century it could be more than accounted for by the fact that the wives of the upper classes marry at a later age than those of the lower, at the present time this factor is only responsible for about half the difference. It is perhaps unfortunate for Mr. Heron that his paper has appeared after two others dealing with the same subject (Newsholme and Stevenson, and G. U. Yule, Journal of the Royal Statistical Society, vol. lxix., part i.), as his methods are very different from, and his conclusions quite independent of, either of them. But owing to the striking way in which these three important papers confirm and supplement one another, it may be to the advantage of the public that they should have appeared in the same year, for warnings of this nature have more chance of obtaining a hearing when they are given simultaneously from different quarters.

IN the Journal of the Franklin Institute of Philadelphia (vol. clxii., No. 1) Mr. Clifford Richardson gives an exhaustive series of analyses of the petroleums of North America, and compares the character of those of the older and newer fields.

A VERY simple and convenient method for calibrating thermometers for use in the determination of freezing points of aqueous solutions is described by Messrs. Richards and Jackson in the *Zeitschrift für physikalische Chemie*, 1906, lvi., 362. The thermometer to be tested is immersed in a mixture of powdered ice and water contained in a Dewar vessel, and hydrochloric acid is then added until the requisite temperature has been attained. The true temperature is determined by the concentration of the acid solution in equilibrium with the ice, and this can be ascertained from the table given by the authors, in which acid concentrations corresponding to temperatures between 0° C. and −5° C. are recorded.

IN a previous measurement of the relative proportion of radium and uranium in radio-active minerals, a neutral solution of radium bromide was employed as standard. It has since been observed, however, that such neutral solutions gradually deposit some of the active substance on the walls of the containing vessel, and this has made a new determination of the proportion of radium to uranium necessary. The number now found by Rutherford and Boltwood (*American Journal of Science*, iv., 22 [127], pp. 1–3) for the quantity of radium associated with 1 gram of uranium is $3{\cdot}8 \times 10^{-7}$ gram, which is about one-half that obtained in the first experiments.

IN the *Journal of Physical Chemistry*, 1906, vol. x., p. 445, Messrs. Carveth and Magnusson give an interesting account of the evolution of the apparatus for the determination of the boiling points of solutions for the purpose of molecular weight measurements. The advantages and disadvantages of the various types are discussed, and a new form of apparatus is described, the distinctive features of

which are a separate boiling flask and a return condenser provided with a mercury trap. With this apparatus measurements can be made very quickly, and the parts liable to break are easily replaceable.

IN the same journal Mr. R. C. Snowdon shows that metallic lead can be electrolytically deposited in a satisfactory and adherent condition from an acidified solution of lead acetate. This result is attained by employing a rapidly rotating kathode and a virtual current density of 1·5 amperes per square decimetre, and adding about 1 gram of gelatin to a litre of the solution. In an investigation of the behaviour of ferromanganese anodes in solutions of caustic soda, Mr. G. R. White finds that permanganate is formed irrespective of the current strength and the concentration of the solution. Metallic manganese yields permanganate at high current densities, but manganous hydroxide is only oxidised to dioxide. The electrolytic formation of permanganate is therefore a direct reaction, the lower oxides not being formed as intermediate products.

WE have received from Messrs. Adam Hilger, Ltd., a copy of their "List A" of spectroscopes and spectroscopic accessories. This list contains descriptions and illustrations of the numerous specialities manufactured by the firm, and should be consulted with interest by all workers in spectroscopy. The spectroscopes, spectrographs, and accessories of especial interest are too numerous to be referred to here, but mention may be made of the fact that the firm is now prepared to supply the strips of plane parallel glass, up to 300 mm. by 40 mm., used in the Lummer and Gehrcke parallel plate spectroscope described in the *Annalen der Physik*, vols. x. (1903) and xx. (1906). These strips may be used with any ordinary spectroscope of suitable size, but the firm will be pleased to quote prices for specially designed instruments.

THE new edition of the Japanese Pharmacopœia, which has been in preparation for some considerable time, has now been completed, and will be issued shortly. Among the alterations in it is the substitution of Japanese characters for the names of drugs and chemicals for the Chinese forms hitherto used.

A NEW magazine, entitled the *University Digest*, is announced for publication by the University Research Extension of Chicago. Its aim (to quote from the prospectus issued) is "to keep before its readers the ideal phenomena that distinguish the modern, the greatest of world-epochs," and the intention of its promoters is to represent the results of scientific research in religion, philosophy, and the social and natural sciences. The periodical will be issued at monthly intervals from September next, excluding the months of July and August.

THE Proceedings and Transactions of the Nova Scotian Institute of Science for the session 1903–4, just received, contains many papers of value. The address of the president—Dr. H. S. Poole—dealt with the progress of the institute and the application of science to mining, and among other communications in the volume we notice the following:—the earthquake of March 21, 1904, in Nova Scotia, by Prof. J. E. Woodman; swim bladder of fishes a degenerate gland, by Prof. E. E. Prince; and determination of elements of terrestrial magnetism at Halifax, Nova Scotia, August, 1904, by Prof. S. M. Dixon.

THE official year-book of New South Wales for 1904–5 has just reached us. It is edited by Mr. W. H. Hall, acting statistician to the State of New South Wales, and is a mine of information, containing as it does papers on the discovery of "Terra Australis," the physical configuration, the geological formation, the meteorology, vegetation, timbers of commercial importance, fish and fisheries, and fauna of New South Wales, besides much information of statistical importance. The volume is illustrated by some twenty-eight well-executed figures, and should be seen by all who are specially interested in the State under review.

THE twenty-sixth annual report of the Manchester Microscopical Society, which has just been issued, tells of continued progress. The address on precious corals delivered by Prof. S. J. Hickson, F.R.S., as president, is to be found in the volume, as is also an illustrated paper by Mr. M. L. Sykes on animal coloration.

THE seventh annual report of the Museum and Art Gallery of Plymouth is of an encouraging nature. During the year ending with March last many interesting additions were made; the public lectures on subjects connected with the work of the museum were, it is stated, on the whole decidedly successful. The museum and gallery were visited during the period under review by 30,760 persons.

A NEW (the second) edition of "The Geology of the English Lake District, with Notes of the Minerals," by Mr. J. Postlethwaite, has just been issued by G. and T. Coward, Carlisle. The little book has been revised and additional lists and plates of fossils have been added, and the section on the Mollusca of the Skiddaw slates has been rearranged.

THE current number of the *Monthly Magazine* contains a very readable account, by Mr. H. W. Strong, of the evolution of the turbine, entitled "The Coming of the Turbine"; it has also an interesting paper by Mr. A. W. Rees on a moorland sanctuary.

## OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN SEPTEMBER:—

Sept. 1. 14h. 42m. to 15h. 46m. Moon occults ι Aquarii (mag. 4·3).
2. 15h. Saturn in conjunction with Moon. Saturn 0° 34′ N.
4. 13h. Mercury in conjunction with Mars. Mercury 0° 10′ S.
,, 15h. Saturn in opposition to the Sun.
8. Predicted date of perihelion passage of Finlay's comet.
9. 14h. 27m. to 14h. 43m. Moon occults α Tauri (Aldebaran, mag. 1·1).
10. 10h. 47m. Minimum of Algol (β Persei).
,, Vesta ½° N. of star 105 Aquarii (mag. 4·7).
11. Vesta (mag. 6·5) in opposition to the Sun.
15. Venus. Illuminated portion of disc = 0·514; of Mars = 0·989.
16. Saturn. Major axis of outer ring = 44″·33, minor axis = 4″·15.
20. 10h. Venus at greatest elongation, 46° 29′ E.
23. 11h. Sun enters Libra, Autumn commences.
29. 11h. 29m. Transit (egress) of Jupiter's Sat. III. (Ganymede).
30. 12h. 30m. Minimum of Algol (β Persei).

DISCOVERY OF A NEW COMET (1906*e*).—A telegram from the Kiel Centralstelle announces the discovery of a new comet by Herr Kopff at the Königstuhl Observatory on August 22.

Its position at 14h. 17m. (Königstuhl M.T.) on the day of discovery was R.A. = 22h. 49m. 32s., dec. = +10° 23′, and the amount of its daily movement was found to be −44s. in R.A. and −2′ in declination. Unfortunately no idea of the comet's brightness is given.

A second telegram from the same source states that the comet was observed at Hamburg by Herr Graff on August 23, its position at 13h. 11·3m. (Hamburg M.T.) being R.A. = 22h. 48m. 53·5s., dec. = +10° 21′ 7″.

From this it is seen that the comet is apparently in the constellation Pegasus, a little to the north of $\sigma$ Pegasi, and is moving in a south-westerly direction. This position crosses our meridian at about 12 o'clock midnight.

FINLAY'S COMET (1906*d*).—This comet will arrive at its perihelion, according to M. Schulhof's elements, on September 7·5.

As shown by the following extract from the ephemeris published in No. 4109 of the *Astronomische Nachrichten*, the comet is now apparently travelling through the extreme north-eastern corner of Orion towards Gemini, which it will enter on September 9. On September 7 it will pass about 1° south of 71 Orionis, and on September 13 about 2° 36′ north of $\gamma$ Geminorum. On the latter date the comet will rise about five hours before sunrise, *i.e.* about 12·30 a.m.

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

| 1906 | α (app.) | δ (app.) | 1906 | α (app.) | δ (app.) |
|---|---|---|---|---|---|
| | h. m. | ° ′ | | h. m. | ° ′ |
| Sept. 1 | 5 40 | +16 37 | Sept. 9 | 6 17 | +18 27 |
| 3 | 5 50 | +17 9 | 11 | 6 25 | +18 47 |
| 5 | 5 59 | +17 39 | 13 | 6 33 | +19 4 |
| 7 | 6 8 | +18 4 | 15 | 6 40 | +19 19 |

GREENWICH SUN-SPOT NUMBERS.—An innovation which is likely to be found a great convenience by everyone who has to discuss sun-spot observations appears in the August number of the *Observatory*.

Up to the present such workers have had to wait until about the middle of the next year before the serial numbers allotted to the sun-spots of any one year by the Greenwich authorities became available for general use. Now, with the sanction of the Astronomer Royal, Mr. Maunder proposes to publish these numbers month by month.

The first instalment, giving the numbers for the quarter January–March, 1906, appears in the current *Observatory*. Next month's issue will contain the data for the second quarter, and after that each month will be given separately, so that the numbers for July will appear in October, and so on.

Other data, *e.g.* the duration and the latitude and longitude of each spot-group, are also given, but, as they are determined from simply a preliminary examination, these are not to be accepted as final values.

THE ORIGIN OF THE ZODIACAL LIGHT.—Some interesting observational results, and deductions therefrom regarding the origin of the zodiacal light, appear in a brochure written by Mr. Maxwell Hall, of Montego Bay, Jamaica, and issued as a reprint from the *Monthly Weather Review* for March, 1906.

Mr. Hall's observations were made at Jamaica in 1899 and 1901, and determined the breadth of the light and its boundaries at different distances from the sun. On reducing the observed latitudes according to their longitudes, or distances from the first point of Aries, Mr. Hall obtained striking evidence which tends to show that the light is parallel to the invariable plane of the solar system, evidence which was apparently confirmed by the results obtained by other observers.

On these grounds Mr. Hall arrives at the conclusion that the zodiacal light is caused by the reflection of sunlight from masses of meteoric matter still contained in the invariable plane, which may be considered as the original plane, of the solar system.

If this conclusion is correct, and the phenomenon is astronomical in its origin, the light should be seen better and more frequently from observing stations situated in high altitudes, and the editor of the Review especially commends its observation to workers located at such stations.

A MODIFIED FORM OF SOLAR EYE-PIECE.—From Prof. Ceraski, of Moscow, we have received a brief description of a solar eye-piece which he is using, and has found to be most effective, for the detailed study of sun-spots. This eye-piece is analogous to one described by Dawes in vol. xxi. of the Memoirs of the Royal Astronomical Society, but as no one seems to have used this for the study of minute details in sun-spots, Prof. Ceraski describes the one he is now using.

The apparatus is furnished with a positive eye-piece and a copper plate pierced with circular apertures of various diameters, thus forming an adjustable diaphragm. This copper plate is protected by a disc of asbestos which contains a central aperture slightly larger than the largest in the diaphragm. The dark glass is a combination of black mica and blue glass.

Using this eye-piece with the full aperture of the Pulkowa 15-inch refractor, Prof. Ceraski was surprised at the amount of detail seen.

## *PHYSICS AT THE BRITISH ASSOCIATION.*

THE proceedings of the Mathematical and Physical Section (A) commenced on Thursday, August 2, with the delivery of the presidential address by Principal E. H. Griffiths, F.R.S. This address has already appeared in full in these columns (August 9, p. 356).

The chief interest of the meetings in this section arose in connection with several discussions which were arranged and taken up with avidity. On August 2 the Earl of Berkeley described his experiments on the measurement of osmotic pressure, both directly and indirectly from measurements of vapour pressure. The two methods give results agreeing to within 5 per cent. Mr. W. C. D. Whetham followed, and treated the same subject from the standpoint of thermodynamics and the dissociation theory, thereby stimulating Prof. Armstrong to make a vigorous attack on everything connected with thermodynamics and dissociation. In Prof. Armstrong's opinion the secret of osmotic pressure is to be sought in a thirst of complexes of water molecules. He laid stress on the importance of recent work in America, which proved that Boyle's law was satisfied for much greater strengths of solution than was shown by Lord Berkeley's results. In the course of discussion it seemed, however, that the difference was rather one of interpretation of results than of the experimental results themselves. Mr. Whetham, in his rejoinder, declared also in favour of a "thirst" hypothesis, but differed in regard to the mechanism of it.

On Friday, August 3, two important discussions took place. The former was opened by Mr. Frederick Soddy, the subject being the evolution of the elements. Mr. Soddy outlined the subject from the earliest times to the most recent developments in connection with radio-active changes. Uranium gradually changes to radium, radium to its emanation and several other successive products, until in all probability it becomes lead. Lead in turn suffers a gradual transmutation into silver. These changes proceed spontaneously, setting free energy as they occur. With regard to active attempts at transmutation in the reverse direction, which, of course, require a correspondingly large supply of energy, Mr. Soddy considers that success will be found first in a nearly complete vacuum carrying an electric discharge. Here there is very little matter carrying a large amount of energy, so that the necessary conditions would seem to be supplied. The Hon. R. J. Strutt laid stress on the fact that in radio-active changes helium was the only non-valent element produced, while in our atmosphere argon was largely preponderant. Had argon been formed by other transmutations? Dr. O. W. Richardson and Dr. H. A. Wilson discussed the apparent disappearance of matter in vacuum tubes, alluding to quantitative experiments made in the Cavendish Laboratory. Prof. Schuster emphasised the nearly complete indifference of radio-activity to temperature changes, the only temperature effect yet discovered being a small one found by Mr. W. Makower working in his laboratory. He had experiments in progress on the influence of high pressures with the aid of apparatus designed by Mr. Petavel. With this apparatus a pressure of 2000 atmospheres can be obtained; no change in radio-active charge brought about thereby had yet been detected,

but the experiments were not yet complete. Prof. S. P. Thompson, in reference to the Cavendish experiments, pointed out that it was well known that gases were *absorbed* by the walls of vacuum tubes. The Rev. A. L. Cortie, speaking from the astronomical standpoint, was able to declare that radium had not been detected in extra-terrestrial bodies, although helium, which is produced during its decomposition, is discovered in the sun. The idea of a primitive substance is very ancient; it is simply the *materia prima* of Aristotle. A considerable part of the discussion turned on the use (or misuse) of the term *atom*, a term which Prof. Tilden, speaking as a chemist, was unwilling to give up. Undoubtedly the term has lost its original etymological signification, but its use has become too fixed to expect a change to be readily made. The discussion proved so interesting and stimulating that Mr. Soddy's paper, which gave rise to it, has been directed to be published in full in the report. A more immediate consequence was that the programme for the day was completely upset; a large number of papers had to be held over in order that the next discussion arranged might be taken. The subject was the notation and use of vectors, and Prof. Olaus Henrici opened it. He explained the various notations which have been proposed for vector and scalar products, and proceeded to give examples of their use. He showed how the operator $\nabla$ might be defined without reference to analytical geometry from the relation $dU = d\rho . \Delta U$, where U = any scalar function of position, and $d\rho$ = length of displacement of the representative point. He then applied the properties of the operator $\nabla$ to the deduction, with great simplicity and elegance, of results connected with the theory of partial differential equations. Dr. C. G. Knott followed, and deplored the substitution of vectors for quaternions, and objected that neither scalar nor vector product was really a true product. He advocated a return to the methods of Sir W. Hamilton. He pointed out that Hamilton does not speak of a vector or a scalar product, but of the vector of a product and the scalar of a product. With regard to the change of the usual negative to the positive sign suggested by certain vectorists, he explained that it had compelled Gibbs to introduce a third kind of product, and more recently Jahncke had introduced a third in order to be able to treat of strains. Prof. W. M. Hicks criticised Henrici's use of brackets to denote vector and scalar products on account of liability to confusion. Prof. Henrici, in an eloquent reply, showed how easily all quaternionic results could be derived from vector analysis.

On Monday, August 6, an important discussion took place on radio-activity and the internal structure of the earth, opened by the Hon. R. J. Strutt. From the examination of a large number of rocks, both igneous and sedimentary, he had come to the conclusion that there is much more radium in all of them than would be needed to maintain the earth's internal heat if the earth were constituted of rock throughout. Hence he concludes that the interior of the globe does not contain radium, and that in all probability its composition is quite different in other respects also from that of surface materials. The thickness of the radio-active crust is estimated at forty-five miles at most, which corresponds to an estimated temperature of 1500° C. at its interior surface. The inside nucleus would be at this temperature throughout just as a loaf of bread which has been in an oven long enough takes up a steady temperature equal to that of the oven. In reply to the possible objection that a gram of radium diffused through an enormous volume of rock may not develop nearly so much heat as it would do if concentrated, it was argued (1) that the rate of emission of alpha particles of pitchblende (to which particles the heat is mainly due) is exactly what might be expected on the view that the radium atoms contained in the mineral are as energetic as they would be if they were all collected together, and (2) direct measurements made by Pegram on uranium and thorium have shown that these feebly active elements give about the amount of heat which their activity would lead one to expect. Prof. J. Milne, who followed, directed renewed attention to the bearing on the problem of the three phases of earthquake tremors. The first, for stations connected by small chords, travels at a slow, nearly constant rate, but for chords penetrating to a depth greater than twenty miles the velocity increases to about 12 kilometres per second, indicating that the wave is carried by something more rigid than the outer crust. Prof. J. W. Gregory, speaking as a representative of the Geological Section, considered that Strutt had struck a blow at the theory of contraction by cooling. We are no longer bound to believe in very high temperatures in the past history of the earth. Arrhenius's theory may now be dismissed. He suggested the importance of mapping a small area completely in regard to the radio-activity of the rocks comprised in it. Sir W. Crookes declared his belief that radium inside the earth may not be so radio-active as at the surface. Pitchblende in thick masses behaves much the same as in thin layers. An experiment in which 50 mg. of radium were sealed in a glass tube and deposited in a cavity in ice, and an exactly similar tube containing 50 mg. of silica was similarly deposited, showed that neither sank as much as one-thousandth of an inch during prolonged observation. Sir G. Darwin directed attention to the work of Gilbeck, Putnam, and Hayford, of the United States Coast Survey, who had fixed a limit of about seventy miles to the thickness of the crust. Sir Wm. Ramsay suggested that Mr. Strutt should make a special examination of sulphides with the object of finding whether they contained radium. He further queried whether alpha particles give out all their energy as heat—a query which must most probably be answered in the negative.

Mr. R. D. Oldham (also representing the Geological Section) gave distinct evidence, derived from earthquake phenomena, that there must be a central core, the radius of which is about 0·4 of the earth's radius, having rather less resistance to compression than the main body. Prof. H. Lamb threw out a warning against laying too much stress on arguments based on observation of earthquake velocities. Too little is known as to effects of pressure and temperature.

Mr. Soddy showed that another explanation of the apparent absence of radium heat might arise from processes of upbuilding going on which may depend upon a possible concentration factor. Prof. Hicks emphasised Mr. Soddy's suggestion, and pointed out that even cooling might be produced by such building-up processes. He also suggested that the reason temperature does not usually affect radio-active changes is that time comes in as a factor, and he would like to see experimentally whether a very long application of a low temperature would not produce some effect. Mr. Fearnsides indicated that in the most radio-active rocks elements of high atomic weight were associated with those of low atomic weight.

The last organised discussion was held on Tuesday, August 7, the subject being the nature of the radiation from gas mantles. Unfortunately Mr. Swinburne, who was to open it, was unavoidably absent; his paper was therefore read by the recorder. It consisted of a spirited outline of the various theories that had been proposed to account for the high luminous efficiency of the Welsbach burner, with a declaration in favour of the simple temperature explanation. Low emissivity allows the mantle to approach the temperature of the flame; a substance of greater emissivity could not rise so high in temperature, and consequently the radiation which the latter would give out would not be so rich in luminous qualities. "Though this simple explanation may be ample it does not follow that there may not be all sorts of curious things, such as selective emission, luminescence, catalytic action, resonance, unstable oxidation and other occurrences whose names are as impressive as vague." Dr. H. Rubens, of Charlottenburg, followed with an account of the experiments which he has recently conducted, and which have been described in Drude's *Annalen*. Ceria for radiations in the immediate infra-red is a very poor radiator, while for luminous and the extreme infra-red radiations it behaves much more nearly as a perfectly black body. On the whole, the thoria-ceria mantle has poor emissivity, and its temperature approaches 1600° C., while the nature of the radiations from the added ceria confers additional richness on the proportion of luminous

rays emitted. An experiment which Dr. Rubens showed to the section is of great importance in connection with the interpretation of the phenomena. Light from an electric lantern is focused upon a cold Welsbach mantle, and after reflection therefrom is re-focused upon a white screen. A blue cell is interposed to isolate the blue portion of the radiation. If now the Welsbach burner be itself lighted so as to heat the mantle, the image on the screen grows fainter; *the mantle is a poorer reflector for blue light at high than at low temperatures*, and it is therefore a better radiator when hot. Indeed, a temperature can be found at which it emits as much blue light as a perfectly black body. When the experiment is made with red light the reflected light increases with the temperature. Thus the fact that a Welsbach mantle is white when cold tells one nothing as to the character of radiation it will emit when hot. In the open discussion which followed Prof. S. P. Thompson considered that Dr. Rubens had demolished statements made by Mr. Swinburne in a previous paper. Prof. Callendar put in a word on behalf of Mr. Swinburne, whom he considered to be essentially in the right, though he had probably not laid sufficient stress upon the importance of the selective character of the radiation of ceria. Dr. Rubens expressed himself also as sharing Mr. Swinburne's views. Sir Wm. Ramsay directed attention to Urbain's recent work on phosphorescence, while the recorder of the section emphasised the distinction between the opposing schools by pointing out that, according to the "temperature" school, the radiation of the mantle is the sum of the radiations which would be given out by the thoria and ceria if separated and still at the same temperature, while according to the "chemical" school there is present an additional radiation arising from interaction between the constituents of the mantle. Dr. Rubens did not seem willing to admit that the radiation is wholly of this additive type, although it is so in the main. The discussion was enlivened by the president reading replies which Mr. Swinburne had sent ready for use against those with whom he had previously engaged in controversy.

We will now turn to the papers in connection with which no discussion had been organised.

Mr. W. G. Duffield read a paper on photographs of the arc spectrum of iron under high pressures. The apparatus by which the pressures were obtained was designed with the help of Mr. Petavel. The photographs which were shown demonstrated clearly that several lines not merely widen out, but undergo an actual shift towards the red.

Major E. H. Hills and Prof. J. Larmor communicated a paper on the irregular motions of the earth's pole, being a preliminary graphical analysis of their causes. In the ensuing discussion Mr. R. D. Oldham asserted that the amount of matter transferred in a recent Indian earthquake was at least 10,000 times that assumed by the authors. Prof. Schuster was inclined to question the accuracy of the observations themselves owing to their minuteness; the whole shift of axis under discussion amounts only to about 20 feet. Besides, the yielding of the earth owing to the shift of its axis might be the determining cause producing the earthquake, and not *vice versâ*.

Prof. H. H. Turner read a note on a possible effect of vibration on zenith distance observations, with special reference to the tremors which threaten the Royal Observatory at Greenwich. The special effect referred to is similar to one observed long ago in Ireland due to the Ulster railway. If the telescope is set and a train passes the adjustment is found afterwards to be upset. The tremor of the passing train causes a release of any existing strain. Even if at each passage the release of strain may not produce a visible effect, yet the continued action of tremors will be to produce a gradual settling down of the instrument at a different rate from that at which it would proceed if tremors were absent. In the discussion the Astronomer Royal for Scotland declared that in his observatory they were probably free from any tremors, except those caused by their own lathes. The following papers on cosmical physics were also read:—the Astronomer Royal for Scotland, spectroscopic observations of solar eclipses; Prof. Schuster and Prof. H. H. Turner, a note on rainfall; the Rev. A. L. Cortie, the connection between disturbed areas of the solar surface and the solar corona; Miss C. O. Stevens, telescopic observations of meteorological phenomena; the Right Hon. the Earl of Rosse, the measurement of lunar radiation; Mr. J. E. Clark, the York rainfall and sun-spots; and Dr. W. J. S. Lockyer, some barometric and rainfall changes of an oscillatory nature.

In the department of general physics, Mr. C. E. S. Phillips described a glass of low electrical resistivity consisting of thirty-two parts of sodium silicate to eight parts calcined borax, to which 1·25 parts Powell's flint glass is added in order to increase the stability. This glass is intended to be used for the windows of electrostatic instruments which require to be electrically shielded. Its electrical conductivity is about 500 times that of the most conducting glass hitherto made. When powdered and fused on to clean copper, it adheres well without cracking. The change of resistivity with heat is being examined. In the discussion Mr. Rosenhain mentioned that glasses of the general composition of this one were not unknown in the trade. Dr. Erich Ladenburg gave an account of his researches on nearly pure gaseous ozone. This has a dark blue colour in a thickness of 30 cm. In the absorption spectrum were discovered five new bands which do not belong to ozone, but which always appear when the liquid ozone is allowed to vaporise. The gas to which they belong can be separated from ozone. The change of volume which occurs when the new gas is transformed and the value of the density indicate that the new gas is a more complex form of oxygen. In the discussion Dr. Rubens, in whose laboratory the research had been conducted, expressed his belief that it consists of hexatomic oxygen. Mr. Herbert Stansfield showed a series of photographs of thin liquid films in which the two kinds of grey and the three kinds of black are sharply distinguishable from one another. A paper by the Rev. B. J. Whiteside was communicated and read by Prof. F. T. Trouton, the subject being the rate of decay of the phosphorescence of Balmain's paint. The photometer employed depended upon the inverse square law. The standard light which was emitted through a small hole could be moved to various distances from an opalescent screen placed adjacent to the surface of luminous paint in a box. The distance was adjusted so as to maintain the intensity of the two illuminations the same, and the times corresponding to equal shifts of the standard were recorded on a revolving drum. The law of variation of intensity was found to be capable of representation by the formula $I=1/(a+bt)$, where $t$ is the time reckoned from that at which the paint ceased to be exposed to the exciting light. This result is of great interest, inasmuch as the same law arises in connection with the recovery of overstressed bodies, and this correspondence suggests that the mechanism involved may be similar in the two cases.

Sir Wm. Ramsay and Dr. J. F. Spencer described experiments on the chemical and electrical changes induced by ultra-violet light. These were in some cases confirmatory of what had previously been done in connection with this interesting subject. The result of greatest novelty and importance is that the fatigue of the surfaces was found to vary in a peculiar way. The rate of falling off when plotted against the time yields a curve presenting obvious breaks. In the case of dyad metals there are two of these breaks, and two places of constant rate of tiring; for tetrad metals four of these stages are observed. The paper was read by Dr. Spencer, and Sir Wm. Ramsay followed with an extended statement showing how the electronic theory of matter accounts for the photoelectric effects observed. Dr. O. W. Richardson mentioned that Dr. Smolochowski in some unpublished experiments had succeeded in showing that in a high vacuum the decay phenomena cease to take place.

An important paper was contributed by Mr. F. Soddy on the positive charge carried by the alpha particle of radium C. The substance of this paper has already appeared in the form of a letter in NATURE for August 2. Is or is not the alpha particle charged when it commences its separate existence? Mr. Soddy thinks he has proved that it is not so charged, and, assuming the validity of this conclusion, he considers that possibly too much stress

has been laid on the importance of electricity in connection with radio-active changes. Papers by Prof. E. H. Barton and J. Penzer and by Prof. W. F. Barrett were taken as read in the absence of the authors.

In the department of mathematics, Prof. A. C. Dixon read a paper on expansions in products of oscillatory functions, being an extension of a paper published recently by the author in the Proceedings of the London Mathematical Society. It deals with the expansion of a function of two variables $f(x, y)$ in the form $\Sigma\Sigma\phi_m(x)\psi_n(y)$, where $\phi$ and $\psi$ are functions of given type. Prof. W. H. H. Hudson described an analytical investigation of the curves traversed by a particle in a cyclonic storm. The curves appear to agree fairly well with observation, thus justifying the assumptions on which they are calculated. Lieut.-Colonel A. Cunningham gave some new properties of certain high powers of 2 called hyper-even numbers. Prof. A. R. Forsyth gave an interesting account of a revised theory of the solution of Lagrange's linear equation $Pp+Qq=R$. He showed that the solution hitherto accepted as the most general, viz. $\psi=f(u, v)$, where $u=a$, $v=b$ are any two independent integrals of the equations $dx/P=dy/Q=dz/R$, is not in reality the most general, and that other solutions exist which cannot be put in the usual form. Major P. A. MacMahon read a paper on two new symmetric functions which showed certain very interesting reciprocal relations between two sets of algebraic quantities. Papers by Mr. H. Hilton, on finite groups; by Prof. T. J. I'A. Bromwich, on multiple series, giving a new test for the convergence of a double series of positive terms; by Mr. A. R. Richardson, on many-valued functions of real variables; and by Prof. Alfred Lodge, on a new method of computing Bessel functions for high values of the argument, were read by Dr. L. N. G. Filon in the absence of the authors. The last paper was the means of the creation of a new committee with a small grant for the purpose of the further tabulation of Bessel functions.

Besides these papers there were the usual reports of committees, which contain much interesting matter. This is especially the case with the seismological report. Unfortunately the programme of the section was so full that the reading of these and of other papers had to be cut down. In order to indicate how full the programme was, it may be mentioned that on the Tuesday morning meeting the section met in three departments simultaneously, as well as at the same time sending representatives to two other sections where joint discussions were being held. In spite of this segregation the separate departments were very well attended. Altogether great interest was taken by the committee and members of the association in making the meetings a success. A. W. P.

## ANTHROPOLOGY AT THE BRITISH ASSOCIATION.

THE Anthropological Section met this year in the Victoria Hall, York, under the presidency of Mr. E. Sidney Hartland.

The president delivered his address on Thursday morning, August 2, taking for his subject recent research in the origin of magic and religion. After tracing the universal belief held by savage peoples that objects, animate or inanimate, are endued with a life and personality which is not confined to any particular object, but to all alike, Mr. Hartland showed how this personality was not only endowed with qualities, but by virtue of these very qualities possessed a potentiality and atmosphere of its own. This potentiality is known among some tribes by the name *orenda*, among others by the name *mana*, but by whatever name it is called the idea is substantially the same. In this *orenda* is found the root of all magic and religion. "Magic is primarily an application of *orenda*. By his *orenda* a man bewitches his enemy . . . causes rain or sunshine . . . divines the cause of sickness and cures it, raises the dead, spells out the future." His incantations and spells would be useless without this. Similarly, prayer is an application of *orenda*; in fact, this belief in a man's supernatural power and the efficacy by which the supernatural can be used to benefit man is the foundation of religion. The medicine man, shaman, or priest is merely the possessor of a more powerful *orenda* than his neighbour. It might be objected that this theory was upset by the Australians, and especially the Arunta, who are supposed to be in a state of primitive atheism; but not one of the Australian tribes is, strictly speaking, primitive, and in none of them is the idea of religion entirely absent, and what ideas they have are not at variance with, but complementary to, the theory here suggested.

The remainder of the morning was taken up with papers on general ethnology.

Messrs. T. A. Joyce and E. Torday communicated a paper, notes on the ethnography of the Ba-Yaka. These people, who live between the Inzia and Kwango rivers, tributaries of the Kasai, in the Congo State, have not previously been described, and the paper was consequently of unusual interest and value. Their culture, which is distinctly allied to the primitive West African type, proves them to be closely connected with the tribes on their southern and western borders. The men are small but well built. They do not practise cannibalism, but eat practically every other kind of flesh. They are skilled in handicrafts, but they have never heard of stone implements. The tribe is ruled by one paramount chief, but each village is immediately governed by a petty chief. The dead are buried in a sitting position, and the people believe that the soul leaves the body at death and visits the living in dreams. In the case of important persons it is thought that the soul is transferred to the body of a large animal.

Mr. F. W. Knocker read a paper on the aborigines of Sungei Ujong, who inhabit the hills to the north and north-west of Negri Sembilan, in the Malay States. The people are short but well built, with thick black hair and dark brown eyes. They have no birth, marriage, or death ceremonies, no religion or belief in an existence after death, nor do they practise any form of magic or witchcraft. Their chief weapon is the blow-pipe, with poisoned darts.

In a short discussion several speakers expressed themselves as very sceptical as to the absence of religious beliefs among the people, and Mr. Knocker, while stating that he had made every possible inquiry, admitted that the natives were extremely reticent when questioned on such matters.

Mr. S. S. Buckman communicated a paper on marriage and mating, in which he contested the views of Mr. Lang and Dr. Westermarck; and the morning's work was concluded by a paper on the Bushmen of Basutoland, by Mr. S. S. Dornan, in which he had collected all that is at present known about these interesting people.

In the afternoon the report of the committee appointed to explore the lake village at Glastonbury was taken. The work on this site is now nearing its completion, and in the past season a large area situated in the north-west corner of the village was explored. During the exploration another dwelling site, hitherto unrecognised, was brought to light, bringing the total number up to eighty-three. The finds were well up to the average of former years.

Dr. A. C. Haddon then gave an illustrated lecture on the ethnology of South Africa, in which he dealt chiefly with the manners and customs of the tribes whom he came across during the visit of the association to South Africa last year.

On Friday, August 3, the papers were generally of an archæological character.

Major P. Molesworth Sykes exhibited a collection of bronze weapons and implements found near Khinaman, in south-east Persia. The find consisted of five bowls, two pins, two knives, two javelin heads, two armlets of ordinary penannular form, two axe-heads, two rods with curved ends, and some clay vessels.

Notes on the collection were communicated by Canon Greenwell. The objects are undoubtedly grave goods, and are of the utmost interest on account of the light they throw upon the early metallic culture of the country. The bowls are of hammered copper, and one of them is provided with a handle or spout. It is difficult to say what the rods represent, but they may be symbols of authority. The axes are the most important part of the find. They were not weapons, as the method of fastening the handles precluded them being used for cutting. They

must either have been made expressly for the purpose of burial or were for ceremonial use. Both are double-ended and are ornamented, while one has, in addition to an incised ornament, two figures of beasts, one standing over the top of the socket, the other on the curve of the sharp end.

The paper led to an interesting discussion. Sir John Evans considered the axes ceremonial, and in some respects similar to Egyptian and Mesopotamian examples. He thought the pottery was of no great antiquity, but beyond that would make no attempt at dating. Prof. Ridgeway considered the objects were of a date within the Christian era, possibly the first or second century, but perhaps even later. Prof. Petrie felt certain that the axes were ceremonial. He hazarded the suggestion that the curved rods might have been models of polo sticks, on the analogy of games found in Egyptian burials. He considered the date of the find to be either late B.C. or early A.D.

Mr. E. M. Andrews communicated a note on the Webster ruin, Rhodesia. So far as is known the ruin is unique, as it is situated within a sacred enclosure containing a large number of graves. The building was probably intended to be circular. Immediately in front of the entrance, which is rounded, are pairs of monoliths, apparently to guard it. Other monoliths are distributed among the graves. The building appears to have been a royal tomb.

Prof. Ridgeway read a paper on the origin of the guitar and fiddle. He argued that these instruments were developed from the shell of the tortoise, as there was a tradition that Hermes made such an instrument, and Pausanias speaks of tortoises existing in Arcadia. There can therefore be little doubt that instruments with a tortoiseshell sounding-board existed in Greece. The waist of the instrument developed from the slightly narrowing waist of the shell. Guitars of tortoiseshell are still in use in some parts of the Mediterranean basin.

Prof. R. C. Bosanquet gave an account of the excavations undertaken at Sparta by the British School at Athens. The wall of the Acropolis was traced, and general conclusions were drawn as to the extent and disposition of the town at different periods. The famous sanctuary of Artemis Orthia was examined, and although its complete examination will take at least another season, many interesting finds have already been made, including geometric pottery and ivories, some of which show interesting affinities to those discovered by Mr. Hogarth in the Artemisia at Ephesus. These Spartan ivories were associated with spiral fibulæ and other bronze objects, lead figurines and masks, some undoubtedly intended to be worn. These masks point to the existence of some dramatic performances connected with the temple, and, in fact, in the third century A.D., a theatre-like building was constructed in the *temenos*, the proscenium of which was the front of the temple.

Mr. T. E. Peet communicated a paper on the prehistoric civilisation of southern Italy, with especial reference to Campania. The object of the paper was to discuss Prof. Pigorini's interpretation of the discovery of a well-marked *terramare* settlement in Scoglio del Tonno. The general conclusion arrived at was that the culture of Campania derived its Villanovan elements from the north, and that Scoglio del Tonno was the result of an isolated raid of *terramare* people, not a representative of a widespread culture of Italic type.

In the afternoon Miss L. F. Pesel read a paper on the evolution of design in Greek and Turkish embroideries. The materials on which the paper was based were collected in Greek lands round the shores of the Ægean. The embroideries are of various ages and styles; the earliest can be dated 1760, but the designs show the influence of Byzantine art modified by contact with Oriental styles from Asia Minor and Persia and with Italian art of the Middle Ages and Renaissance.

On Monday, August 6, the papers were again archæological, and, with the exception of two, dealt with the early antiquities of England.

Messrs. F. W. Rudler and W. H. Dalton communicated a paper on the "red hills" of the east coast salt marshes. The hills are low mounds of burnt earth, and are scattered along the estuarine marshes of the east coast. They have been the subject of much speculation and controversy, but no satisfactory conclusions have been arrived at, except that they appear to be of Roman date.

A paper was communicated by Dr. E. Cartailhac entitled "Découverte archéologique," which recorded the discovery, in the grotto at Gargas, of hands painted in red on the walls of the cavern. These hands have distinct affinities with similar paintings found in Australia. It is noticeable that at Gargas left hands predominate.

Miss Nina F. Layard read a paper on the Palæolithic site at Ipswich, supplementary to two papers laid before the association at former meetings. The finds of implements have, on the whole, been up to the average of former years, but the most important result was the discovery that the two layers of the pit, which seemed to point to two distinct and widely separated dates, are in reality one, and have been separated by a layer of mud silting in. This would account for the occurrence of tools of a similar type in the upper and lower gravels, and tends to show that the pit must be dated from the highest position in which the implements were found.

Miss Layard also read a paper on an Anglo-Saxon cemetery at Ipswich. Thirty-three graves were found from which numerous relics were taken, the most important being fibulæ of a type rarely met with in England, one being cruciform with a stud in the bow. Remnants of garments, consisting of a loosely-woven plaited fabric with a dress of coarse material above, were found adhering to one of the brooches.

An account of excavations in another Anglo-Saxon cemetery, at South Cave, Yorkshire, was given by Mr. T. Sheppard. Several skeletons were found, and with one, a female, was associated an exceptionally fine series of ornaments which appear not to have been previously worn, but to have been new when interred. The relics consisted of amber and glass beads, annular and other fibulæ, a pair of girdle hangers, and brooches. With a male skeleton several iron objects were discovered.

Mr. Sheppard also gave an account of some Roman and other remains from South Ferriby, on the Humber, now in the Hull Museum. The collection consisted of coins, fibulæ, rings, &c., mostly of bronze, as well as of specimens of Samian ware and other pottery. The objects were probably from the site of a small Roman camp and cemetery.

A collection of pygmy flint implements from Lincolnshire and Yorkshire, made by the Rev. R. Scott-Gatty, was exhibited by Dr. G. A. Auden.

Two important reports of committees were taken as read. The first, on the age of stone circles, chronicled the results of diggings at the Stripple Stones in Cornwall, with the result that the date of the circle is shown to be not earlier than late Neolithic or later than early Bronze age times. The other report, of the committee to conduct explorations on Roman sites in Britain, gave some account of recent excavations at Caerwent, Melandra Castle, Newstead near Melrose and Silchester.

Mr. D. G. Hogarth gave an account of the recent exploration on the site of Ephesus, and of the discovery of the primitive Artemisia.

In the afternoon Dr. T. Ashby, jun., described the excavations now being conducted at Caerwent. During the first part of the season the inner side of the south gate was cleared, and the inner arch was found to be to a great extent still preserved. The rest of the season was spent on work in the northern half of the town. Five buildings were excavated, one of which appears to have been the public bath. Of the other buildings, one possessed a colonnade, while in another remains of painted plaster were found on one of the walls, which was preserved for a height of more than 10 feet. Two wells were also excavated, and yielded a number of plant remains.

Dr. Ashby also gave an illustrated lecture on recent discoveries in the Roman Forum, in which he detailed the results obtained during the past year in the excavations. These included the discovery of the Lacus Curtius, of the tribunal prætorium, and of the position of the rostra. The place where Cæsar's body was burnt and the base of the equestrian statue of Diocletian were also found.

The work on Tuesday morning dealt exclusively with

physical anthropology, and the papers led up to a discussion on the physical characters of the races of Britain.

Dr. F. C. Shrubsall gave a demonstration of the methods of determining racial characters, in which he explained the meaning of the various terms used in craniology, and showed the distribution of the various races in Europe.

Dr. G. A. Auden exhibited a collection of crania, all from the neighbourhood of York, and to a great extent from the collection of the Yorkshire Philosophical Society. The exhibit included specimens of Celtic, pre-Roman, and Roman skulls, while one series showed the great change in head form which took place in York after the Norman conquest. Some of the Roman skulls had a sentimental interest, as they were from coffins unearthed in York and the names and ages of the persons were known.

A paper by Messrs. H. Brodrick and C. A. Hill on a recently discovered skeleton in Sooska cave was then read. The bones, which all belong to one individual, were found under a layer of stalagmite. The skeleton is that of a female Celt, and the skull is brachycephalic. Above the right mastoid process is an irregularly shaped hole, evidently the cause of death. The height appears to have been about 5 feet 3 inches.

Mr. J. R. Mortimer communicated a paper on the relative stature of the men with long heads, short heads, and those with intermediate heads in the museum at Driffield. Some doubt was thrown on the correctness of the figures, but if correct the paper was most important, as it entirely reversed the accepted theories as to the height of the Neolithic peoples of Britain, showing that the long-headed Neolithic man was taller than the broad-headed Neolithic and Bronze age man.

Mr. J. Gray read a paper on England before the English, in which, after stating the present condition of our knowledge of the subject, he argued that Neolithic man corresponds with the present Mediterranean race, and that the Anglo-Saxons and other fair races of northern Europe are a variety of Neolithic man with somewhat broader heads. The Bronze age race, which subsequently settled in Britain, was brachycephalic and tall, and came by sea from the eastern Mediterranean and Asia Minor.

At the conclusion of the papers Dr. W. Wright opened the discussion on the physical characters of the races of Britain. After quoting Cæsar to show that the coastal area was occupied by the Belgic Gauls and the interior by another race, he argued that all the evidence pointed to the fact that a mixed race came to Britain in Neolithic times, and that the population was not a pure broad- or a pure long-headed one.

Dr. Shrubsall urged the necessity of knowing exactly where skulls were found, considering that as careful evidence was required as in geology. He thought it a mistake to deal only with the length and breadth of the skull, and felt that the proportions of the face were just as important. Also all work required revision on biometric lines. As to coloration, which was very important, he pointed out that the Anglo-Saxons never called the Welsh dark, and felt that it was by no means certain that the Britons were a dark people. He also considered it quite possible that there was a Teutonic element in the population before Roman times.

Prof. Ridgeway insisted that all classical references speak of the Celts as a fair or rufous and tall race, and considered that there was no evidence of a pre-Celtic language in Britain.

Mr. J. L. Myres urged Prof. Rhys's view as to there being a non-Aryan structure in Welsh and Irish, and also protested against the practice of arbitrarily drawing conclusions from skull measurements.

Prof. Petrie considered that a *prima facie* case had been made out for an invasion of Britain, even in pre-Brythonic times, by a mixed race, but felt that much more material was needed before any definite conclusions could be drawn.

Dr. C. S. Myers threw doubt on the "Crania Britannica" records as perhaps affected by the collection of type skulls, and Mr. H. Fleure gave some account of the anthropometric work at present in progress in Wales.

The general conclusion to be drawn from the discussion was that it is of paramount importance that the existing material should be revised by improved methods, and that a better comparison with Continental data is essential.

In the afternoon Prof. Petrie gave an illustrated lecture on the Hyksos and other work of the British School of Archæology in Egypt. The most important work was the excavation of a great camp of the Hyksos or Shepherd Kings. The camp consists of an earth bank faced on its outer slope with white stucco, and with a slope, more than 200 feet long, serving as an entrance. This slope does not pierce the wall, but goes over it. Flanking walls were added to command this entrance, and the whole scheme of defence proves that archery was the only arm employed. Some sixty years later a wall of limestone was built outside the bank. There seems little doubt that the place is Avaris, and the account in Manetho's chronicle agrees with the arrangement of this site. The people appear to have been Semites from Syria and Mesopotamia. Other work resulted in the discovery of the city of Raamses, built by the Israelites, and of the town and temple of Onias, under whom the Jews founded a settlement in the second century B.C.

The work of the section concluded on Wednesday morning, August 8. Mr. J. L. Myres read a paper on early traces of human types in the Ægean. The population of the Ægean area as far back as the beginning of the Bronze age, before which there is no evidence, was not a purely Mediterranean type of dolichocephalic man, as brachycephalic individuals occur sporadically over the whole district. Ægean culture, therefore, cannot be the exclusive production of "Mediterranean" man. This evidence for brachycephalic types in the Ægean, when compared with the evidence as to the existence of a very pure brachycephalic race in the Balkan and Anatolian highlands, makes it probable that these latter people were established in these highlands at least as early as the beginning of the Ægean Bronze age, and were in competition with dolichocephalic "Mediterranean" man. Intruders from the north cannot have been brachycephalic, as the steppe of southern Russia was inhabited from Neolithic to Classical times by a dolichocephalic population. It seems improbable that the brunet dolichocephalic type of the southern Ægean could have arrived by a land route, owing to the presence of a brachycephalic type in the Balkan and Anatolian highlands, while its brunetness precludes affiliation to the dolichocephalic peoples of the north. This type, therefore, must be considered an immigration by sea from North Africa, and its littoral habits are a strong argument in favour of this view.

Dr. T. Ashby, jun., and Mr. D. Mackenzie communicated a paper on the ethnology of Sardinia.

Two papers were then read by Dr. W. H. R. Rivers. The first, entitled "A Survival of Two-fold Origin," dealt with the relation between a man and his maternal uncle. This connection, although in most races a survival from mother-right, in India originates, in many cases, in the regulation that the children of a brother and sister should marry one another. This involves that a man's maternal uncle is also his actual or potential father-in-law. The practice is now chiefly confined to the southern parts of India.

Dr. Rivers's other paper dealt with the astronomy of the islanders of the Torres Straits, who group together many stars in constellations, which often represent mythical persons. In Murray Island private property was found in stars, two stars being the property of two men who had inherited them from their ancestors.

Two physical papers were communicated by Dr. W. L. H. Duckworth. The first directed attention to a rare anomaly in human crania from Kwaiawata Island, New Guinea, the anomaly consisting in the presence of small but sharp spicular projections of bone springing from the margin of the nose due to a bony deposit formed in fibrous bands, which in all cases exist in a corresponding situation. Dr. Duckworth's other paper was a chronicle of observations made on a "eunuchoid" subject in the Anatomy School, Cambridge.

The last paper presented was a demonstration of photographs of racial types by Mr. T. E. Smurthwaite. Mr. Smurthwaite has evolved a new classification of the races of man from observations of the contours of the head and face, and he resolves all the races into six common types.

Three important reports were taken as read, namely, that of the committee to conduct anthropometric investi-

gations among the native troops of the Egyptian Army, to which was added some observations on nasal and cephalic indices in Egypt by Dr. C. S. Myers; that of the committee to conduct anthropometric observations in the British Isles, which issued in its report a series of photographs and diagrams of the living figure with the points, between which dimensions are to be measured, marked; and that of the committee to collect anthropological photographs, which issued a first list of photographs registered.

## *M. LIPPMANN'S METHOD OF PHOTOGRAPHY IN COLOUR.*

THE original method of photography in colour proposed by M. G. Lippmann was based on the production of interference fringes in the photographic plate, and had the disadvantages of requiring very delicate adjustments and a long exposure. In the *Comptes rendus* for July 30 M. Lippmann gives an account of a method in which long exposures are not required. Consider a photographic spectroscope consisting of a slit, a prism, a lens, and a sensitised plate. The light falling on the slit is analysed by the prism, and the rays produce a corresponding number of dark lines on the negative, each of which is a conjugate image of the slit. If a positive is taken from this negative, and the former placed in the exact position originally occupied by the latter, the system is reversible. If the plate is now illuminated by white light, the light passing through the transparent portion of the plate formed by any particular line will produce at the slit only that ray which originally imprinted the negative. On the whole spectrum, the net result will be to reconstitute at the slit the original colour. In order to apply this principle to photography in colours, the following apparatus has been arranged. The single slit of the spectroscope is replaced by a series of slits very close together, consisting of fine transparent lines ruled five to the millimetre. This grating is fixed at one end of a solidly built box, the other end carrying the photographic plate, and between these is a converging lens, in front of which is a prism of very small angle. The object to be reproduced is projected on the grating, illuminated with white light. The light passing through the prism and lens falls on the sensitive plate producing a negative in black and white, which under the lens appears lined, each line being divided into small zones, which are parts of an elementary spectrum. If the negative be now replaced in its original position and illuminated by white light, the eye being placed at the distance of distinct vision from the grating, the image of the object photographed is seen in colours, these colours being complementary to those of the object; the latter appears in its own proper colours when the negative is replaced by a positive. The spectrum of the electric light has been produced with this apparatus by the aid of a positive in its natural colours. It is necessary that the angle of the prism used should be so small that the length of each spectrum produced by it should be less than the length between each line, otherwise the spectra interfere with each other. Ordinary sensitive orthochromatic plates can be used, and the exposure required is very much less than with the interference method. The chief drawback at present is the necessity of using the identical apparatus in which the exposure is made to view the colours, but M. Lippmann suggests a method by which this difficulty may possibly be overcome.

## *UNIVERSITY AND EDUCATIONAL INTELLIGENCE.*

CAMBRIDGE.—The Frank Smart studentship in botany has been awarded to Mr. D. Thoday, of Trinity College. The studentship is held at Gonville and Caius College.

ENGINEER F. R. EICHHOFF has been appointed professor of iron metallurgy in the Berlin Mining School.

A MOVEMENT is on foot for the foundation in the Glasgow Agricultural College of a bursary, to be known as "the Biggar Bursary," in memory of the late Mr. James Biggar.

THE metallurgical laboratory of the Technical High School, Charlottenburg, is to be divided into two sections, the one, especially for iron and steel, to be under Prof. Mathesius, and the other, for the metallurgy of other metals, under Prof. Doeltz. Near the technical chemistry institute of the same high school a chemical museum has been provided and placed in the charge of Prof. O. N. Witt.

PROF. EDUARD SUESS, president of the Vienna Academy of Sciences, celebrated his seventy-fifth birthday on August 20, and also the fiftieth anniversary of his appointment as extraordinary professor of palæontology in the University of Vienna. Prof. E. Ludwig, the holder of the chair of medical chemistry in the same university, has been elected an ordinary member, and Prof. J. Herzig, professor of chemistry, a corresponding member, of the Vienna Academy of Sciences.

THE issue of *Science* for August 17 gives particulars as to the degrees of Doctor of Philosophy and Doctor of Science conferred during the past year by American universities. The number of students receiving one or other of the degrees in 1906 was the same as in 1905, viz. 325, while the total number of doctorates (in philosophy or science) conferred in nine years was 2387. The names of those on whom the degrees were conferred, the subjects of their theses, and the names of the institutions conferring the degrees are given in the number.

IN connection with the meeting in Canada of the British Medical Association, the honorary degree of LL.D. has been conferred by the University of Toronto upon the following medical men:—Prof. T. Clifford Allbutt, F.R.S., Dr. A. H. Freeland Barbour, Sir Thomas Barlow, Bart., Sir James Barr, Sir William Broadbent, Bart., F.R.S., Prof. G. Cooper Franklin, Prof. W. D. Halliburton, F.R.S., Sir Victor Horsley, F.R.S., Dr. Donald MacAlister, Dr. W. Julius Mickle, Dr. Louis Lapicque, Paris, Dr. Ludwig Aachoff, Marburg, and Dr. W. J. Mayo, president of the American Medical Association. The degree was also conferred *in absentia* upon Dr. H. W. Langley Browne, chairman of the British Medical Council. The same degree is also to be conferred *in absentia* on Sir Thomas Barlow, Bart., Sir William Broadbent, Bart., F.R.S., Prof. T. Clifford Allbutt, F.R.S., and Sir Victor Horsley, F.R.S., by the McGill University, Montreal.

IN the last of six lectures on British institutions, delivered to students attending the University Extension summer meeting at Cambridge, Prof. Masterman dealt with education. He said we are just at the beginning of a systematisation of our secondary education as an attempt to complete the ladder for brilliant pupils from the elementary school to the university. There is a danger, he said, that the majority of children unable to climb such a ladder may be neglected. Prof. Masterman thinks that the next two towns to obtain a university charter will be Bristol and Newcastle. The new universities are largely dependent on the subsidies of municipal authorities. In this the lecturer sees the danger, and he does not speak without knowledge, that the universities will be hampered from the higher education point of view by the entirely inadmissible conditions of the municipal authorities. The men who provide the money may claim to control the expenditure of it and disregard the opinions of experts. That can only be averted by a large subsidy paid from the central authority. He urged that universities ought to receive greater assistance from the State.

## *SOCIETIES AND ACADEMIES.*

LONDON.

**Royal Society**, May 10.—"The Action of Anæsthetics on Living Tissues. Part II.—The Frog's Skin." By N. H. **Alcock.**

This paper is a continuation of researches made on isolated nerve (Proc. Roy. Soc., B, vol. lxxvii., p. 267), and the phenomena here described are to be considered in connection with them.

The experiments may be summarised as follows:—

(1) $CHCl_3$ vapour locally applied to the outer surface of the frog's skin abolishes the normal ingoing resting current.

(2) $CHCl_3$ to the inner surface leaves the current unaffected.

(3) $CHCl_3$ to a combination of (outer-inner) surfaces, connected with another spot on the outer surface, diminishes the current.

(4) The electrical resistance of the skin is diminished by about 24 per cent. of its value by $CHCl_3$.

Certain conclusions can be deduced from these observations:—

(*a*) The apparatus furnishing the current is located at the outer surface.

(*b*) A diagram of an electrical apparatus which would give similar results to those observed on the skin shows that the latter must consist of structures resembling galvanic cells, the positive elements of which lie towards the outer surface, and are insulated from each other, the negative elements towards the inner surface, and connected together. If it is assumed that the current in the skin is due to the movement of ions, it appears from the present experiments (and also from those in part i.) that there must be some semi-permeable apparatus in both skin and nerve, and that choloroform renders this apparatus completely permeable, so making the whole tissue iso-electric. The diminution of resistance can be accounted for by this action, which is equivalent to a diminution of viscosity.

If this interpretation of the results is correct, it furnishes an actual demonstration of the existence of some form of semi-permeable apparatus in the tissues, and suggests that a similar mechanism may play a larger part in vital phenomena than had previously been supposed.

PARIS.

**Academy of Sciences**, August 13.—M. Bouquet de la Grye in the chair.—Irrigation and the permeability of soils: A. **Müntz** and L. **Faure**. The authors discuss the value of the application of irrigation to parts of France, and argue that irrigation works must prove unremunerative in private hands, and should be undertaken by the State. Proper attention does not appear to have been paid in the past to the different requirements of different classes of soil for water. The nature of the soil is not a sufficient guide in this matter, apparently similar soils having been found to require very different amounts of water. A description is given of a simple instrument for making this determination.—The two specific heats of a slightly deformed elastic medium; the fundamental formulæ: P. **Duhem**.—The preparation of pure barium starting from its suboxide: M. **Guntz**. Equivalent portions of magnesium and baryta, heated in a vacuous porcelain tube containing a water-cooled steel tube, gave a deposit on the cold tube of one-half the magnesium employed, together with traces of barium. The residue in the boat possessed properties corresponding to an oxide $Ba_2O$. If the magnesium is replaced in this reaction by aluminium, crystallised barium deposits on the cold tube. This was found to contain 98·8 per cent. of barium, and on a second distillation in a vacuum gave pure barium. Strontium can be obtained in the same way.—The aromatic azocyanamides: P. **Pierron**.—A property of diastase: J. **Duclaux**. The application of recent studies on colloids to diastase. The author holds that the quantity of active material in diastase, by reason of which it exerts its diastatic functions, need, in a set of experiments, bear no constant and necessary relation to the quantity of crude diastase taken, and that different experiments, even simply made at different dilutions, are not comparable among themselves.—The copper-steel alloys: Pierre **Breuil**. Copper increases the tenacity and reduces the ductility of steels, but the results obtained with a given alloy depend very largely upon the treatment the metal has received.—The cultivation of micro-organisms in chemically defined media: J. **Galimard**, L. **Lacomme**, and A. **Morel**.

August 20.—M. Bouquet de la Grye in the chair.—The progress of a fruit-attacking insect, *Ceratitis capitata*, in the neighbourhood of Paris: Alfred **Giard**. Six years ago the author pointed out the presence of this destructive exotic in the neighbourhood of Paris. At that time there were only a few apricot trees attacked, and it should have been easy to prevent its acclimatisation. The author's suggestions made at that time were, however, disregarded, and at the present time damage is being done to peach trees in various localities round Paris, damage which may, given a few dry seasons, become as disastrous as at the Cape of Good Hope, unless prompt measures are taken.—The Valparaiso earthquake (August 16, 1906), registered at Paris: G. **Bigourdan**.—Observations of the Finlay comet made with the large equatorial of the Bordeaux Observatory: E. **Esclangon**.—Definitive orbit of the comet 1905*a*: M. **Giacobini**.—The boiling points of some secondary and tertiary alcohols: G. D. **Hinrichs**. Referring to a recent note by M. Louis Henry on this subject, the author points out that the relationships between the boiling points of the secondary and tertiary alcohols need not be regarded as unusual, since they can be deduced, at least qualitatively, from a consideration of the moments of inertia of the molecules.—Researches on the relations between functional groupings in distant positions. Decamethylene-imine: E. E. **Blaise** and L. **Houillon**.—The influence of some mineral compounds on the liquefaction of starch: J. **Wolff** and A. **Fernbach**.—Cultures of Protozoa and variations of living material: J. **Kunstler** and Ch. **Gineste**.

NEW SOUTH WALES.

**Royal Society**, July 4.—Prof. T. P. Anderson Stuart, president, in the chair.—The testing of building materials on abrasion by the sand-blast apparatus: H. **Burchartz**. The paper described a method of testing building material by means of a sand-blast apparatus. The sand-blast apparatus is used on cubes of the material, exposing an area of 4·34 square inches for two minutes, and the loss of weight, and the appearance of the area eroded by the sand, give accurate data in regard to the durability of the material. The author compared the results of testing a great variety of materials by means of the sand blast with those subjected to the grinding process proposed by Bauschwiges, and showed the superiority of the sand blast over all other tests for abrasion.

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