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University Grants.

THE governing bodies and teaching staffs of the universities will view with dismay the proposal of the Lords Commissioners of H.M. Treasury to reduce the annual grant-in-aid of university education from 1,500,000*l.*, at which it stands in the current year, to 1,200,000*l.* for the coming financial year 1922–23.

It will be recalled that in the Estimates for 1921–22 a sum of 500,000*l.* was added to the annual grant, which at that time stood at one million. Of this 500,000*l.* it appears that 200,000*l.* has already been allocated in the form of *annual* grants to the various institutions participating in Parliamentary grant, while it is presumed that the remaining 300,000*l.* has been, or will be, available for non-recurrent allocation. On some such assumption it is explainable how the sum of 1,200,000*l.* has been arrived at. If the reduction of 300,000*l.* is agreed to by Parliament there will be in consequence no addition in the coming financial year to the annual grants now paid to these institutions, and obviously no non-recurrent allocation.

In the light of these statements it is important to review the question of university grants. Two facts are clear: (1) When Parliament voted the additional annual grant of half a million last session it did so on the ground of necessary and essential expenditure—this was made perfectly clear by Sir Philip Magnus and others in the debate on the Estimates; and (2) the governing bodies and teaching staffs of the universities assumed, and with perfect justification, that the grant, voted as an *annual* grant, would be disbursed as such. That only 200,000*l.* was allocated as annual grant and the rest as a non-recurrent allocation—a principle which, whatever its good points, is open to serious criticism—does not make the assumption less justifiable. Accordingly it was perfectly legitimate for the universities to make their plans in the belief that the 300,000*l.* would be available in succeeding years. The withdrawal will mean that these institutions will be let down and let down badly. One can readily understand why, at the recent opening of a bazaar to raise funds for Manchester University, "this grave fact was a subject of pained comment" by the vice-chancellor. "Comment" characterised by quite a different word from "pained" would not have surprised us. Sir H. A. Miers must have exercised great restraint on that occasion.

If the additional grant of 500,000*l.* is necessary and essential for the current year, what is the reason for the proposed withdrawal of three-fifths of it for next year? Is it less necessary or essential then, or is there some other reason? The plea of national economy cannot be justified. Very little consideration will show that to curtail the range of university education or to limit its possibilities is to curtail and limit the progress of civilisation, whether in things of the spirit or in the organisation and development of science as applied to commerce and industry. It is a short-sighted policy and one fraught with sinister import if the highest institutions of learning in the country are allowed to flounder in a morass of financial difficulties. It is certainly economy, but economy of a peculiar kind; it is the economy which leads to spiritual and material bankruptcy.

Let us examine the question a little more closely. Last February the University Grants Committee reported in no doubtful terms upon the clamant needs of the universities, and in particular upon the emoluments of university teachers. The report stated that the salaries were still below the minimum necessitated by economic conditions, and that the committee was satisfied that unless further substantial improvement was made the efficiency of university education would be seriously endangered. It went on to say that "the best men and women would neither enter nor continue in the profession at the rate of salaries then within the competence of the authorities to offer, nor could a teacher under the perpetual shadow of financial anxieties give his best to the work of instruction and research." This statement, strong as it is, has been amply confirmed by the difficulties which various departments in the universities are experiencing at the present time in recruiting their staffs.

Upon the strength of this report, together with representations made to Parliament by various interested bodies, the additional annual grant referred to above was made by Parliament. Now it is proposed to ask Parliament to cut down this grant. Such a proposal, in our opinion, can be justified only if it is shown that the grant is neither necessary nor essential in the coming year. Without considering the question of the further development of the universities, all-important as it is, let us examine one of the factors in the situation—university stipends.

Last July a conference of the heads of university institutions, the non-academic members of university governing bodies, and the council of the Association of University Teachers approved of a scale of minimum salaries for university teachers. This scale is extremely moderate, and, as a *minimum* scale, seems likely to meet with general approval. On the basis of these very reasonable proposals it was estimated that it would require an additional sum of about 400,000*l.* to raise the full-time teachers in university institutions in England and Wales to the minimum salary of the scale. Assuming that since the date when the Estimate was made an aggregate sum of 100,000*l.* has been added to the emoluments of the university teachers referred to, there still remains a sum of 300,000*l.* required to raise these teachers to their minimum on the scale. In this figure no allowance is made for an increase in the number of teachers or in the stipends of those who have reached their minimum.

Thus at the very time when an annual sum of 300,000*l.* is required in England and Wales to put university teachers on a minimum scale, which has been drawn up with due and proper consideration of the necessity of national economy, the Lords Commissioners of the Treasury propose to reduce the annual grant by 300,000*l.*, precisely the sum which, if distributed as an annual grant for salary purposes, would have enabled the university authorities to establish a reasonable and just scale of remuneration. Is it any wonder that the governing bodies and teaching staffs of the universities are dismayed at the proposal? We trust, however, that Parliament will not deal with our universities in this fashion, but, recognising that their necessities will be no less in the coming year than they are at the present moment, decline to be a party to a proposal which, in our opinion, from whatever side it is examined, cannot be justified.

Psychological Medicine.

The Basis of Psychiatry. By Dr. Albert C. Buckley. Pp. xii+447. (Philadelphia and London: J. B. Lippincott Co., 1920.) 30*s.* net.

AT the present time, when great interest is being taken by both public and Press in the questions of body in relation to mind, psychoanalysis in the treatment of the psychoneuroses and psychoses, and the necessity of lunacy reform, a book which deals comprehensively with the subject of psychological medicine is especially welcome. Moreover, now that the conjoint board of the Royal Colleges of Physicians and Surgeons and many of the universities, notably Cambridge and London, have instituted a diploma of psychological medicine, a book such as "The Basis of Psychiatry" is notably opportune, and we have no hesitation in recommending this book strongly to students and practitioners, for it satisfies a long-felt want.

The author first discusses biologic phenomena, including the laws of heredity and their application to mental and nervous diseases. Then follows a brief but useful chapter on cerebral development and receptive organs, with a description of the autonomic system and its functions. We are rather surprised to find that no mention is made of Hughlings Jackson's levels. The author shows how sensitivity and differential sensitivity constitute fundamental biological phenomena, but Head's theory of protopathic and epicritic sensibility is not alluded to. This may be an omission on account of space rather than disbelief in its validity.

Chap. 5 is devoted to psychological processes, and should prove very useful to students and practitioners, for it enables the reader to grasp principles and become familiar with psychological terms sufficiently to enable him to understand and express in suitable language disorders of the mind.

Since psycho-analysis is at the present time attracting so much attention of the profession, the public mind, and the Press, it will be interesting to consider a little fully the views of Prof. Buckley. The doctrine of the unconscious mind is discussed, and the author points out that it was an outgrowth of abnormal psychology led by Charcot and continued by his pupils Janet and Freud. He describes briefly Janet's pioneer work on dissociation of consciousness upon the basis of which the symptoms commonly met in hysteria were explained by the eminent French psychiatrist. The further development of the unconscious by Freud, according to whom psychoneuroses are due to a complex carrying with it a mentally painful emotional tone, is also discussed briefly. His theory of repression of painful experiences and mental conflict are referred to, but no mention is made of infantile repression, the theory of erogenous zones, and the analysis of dreams and their significance, to which so much importance is attached by psycho-analysts. We are of opinion that a fuller account and criticism of Freud's theories, whether the author is in agreement therewith or not, would have been of service to the student and practitioner. Whatever view Prof. Buckley takes of the Freudian theories he certainly is not in agreement with treatment by psycho-analysis, for he says :—

"The matter of psycho-analysis has as yet not reached its proper level. Until that condition has been reached it would be well to accept those portions of it that can be demonstrated beyond hypothetical bounds to be of real value and avoid as far as possible going out of the way to inject into the fatigued patient's mind a score of ideas which though 'submerged' in the unconscious, possibly may do less harm than if brought to the patient's realisation."

Another matter which we have indicated previously as arousing public interest and exciting an uneasy feeling in a large section of the public at the present time is the failure to adopt hospital methods of treatment of recoverable cases in our large asylums in accordance with medical science. At present these institutions are, generally speaking, mental hospitals only in name. They appear in a large number of instances to be really institutions of detention in which recoverable cases are herded together with, and treated in the same old institutional manner as, the chronic and senile cases. The superintendent of an institution in which the majority of cases demand merely administrative duties tends to grow out of touch with medical science and progress. Mental hospitals for the recoverable cases are urgently needed in which medical officers are able to apply hospital methods of psychological, clinical, and laboratory investigation of the patients committed to their care.

Methods are described and their utility in diagnosis, prognosis, and treatment are admirably discussed by Prof. Buckley, who, from the following paragraph in the preface, clearly emphasises the importance of treating the bodily condition :—

"As physicians and practitioners we have come to consider the group of mental disorders which belong to the class of recoverable psychoses, not primarily as mental diseases, but as reflections of some bodily disorder, which through its effect upon the organ of adjustment, the nervous mechanism and its lower and higher (psychic) reflexes prevents the patient from making the necessary appropriate adaptations to environmental conditions, and therefore constitutes a thoroughly biological problem."

The author gives three fundamental groups of factors in the production of mental disorders.

"(1) The biogenetic factor dependent upon defects of development, either structural or functional; (2) disturbances of function brought about by toxic agents either exogenous or endogenous; (3) organic neuronic changes, occurring either as primary disintegrative processes or structural changes secondary to pathologic conditions in non-neuronic structures."

The most important question in reference to the etiology, prognosis, and treatment resolves itself into the matter of determining first of all to which of these three groups the case belongs. After eliminating the psychoses which may be the result of bodily disturbances there remains a group of biogenetic psychoses comprising dementia præcox and the manic-depressive psychosis, "which develop upon an inherently defective foundation." "The dementia præcox patients present an original defect, which is intensified by some as yet unknown operative cause." The author does not refer to the researches of Mott upon the reproductive organs, who has shown a primary, germinal, regressive atrophy of the testis and ovary, which he correlates with the primary nuclear degeneration of the neuron affecting first the highest evolutional level. Nor does he refer to the same observer's researches upon the ages of admission to asylums of more than 3000 relatives, showing that the offspring of insane parents exhibit a marked tendency to have their first attack at a much earlier age. This antedating or anticipation tends to elimination of the unfit by bringing the disease on in adolescence, rendering the subject unable to compete with his fellows, and antisocial, thereby necessitating segregation. These psychoses are not peculiar to civilised races, and are doubtless due to germinal variation.

Nevertheless, Prof. Buckley's work is excellent and calls for little criticism, though we are of opinion that the pathology of mental diseases is not on the same high level and as up-to-date as the clinical and therapeutic portions of it. To take an example, in discussing the symptoms of myxœdema the author does not refer to the fact of the diminution and, in extreme cases, of the disappearance of the Nissl substance in the neurones, while the important functions of the cortex adrenalis are not mentioned.

There are seventy-nine excellent illustrations, mainly anatomical, psychological, clinical, and experimental, but the cost of the coloured plate in the frontispiece, presumably an advertisement of the publishers, would have been better expended in illustrating such pathological changes as are known in the explanation of mental disease. The bibliography at the end of each chapter is valuable, and the index is well compiled. We hope to see published at an early date a second edition of this valuable text-book.

British Mammals.

British Mammals. Written and illustrated by A. Thorburn. (In two vols.) Vol. 2. Pp. vi+108+plates 26–50. (London: Longmans, Green and Co., 1921.) 10*l.* 10*s.* net (2 vols.).

IT is somewhat unfortunate that seals, whales, and bats constitute so large a proportion of our mammals, for the public, after all, take a lively interest only in such creatures as come under their notice. Including sub-species, there are roughly eighty in all, of which twenty-eight are sea creatures, mostly rare and generally thrown up on our coasts in a decomposing condition, whilst the bats, which number twelve, being crepuscular or nocturnal in their habits, are also known to few. When we add to this total the rats, mice, and voles, for the most part shy and elusive inhabitants of the earth, the total number of British mammals that come under the notice even of the most observant country dwellers is remarkably small.

In his second volume Mr. Thorburn treats his subject with the same care and attention to detail that he gave to us in volume one. Even when the subject is somewhat dull he succeeds in making an interesting feature of it by means of skilfully introduced natural features or landscape. We cannot say, however, that in the present volume he is equally at home in depicting deer or the so-called wild cattle as he is with the small rodents or Cetaceæ. The mountain hare is good, but the common hare is stiff and inartistic. Of all our mammals it is the most difficult to draw, and in this case the artist has failed to reproduce it in one of its more favourable attitudes. Nor are we enamoured of the pen drawings; they fall far behind the brush work, and being reproduced on pure rag-paper lose much of their original delicacy. In his coloured plates of mice and voles Mr. Thorburn is at his best, and that is saying a great deal, for it is evident he has drawn the majority of these from life, and has given us all their sleek beauty and rotundity. Here his art is triumphant, which is to say it is entirely satisfactory. Such work will live and hold its own, and take high place among works on British birds and beasts. Mr. Thorburn, too, has achieved a notable success in his representations of the British Cetaceæ, difficult subjects either to render accurately or to make interesting. We notice few errors, with the exception that the teeth of the sperm whale are too small and too white, while the head and flippers of the hump-backed whale are scarcely long enough.

The letterpress gives a short and on the whole very accurate account of all the species of rodents, ungulates, and whales. The author describes each species from careful research in standard works, supplemented by interesting little notes from personal observation. That he is a real lover of animals is evinced on every page where he describes the intimate habits of little harvest mice and other small creatures that he has kept in confinement and allowed to escape when they have been sufficiently studied and have sat for their portraits.

The second volume of "British Mammals" is a notable achievement and worthy of Mr. Thorburn's high reputation, but it is not on a level with the first volume. The printing, both of the coloured plates and of the text illustrations, leaves much to be desired. These faults, however, cannot be attributed either to the author or his publishers, but are due to the carelessness of printers and block- and paper-makers, who, we think, do not take the same care and pride in their work as in pre-war days. J. G. M.

Plant Biochemistry.

The Chemistry of Plant Life. By Dr. R. W. Thatcher. (Agricultural and Biological Publications.) Pp. xvi+268. (New York and London: McGraw-Hill Book Co., Inc., 1921.) 18*s.* net.

OF recent years much attention has been given to plant- or phyto-chemistry, if we may judge from the number of books which have been published on the subject. The origin of this attention can be traced to the strides that have been made in the organic chemistry of the carbohydrates, proteins, and other complex compounds, and to the development and wide general applications of physical chemistry. The purely chemical and physical details are the essential foundations for a proper understanding of the subject and for throwing new light upon the complicated chemical and physical processes going on simultaneously in life. Authors of books on plant chemistry have an advantage over their colleagues in the other branch of biochemistry—physiological or animal chemistry—in not being cumbered with a mass of material which may be described as traditional, and requires considerable pruning.

Dr. Thatcher's aim has been to present the chemical and physical details in an elementary manner, to point out their application in plant life, and at the same time to instil a spirit of inquiry into his readers. We think he has succeeded in his efforts. A previous acquaintance of elementary inorganic and organic chemistry is assumed, and it depends upon the depth of this acquaintance whether the student will grasp the contents. There will be no difficulty with the chapters on plant nutrients and photo-synthesis, but unless stereochemistry has been previously well learnt, the carbohydrate chapter will scarcely be understood. Herein we miss the equations for the formation of osazones. Also we can scarcely agree with the author that tannins are glucosides. Chlorophyll and plant pigments are really the most complicated in structure of plant products, and might well have formed the last chapter, instead of preceding organic acids, esters, and fats. Too little space is given to the nitrogenous constituents —a single chapter includes amines, alkaloids, purine and pyrimidine bases, and nucleic acid—while the classification of proteins is more complicated than usual.

The last third of the book deals with enzymes, colloids, and physical chemistry, mainly to show their importance in plant life. Finally there is a brief reference to hormones, auximones, vitamins, and toxins. Altogether, the book gives an excellent orientation of the subject, and much should be learned from it by the student; at any rate, he could probe further if he so desires, for references are given at the end of each chapter.

Our Bookshelf.

A History of the Cambridge University Press, 1521–1921. By S. C. Roberts. Pp. xv+190. (Cambridge: At the University Press, 1921.) 17*s*. 6*d*. net.

MR. ROBERTS's "History of the Cambridge University Press" is a very interesting account of the difficulties met with in the gradual advance from small beginnings, culminating in the highly efficient organisation of the present time. The numerous illustrations representing title-pages and the list of books published between 1521 and 1750 add much to its value.

John Siberch, otherwise John Laer of Siegburg, near Cologne, set up the first printing press in Cambridge in 1520, having settled there probably at the wish of his friend and patron, Erasmus, who in 1510 had come to live in the turret chamber of Queens' College, and to be the first teacher of Greek at the University.

There are examples of several books printed by Siberch at Cambridge in 1521. He may thus be looked upon as the founder of the Cambridge University Press. Accordingly, 1921 is the four hundredth anniversary of University printing in Cambridge.

It is not clear that John Siberch was officially recognised as printer to the University, but in 1534 King Henry VIII., by letters patent, gave licence to the chancellor, masters, and scholars to elect from time to time three stationers and printers or sellers of books, residing within the University.

The Stationers Company of London repeatedly but unsuccessfully challenged the rights thus conferred upon the University, until they were finally confirmed in a Charter granted in 1628 by Charles I.

Although it appointed printers, the press did not come directly under the control of the University until 1697, when, by a grace of the senate, the first Press Syndicate was appointed.

A Text-book of Physics. Edited by A. Wilmer Duff. Fifth edition, revised. Pp. xiv+700. (London: J. and A. Churchill, 1921.) 16*s*. net.

No sweeping changes appear to have been made in the "Text-book of Physics," edited by Prof. A. Wilmer Duff, since the last edition, referred to in NATURE of March 15, 1917, p. 41, was published. The editor states in his new preface that "students of college Physics should have some acquaintance with such new and live topics of scientific, and even popular interest" as wireless telegraphy and telephony, sound-ranging, submarine detectors, the diffraction of X-rays, the instruments used in aeroplanes, and the principle of relativity, but with the exception of the paragraphs dealing with wireless telegraphy, the information afforded by the additional matter is of little value. Many of the illustrations, particularly those showing actual apparatus, are of a sketchy type.

The Elements of Illuminating Engineering. By A. P. Trotter. (Pitman's Technical Primers.) Pp. xii+103. (London: Sir I. Pitman and Sons, Ltd., 1921.) 2*s*. 6*d*. net.

THIS booklet contains, in a revised and condensed form, much of the information conveyed in the author's well-known larger volume; some additional practical hints are also included. The initial chapter deals with laws and definitions. The effect of light on vision and the origin of glare are then briefly treated. Next Mr. Trotter passes on to a discussion of the chief sources of light, illustrating the distribution of light in each case and pointing out the fundamental principles involved in effective shading. Finally there are chapters on photometry and the planning of lighting installations. The diagrams are invariably clear and informative, and the explanations are lucid. The author has made good use of the space available, and his work will form a useful introduction to illuminating engineering.

Letters to the Editor.

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Metallic Coloration of Chrysalids.

I HAVE read Mr. Mallock's letter (NATURE, November 3, p. 302) on iridescent colours with the greatest interest, but I cannot help thinking that in some cases his statements are slightly misleading. Mr. Mallock seems to imply that all the iridescent colours of the animal world are due to some form of interference. It is true that he restricts his statement to the cases he has examined, but it seems safe to assume that if many colours were due to other causes, Mr. Mallock would have met with some of these among the many hundreds of cases investigated during the twenty years in which he has prosecuted his researches.

I cannot lay claim to having carried out such extensive investigations, nor have I the training in physics which gives so much weight to Mr. Mallock's words, nevertheless I venture to urge that the phenomena of insect iridescence (not to speak of the rest of the animal world) include many cases which cannot be brought into the category of interference. These exceptions cannot be described now, but some have appeared in NATURE (September 30, October 7, and October 14, 1920), and a fuller account is to be found in Phil. Trans. Roy. Soc., B, vol. 211, pp. 1–74.

It would be interesting to know how Mr. Mallock explains the colours of the wings of those beetles, bees, and dragon-flies which the late Lord Rayleigh, Prof. Poulton, and myself have found would change colour neither on pressure nor when immersed in fluids under reduced pressure. Such beetles include the rose beetle (*Cetonia aurata*), many Buprestids, and other common insects, some of which Mr. Mallock is sure to have examined. Then there are the golden elytra of *P. resplendens,* which resist pressure and change to magenta on being polished; also the numerous iridescent tortoise beetles, the colour of which not only resists pressure, but even the removal by polishing of the thick surface-layer of chitin without altering its appearance. Among iridescent birds Mandoul has found that peacock's feathers resist pressure, and even hammering on an anvil; the bright-coloured feathers of Cotinga, which Haecker and Meyer attribute to "blue due to the scattering of small particles" by fine canals (*Porencanälen*) in the keratin, would, I presume, not be considered by Mr. Mallock as true iridescent objects.

Finally, there are the beetles to which Biedermann first directed attention (*e.g. H. africana*). Whether or not the cause of their colour is the same as in the last case, sections of the elytra in the plane of the wing are of nearly the same colour as the original beetle. Sections at right angles to the elytra are the same yellowish colour as the chitin.

Mr. Mallock also asserts that the colours of birds and insects are not, as has so often been said, due to diffraction. I admit that I know of no butterfly in which the principal colours are caused in this way, but what of the pale Morphos and other insects which, when the wing is partly turned, exhibit all the colours of the spectrum superimposed on the ground colour? These colours correspond exactly, in appearance and angle, to those of the replica diffraction gratings made in collodion from the wings.

Personally, I am prepared to agree that the wings of almost all iridescent Lepidoptera owe their colours to interference, but it would be interesting to learn Mr. Mallock's reasons for disagreeing with so eminent an authority as Prof. Michelson, who is of the opinion, on purely physical grounds, that all the colours of insects are due to selective metallic reflection, with the exception of the iridescent scale-bearing weevils (*e.g.* the diamond beetle), the colours of which he attributes to diffraction—a cause ruled out by Mr. Mallock.

I have referred only to the colours of insects and birds, but it would be most interesting to know to what forms of structure Mr. Mallock attributes such striking examples of iridescence as are to be found among the hairs of some mammals, the setæ of many marine worms, certain ferns and seeds, and many brilliantly coloured crustacea, some of which Mr. Mallock must surely have examined.

H. ONSLOW.

3 Selwyn Gardens, Cambridge, November 9.

The Softening of Secondary X-rays.

A NUMBER of experimenters have noticed that when a beam of X-rays or γ-rays traverses any substance, the secondary rays excited are less penetrating than the primary rays. Prof. J. A. Gray (Franklin Institute Journal, November, 1920) and the present writer (*Phil. Mag.*, May, 1921, and *Phys. Rev.*, August, 1921) have shown that the greater part of this softening is not due, as was at first supposed, to a greater scattering of the softer components of the primary beam, but rather to a real change in the character of the radiation. My conclusion was that this transformation consisted in the excitation of some fluorescent rays of wave-length slightly greater than that of the primary rays. Prof. Gray, on the other hand, showed that if the primary rays came in thin pulses, as suggested by Stokes's theory of X-rays, and if these rays are scattered by atoms or electrons of dimensions comparable with the thickness of the pulse, the thickness of the scattered pulse will be greater than that of the incident pulse. He accordingly suggests that the observed softening of the secondary rays may be due to the process of scattering.

It is clear that if the X-rays are made to come in long trains, as by reflection from a crystal, the scattering process can effect no change in wave-length. On Gray's view, therefore, if X-rays reflected from a crystal are allowed to traverse a radiator, the incident and the excited rays should both have the same wave-length and the same absorption coefficient. If, on the other hand, the softening is due to the excitation of fluorescent rays, as I had suggested, reflected X-rays should presumably be softened by scattering in the same manner as unreflected rays. An examination of the absorption coefficient of reflected X-rays before and after they have been scattered should therefore afford a crucial test of the two hypotheses.

The double reduction in intensity which occurs when the X-ray beam is first reflected by a crystal and then scattered by the radiator made Gray's preliminary attempts to perform this experiment unsuccessful. In the September (1921) issue of the *Philosophical Magazine*, however, Mr. S. J. Plimpton describes a successful attempt to measure the absorption of the K lines from rhodium and molybdenum after being scattered by paraffin and water. He observed no change in the absorption coefficient of the rays after being scattered by the paraffin. Apparently his measurements were made on the secondary rays at comparatively small angles, and this, together with the relatively long wave-lengths employed, form the conditions under which the least change in hardness occurs when unreflected X-rays are used. I accordingly repeated Mr. Plimpton's experiments, using the K lines from tungsten (effective $\lambda=0{\cdot}196$ Å.) reflected from rock-salt, and measured the absorption coefficient of the secondary radiation excited by these rays in paraffin. The absorption coefficient of these rays was found to be considerably greater, by about 52 per cent. at 90° and 22 per cent. at 30°, than that of the beam incident on the paraffin.

In order to compare my results with those of Mr. Plimpton, a molybdenum Coolidge tube was then substituted for the tungsten one, and the K_α line ($\lambda=0{\cdot}708$ Å.) was employed. An increase in the absorption coefficient of the secondary rays excited in paraffin was again observed, though it amounted to only 29 per cent. at 90° and only $6 \pm 1{\cdot}2$ per cent. at 20° with the primary beam.

The softening thus observed when reflected X-rays are scattered is substantially the same as that found when unreflected rays of the same hardness are employed. Mr. Plimpton's negative result is apparently due to the fact that his experiment was performed under unfavourable conditions of wave-length and scattering angle. The conclusion seems necessary, therefore, that the softening of secondary X-rays is due, not to the process of scattering, but to the excitation of a fluorescent radiation in the radiator.

ARTHUR H. COMPTON.

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The Colour of the Sea.

THE view has been expressed that "the much-admired dark blue of the deep sea has nothing to do with the colour of water, but is simply the blue of the sky seen by reflection" (Rayleigh's Scientific Papers," vol. 5, p. 540, and NATURE, vol. 83, p. 48, 1910). Whether this is really true is shown to be questionable by a simple mode of observation used by the present writer, in which surface-reflection is eliminated, and the other factors remain the same. The method is to view the surface of the water through a Nicol's prism, which may for convenience be mounted at one end of a tube so that it can be turned about its axis and pointed in any direction. Observing a tolerably smooth patch of water with this held in front of the eye at approximately the polarising angle with the surface of the sea, the reflection of the sky may be quenched by a suitable orientation of the Nicol. Then again, the sky-light on a clear day in certain directions is itself strongly polarised, and an observer standing with his back to the sun when it is fairly high up and viewing the sea will find the light reflected at all incidences sufficiently well polarised to enable it to be weakened or nearly suppressed by the aid of a Nicol.

Observations made in this way in the deeper waters of the Mediterranean and Red Seas showed that the colour, so far from being impoverished by suppression of sky-reflection, was wonderfully improved thereby. A similar effect was noticed, though somewhat less conspicuously, in the Arabian Sea. It was abundantly clear from the observations that the blue colour of the deep sea is a distinct phenomenon in itself, and not merely an effect due to reflected sky-light. When the surface-reflections are suppressed the hue of the water is of such fullness and saturation that the bluest sky in comparison with it seems a dull grey.

By putting a slit at one end of the tube and a grating over the Nicol in front of the eye, the spectrum of the light from the water can be examined. It was found to exhibit a concentration of energy in the region of shorter wave-lengths far more marked than with the bluest sky-light.

Even when the sky was completely overcast the blue of the water could be observed with the aid of a Nicol. It was then a deeper and fuller blue than ever, but of greatly enfeebled intensity. The altered appearance of the sea under a leaden sky must thus be attributed to the fact that the clouds screen the water from the sun's rays rather than to the incidental circumstance that they obscure the blue light of the sky.

Perhaps the most interesting effect observed was that the colour of the water (as seen with the Nicol held at the polarising angle to the surface of the water and quenching the surface-reflection) varied with the *azimuth* of observation relatively to the plane of incidence of the sun's rays on the water. When the plane of observation and the plane of incidence were the same, and the observer had his back to the sun and looked down into the water, the colour was a brilliant, but comparatively lighter, blue. As the plane of observation is swung round the colour becomes a deeper and darker blue, and at the same time decreases in intensity, until finally when the plane of observation has swung through nearly 180° the water appears very dark and of a colour approaching indigo. Both the colour and the intensity also varied with the altitude of the sun.

The dependence of the colour on the azimuth of observation cannot be explained on a simple absorption theory, and must evidently be regarded as a *diffraction* effect arising from the passage of the light through the water. Looking down into the water with a Nicol in front of the eye to cut off the surface-reflections, the track of the sun's rays could be seen entering the water and appearing by virtue of perspective to converge to a point at a considerable depth inside it. The question is: What is it that diffracts the light and makes its passage visible? An interesting possibility that should be considered in this connection is that the diffracting particles may, at least in part, be the *molecules* of the water themselves. As a rough estimate, it was thought that the tracks could be seen to a depth of 100 metres, and that the intensity of the light was about one-sixth of that of the light of the sky from the zenith. If we assume that clear water, owing to its molecular structure, is capable of scattering light eight times as strongly as dust-free air at atmospheric pressure, it is clear that the major part of the observed effect may arise in this way.

It is useful to remember that the reflecting power of water at normal incidence is quite small (only 2 per cent.), and becomes large only for very oblique reflection. It is only when the water is quite smooth and is viewed in a direction nearly parallel to the surface that the reflected sky-light overpowers the light emerging from within the water. In other cases the latter has a chance of asserting itself.

C. V. RAMAN.

S.S. *Narkunda*, Bombay Harbour,
September 26.

The "Proletarisation of Science" in Russia.

DR. H. LYSTER JAMESON asks in NATURE of September 29, p. 147, for an account of the constructive elements of the "proletarisation of science" in Russia, and seems to praise the effort of the Soviet Government to bring the fundamental conclusions of scientific thought within the reach of the "proletariat" by editing a whole series of elementary text-books of natural science.

A Russian university professor, whose friendship I have enjoyed for more than twenty-five years, who has just escaped from the "Bolshevik Paradise," gave me some information on the point in question which will, no doubt, interest British men of science, whose deep religious feeling I had the opportunity of admiring during the days when I studied in England some forty years ago.

According to this professor's experience, the aim of this "popularisation" of science is to replace the old religion by a new religion—Bolshevism. It is announced to the completely uneducated people that the Old and New Testaments are myths, that God, Creation, and the sublime Christian morals connected with our religion are mere prejudices of the "bourgeois," and that man is only an animal somewhat more developed than the ape, etc.

As regards education in the universities, there are still capable professors teaching who are unable to leave the country, but they have practically no rights, and there is no possibility of free scientific work. The place of the rector of the university to which my friend was attached is occupied by a former demonstrator, "whose only printed matter is his visit card," but he is a trustworthy Bolshevik, just as are the stewards ruling the university.

The only qualification for the teachers in secondary and primary schools is a Bolshevik faith—other qualification is not needed. It is, therefore, easily understood that the teaching of the old religion and morals is abolished from all types of schools.

A translation of Geikie's "Physical Geography" has been known in Russia for some years, but nowadays there are few people whose preliminary scientific education would allow them to read this or a similar work with any profit. My friend also assures me that ostensible editions of the popular scientific books quoted by Dr. Jameson are, to use a household word, "Potemkin's villages," the object of which is to acquire sympathy for Bolshevism among men of science who are far away and unable to witness the charms of this "paradise."

As regards the passage quoted in Dr. Sokoloff's article in NATURE of September 1, 1921, p. 20, which gave rise to the present discussion: "There is Prof. Behtereff, who declares that all Russian men of science now abroad should return to Rusia"—this is fortunately impossible, since, according to the recent "ukaz" of the Soviet Government (see *Rul* of October 14), no Russian is allowed to return to Russia unless he possesses food enough for three or four months.

This challenge was also answered at the meeting of Russian men of science, mostly university professors from all parts of Europe, held last week in Prague, which is to-day the centre of Slavonic scientific culture. Resolutions were accepted at this meeting by which the Russian *savants* who were present organised themselves for permanent scientific work outside their country. Moreover, steps were taken to enable Russian students, with the aid of our Government, to study in our university and in other schools (we know Russian, and they learn Bohemian easily). Surely all this proves that Russian professors are by no means willing to accept Prof. Bechtěrev's (or Behtereff's) invitation.

The President of our Republic, Dr. Masaryk, formerly professor of philosophy and sociology in this university, has just published a remarkable article, "Political Anthropomorphism," in which he states that Bolshevik Government placards in Moscow have inscriptions: "Religion is Opium for People." In his opinion the social and political ideal of an uneducated and uncultured ("negramotnyj") Russian mujik (mužik) is to stand on the dunghill and to crack the whip instead of working, and to use it not only on his horses, but also on his fellow-creatures. The President concludes: "The Bolshevik experiment did not succeed, and cannot succeed, because the Bolsheviks, who are not at the level of human culture, succumbed to rude anthropomorphism."

I conclude with the question: What is left now of the *fata Morgana* of Bolshevism? I am very glad that no other Government in the world is following its example. BOHUSLAV BRAUNER.

Chemical Laboratory, Bohemian University, Prague, October 20.

Biological Terminology.

DR. BATHER in NATURE of October 27, p. 271, referred Sir Archdall Reid to Prof. Goodrich's presidential address to Section D of the British Association at its Edinburgh meeting this year for a discussion of certain questions, and characterised that address as "clear and thoughtful." It appears to me that Prof. Goodrich had adopted Sir Archdall Reid as his guide and authority in questions of evolution, and it is difficult to understand how the teacher could learn from his pupil. Prof. Goodrich's address ignores the greater part of all the new conceptions and new results obtained by recent research on heredity and genetics. The only recent work of importance which he mentions is that of Guyer on the effect of lens-destroying serum injected into rabbits.

Prof. Goodrich states that the newest characters may be inherited as constantly as the most ancient *provided they are possessed by both parents*, stating in a footnote that he sets aside complications due to Mendelian segregation, which do not bear on the questions at issue. But surely Mendelian segregation bears most fundamentally on the proviso that a character must be possessed by both parents in order to be inherited, since Mendelian researches have shown that a character may be inherited when it is apparent only in one parent or in neither. It may be asked whether "possessed" means "apparent" or not, but the context shows that Prof. Goodrich meant the two terms to be synonymous, since he states that the question, "Why are some characters inherited and others not?" is the same as the question, "Why do some characters reappear in the offspring and others not?" Characters could not reappear in the offspring if they did not appear in the parents. When a person bearing the abnormality brachydactyly marries a normal person, half the children are brachydactylous. Here the character is possessed by only one parent. In many other cases, where the one parent is homozygous for a dominant character which is absent in the other parent, all the offspring show the character. Again, there are cases in which a man with normal sight marries a woman with normal sight, and half the male children are colour-blind. According to Prof. Goodrich's definitions this would not be inheritance at all, but we know it is due to heredity, and that is more important than any arbitrary definition of inheritance. The antlers of stags are normally possessed by one parent only, but they are certainly inherited.

Prof. Goodrich states that inheritance depends on the condition that the germinal factors and the environmental conditions which co-operated in the formation of a character in the ancestor should both be present. Suppose we consider the case of an albino. What are the environmental conditions which cooperated in the formation of this character? The fact is that a new character or a change of character may be due *either* to an alteration of the germinal factors *or* of the environmental conditions. In the former case the variation or mutation is produced without any change of environment, and often persists under a great range of difference in environment. We call such a change due to difference in germinal factors a mutation or congenital variation, a change due to environment or modification an acquired character. Therefore, to assert, as Prof. Goodrich and Sir Archdall Reid do, that all characters are acquired during the lifetime of the individual is a misuse of terms, and tends to confuse and obscure a perfectly clear distinction. Characters due to genetic factors are developed, not acquired; characters due to environmental change without change of genetic factors are acquired.

Prof. Goodrich states that in an environment which, on the whole, alters but little, evolution progresses by the cumulation, along diverging lines of adaptation, of new characters due to mutation. I regret to have to disagree fundamentally with a zoologist for whose work in his own special field I have so great a respect, but my own studies have led me to the conclusion that this statement is not in accordance with our present knowledge. What we know of mutation and adaptation seems to me to indicate very strongly that they have nothing whatever to do with each other.

J. T. CUNNINGHAM.

University of London Club, 21 Gower Street, November 2.

Reflection "Halo" of (Semi-)Cylindrical Surfaces.

I RECENTLY noticed on the wall of a staircase in this college a clear ring of light, produced by a low sun shining through an open window. The ring was free from colour, circular so far as could be judged by eye, and complete except towards the bottom, where it was cut across by the shadow of a polished wooden handrail. A little investigation showed that the appearance was due to the reflection of sunlight falling on this rail, the upper surface of which is more or less cylindrical. Sighting along the rail showed that the axis of this cylinder passed approximately through the centre of the ring. The phenomenon must have been observed often enough, but I have not seen it described. It is readily treated by simple geometrical methods as follows:—

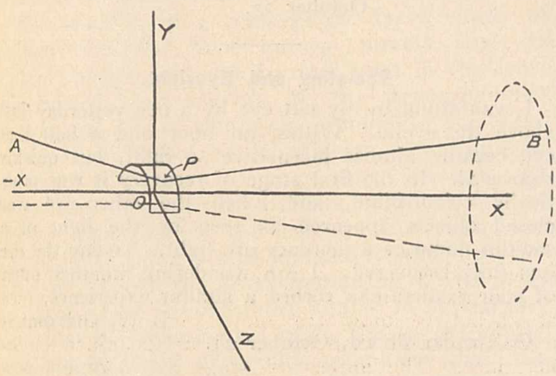

FIG. 1.—AP=incident ray; PB=reflected ray. Broken lines are projections on XZ plane of these rays; broken ring shows form of "halo" on a screen parallel to the YZ plane.

Let the reflecting segment of cylinder considered have its centre at the origin, and let its radius be r and its axis that of X (Fig. 1). Let an incident ray AP parallel to the XY plane fall, from the −X direction, on the point $P(0,y_0,z_0)$ of the cylinder; the equations of the ray may then be written $y+mx=y_0$, $z=z_0$. The normal at P is $z_0y=y_0z$, and the perpendicular plane through the origin is $y_0y+z_0z=0$. The incident and reflected rays must cut this plane in two points, the join of which is bisected by the origin. The incident ray meets it at

$$\left(y_0+\frac{z_0^2}{y_0}\Big/m,\ -z_0^2\big/y,\ z_0\right),$$

so the point with equal and opposite co-ordinates must lie on the reflected ray; so does $P(0,y_0,z_0)$. Hence the reflected ray is given by

$$my_0x\Big/\left(y_0^2+z_0^2\right)=\left(y-y_0\right)\Big/\left(y_0-\frac{z_0^2}{y_0}\right)=\left(z-z_0\right)\Big/2z_0.$$

From this it follows at once that $(y-y_0)^2+(z-z_0)^2=m^2x^2$. Thus, considering all values of y_0 and z_0, we see that so long as y_0 and z_0 are small compared with x, y, z, the reflected light is practically a right cone, with its axis along that of the cylinder. The distribution of brightness and other points can easily be worked out, but would make this note unduly long.

The phenomenon is shown by any reflecting cylinder; a nickelled shaving-soap tin answers admirably. The radius of the ring thrown on a screen normal to the axis is readily shown to be practically independent of the diameter of the cylinder, but proportional to the tangent of the angle between the incident rays and the axis, as the final equation shows. The ring stops at $z=\pm r$ on the −Y axis—*i.e.* appears to be cut across by the shadow of the cylinder. Increase of length of the cylinder, of course, results in a widening of the ring.

J. H. SHAXBY.

University College of South Wales and Monmouthshire, Cathays Park, Cardiff, October 31.

Microscope Illumination and Fatigue.

A VERY large part of the fatigue produced by working at the microscope for long hours is due to the use of incorrectly adjusted illumination, whether too bright or too weak. In routine work of a critical nature, where daylight is out of the question for several reasons and an artificial light source must be used, the light may be regulated so as to be satisfactory for the combination of eyepiece and objective most frequently used, but any change of either materially alters the brilliancy of the field. Any alteration of the substage to correct for this will upset the critical adjustment of the optical system; the changing of light-filters is a rough-and-ready solution, but fine differences cannot easily be made without varying the quality of the light, and, in most cases, require the removal of the eye from the microscope to carry out.

When working with a 30-c.p. "Pointolite" lamp (which provides the ideal homogeneous source of light, and with a suitable condenser and monochromatic filter gives more than enough light for any combination), it was found that the excess of light was very tiring to the eyes, and the manipulation of extra filters for each change of eyepiece or objective involved a great loss of time. It seemed possible that the pyrometric lamp advertised by the same makers might produce better results, as the candle-power can be varied between very wide limits; but before trying it experiments were made with the 30-c.p. lamp.

It was found that by inserting extra resistance into the arc circuit (which in this case was some 350 ohms) the light may be varied from full to a dull red glow, or practically zero when a monochromatic blue or green filter is used. The only precaution necessary is to cut out the extra resistance when starting up, as the arc tends to strike on to the ioniser spiral.

By using a sliding resistance of 800 ohms (suitably protected) fastened to the bench near the microscope, where it can be found and adjusted without moving the head from the eyepiece, complete control over the lighting is obtained, and the optimum intensity for any combination of any eyepiece, objective, condenser, and light-filter becomes possible with fully critical illumination.

Apart from the reduction of optical fatigue, the system has the further advantage of rendering fine detail more easily visible, and in cytological work the achromatic structures are much plainer. When working with the Abbe drawing apparatus the difficulty of balancing the illumination of the field and the drawing surface is eliminated.

There is nothing new in the use of a resistance with an electric lamp for microscope work, but users of "Pointolites," with all their advantages over other types, may be interested to know that such control is feasible.

H. J. DENHAM.

Botanical Laboratory, British Cotton Industry Research Association, Shirley Institute, Didsbury, Manchester, November 11.

The Aurora Borealis of September 28–29.

WITH reference to my letter in NATURE of October 6 on the observation of the aurora on the night of September 28–29 and Father Cortie's record of the accompanying magnetic storm (NATURE, October 27), I have just received a communication from Mr. J. W. Young, of Glasgow, a portion of which may be of interest in the above connection :—

"It may interest you to know that by my records I find I also saw this. The back of my house (on south-west of Glasgow) gives me a clear view of some twenty miles along the Loch Lomond valley in the direction of magnetic north, and for some years it has been my practice to keep watch for such occurrences, much more frequent here than most are aware. Usually 8–11 p.m. is the period of greatest brilliancy, and the streams of yellow, pink, and green light sometimes extend, pulsating, almost to the zenith. . . ."

WILLIAM J. S. LOCKYER.

Norman Lockyer Observatory, Salcombe Hill, Sidmouth, S. Devon, November 7.

Applied Anthropology.

I WAS, unfortunately, unable to take part in the discussion on a possible Anthropological Service at Edinburgh, referred to in the leading article in NATURE of November 10, but there is one point on which I would have insisted had I been present: the danger of a little knowledge. Anthropology is fundamentally a branch of biology, not of literature or philosophy, except in so far as the latter is biological. It is, perhaps, the most complicated of all the branches of biology, and the branch in which the collection of precise data is the most difficult. To me it is inconceivable that a sound knowledge of anthropology can be obtained without a preliminary training in biological method. At present anthropological study, especially that of the physical or anatomical side, is in a state of chaos, largely because the comparative student has to make use of information of all degrees of accuracy or the reverse—mostly the reverse. What a missionary said two hundred years ago may carry greater weight than a recent investigation on sound scientific lines.

My own investigations in the Malay Peninsula and my more recent experience as a Government official in India have taught me the disadvantages under which an official labours in collecting anthropological information, and I think that most scientific men in the employment of any Government would agree with me in their hearts that there is no danger more to be feared in scientific administration than the interference of the administrative officer who possesses, or is led to think he possesses, a peculiar, but superficial, knowledge of any branch of science.

If anthropology is a branch of science, or rather, as I believe, a complex of the terminal twigs of several distinct branches, it must be studied seriously and scientifically, not merely tacked on as a kind of floral decoration to a classical or commercial education.

N. ANNANDALE.

Abden House, Marchhall Crescent, Edinburgh, November 11.

Use of Carborundum for Ruling Test Plates.

THE communication from Mr. A. Mallock in NATURE of September 1, p. 10, reminds me of the marked success that I have had in the use of fine carborundum points for scratching on glass. Some years ago, when confronted with the task of preparing small oscillograph mirrors from microscope cover-glasses, I found that a small fragment of carborundum crystal tied in the split end of a match or forced into a piece of soft rubber for a handle made an excellent glass-cutter. The scratches were so fine and clean-cut that the glass could easily be broken into very narrow strips.

Although very hard and sharp, the points are wide-angled, the angles as viewed in a microscope appearing to be in the neighbourhood of 90°.

It seems possible that these crystals, if the pressure were sufficiently light, might be used to rule lines on thin films of aniline colours without scratching the glass.

W. G. CADY.

Wesleyan University, Middletown, Conn., October 22.

Bee-sting and Eyesight.

I WAS stung in my left eye by a bee yesterday just above the eyelid. Within an hour and a half that eye became almost insensitive to light, but quickly recovered. In the first stage of recovery it was practically colour-blind, and when the other eye was closed objects appeared as seen by the light of a sodium flame or a mercury arc light. To-day the eye has fully recovered. I am wondering whether other of your readers can record a similar experience.

J. W. GIFFORD.

Oaklands, Chard, October 21.

The Age of the Earth.

WITH regard to Lord Rayleigh's letter (NATURE, November 10), I think my use of the word "suggestion," instead of "statement," for example, sufficiently indicated that I appreciated the fact that he did not definitely assert that the earth was becoming hotter. I am glad to find that his views and mine are not in essential disagreement.

HAROLD JEFFREYS.

Meteorological Office, South Kensington, London, S.W.7, November 15.

A New Cave Man from Rhodesia, South Africa.

By DR. ARTHUR SMITH WOODWARD, F.R.S.

DURING recent years the British Museum has received from the Rhodesia Broken Hill Development Co. numerous bones from a cave discovered in their mine in North-west Rhodesia about 150 miles north of the Kafue river. All except the smaller of these bones are merely broken fragments, and they evidently represent the food of men and flesh-eating mammals who have at different times occupied the cave. As described by Mr. Franklin White (Proc. Rhodesia Sci. Assoc., vol. 7, p. 13, 1908) and Mr. F. P. Mennell (*Geological Magazine* [5], vol. 4, p. 443, 1907), rude stone and bone implements are abundant among the remains, and there can be no doubt that the cave was a human habitation for a long period. Very few of the bones can be exactly named, but, so far as they have been identified by Dr. C. W. Andrews and Mr. E. C. Chubb, they belong to species still living in Rhodesia or to others only slightly different from these. The occupation of the cave, therefore, seems to have been at no distant date—it may not even have been so remote as the Pleistocene period.

Until lately no remains of the cave man himself have been noticed at Broken Hill, but at the end of last summer Mr. W. E. Barren was so fortunate as to discover and dig out of the earth in a remote part of the cave a nearly complete human skull, a fragment of the upper jaw of another, a sacrum, a tibia, and the two ends of a femur. These specimens have just been brought to England by Mr. Ross Macartney, the managing director of the company, and they are to be added to the many generous gifts of the company to the British Museum.

The skull is in a remarkably fresh state of preservation, the bone having merely lost its animal matter and not having been in the least mineralised. As shown in the accompanying photograph, it is strangely similar to the skull of the Neanderthal or Mousterian race found in the caves of Belgium, France, and Gibraltar. Its brain-case is typically human, with a wall no thicker than that of the average European, and its capacity, though still not determined, is obviously well above the lower human limit. Its large and heavy face is even more simian in appearance than that of Neanderthal man, the great inflated brow-ridges being especially prominent and prolonged to a greater extent at the lateral angles.

The roof of the skull at first sight appears remarkably similar to that of Pithecanthropus from Java, having the same slight median longitudinal ridge along the frontals and rising to its greatest height just about the coronal suture. It is, however, very much larger, and the resemblance may not imply any close affinity. The length of the skull from the middle of the glabella to the inion is about 210 mm., while its maximum width at the parietal bosses is 145 mm. The skull is therefore dolichocephalic, with a cephalic index of 69. Its greatest height (measured from the basion to the bregma) is 131 mm. In general shape the brain-case is much more ordinarily human than that of the La Chapelle Neanderthal skull, which differs in the expansion and bun-shaped depression of its hinder region. The mastoid process, though human, is comparatively small. The supramastoid ridge is very prominent and broad. The tympanic meatus is short and broad, as always in man. The foramen magnum occupies its usual forward position, so that the skull would be perfectly poised on an erect trunk.

The facial bones much resemble those of the La Chapelle skull, the great flat maxillaries, without canine fossæ, being especially similar. The nasal bones, however, are more gently sloping; the sharp lateral edge of the narial opening runs down on the face (as in the gorilla), allowing the

premaxillary surface to pass uninterruptedly into the floor of the narial cavity; and the infranasal region is unusually deep. The typically human anterior nasal spine is conspicuous.

The palate is of enormous size, as large as that inferred by Boule from the fragments preserved in the La Chapelle skull. It is, however, in all respects human, being deeply arched and bounded by the horse-shoe-shaped row of teeth, which are unusually large, but also entirely human. The teeth are much worn, and those of the front of the jaw met their lower opposing teeth in the primitive way, edge to edge. The canines are not enlarged. The second molar is square, 13·5 mm. in diameter. The third molar is much reduced, measuring 12·5 mm. in width by 9·5 mm. in length. The total length of the molar series is about 33 mm. The outside measurement of the dentition across the second molars is 78 mm. The width between the sockets of the third molars is 51 mm. The length from the socket of the median incisor to a line drawn across the back of the third molars is also 51 mm. The whole dentition is much affected with caries, and the disease has spread to the tooth-sockets, which are pierced in some places.

The lower jaw is unfortunately absent, but the size of the palate and the extent of the temporal fossæ show that it must have been massive. Even the Heidelberg jaw is slightly narrower and shorter than this must have been.

Although the new skull from the Rhodesian cave so much resembles that of Neanderthal man, the shape of the brain-case and the position of the foramen magnum are so different that we may hesitate to refer the two skulls to the same race. This hesitation seems to be justified when the associated limb-bones are considered, for the tibia is long and slender, of the typically modern type, and the extremities of the femur do not differ in any essential respect from the corresponding parts of a tall and robust modern man. They are thus very different from the tibia and femur of Neanderthal man found in the caves of Belgium and France. As the skull appears to postulate an erect attitude, the congruous limb-bones may well be referred to it. We therefore recognise in the Rhodesian cave man a new form which may be regarded as specifically distinct from *Homo neanderthalensis*, and may be appropriately named *Homo rhodesiensis*.

The precise systematic position of this new species of primitive man can be determined only by further discoveries. It has, however, been pointed out by Prof. Elliot Smith that the refinement of the face was probably the last step in the evolution of the human frame. The newly discovered Rhodesian man may therefore revive the idea that Neanderthal man is truly an ancestor of *Homo sapiens*; for *Homo rhodesiensis* retains an almost Neanderthal face in association with a more modern brain-case and an up-to-date skeleton. He may prove to be the next grade after Neanderthal in the ascending series.

Problems of Physics.[1]

By PROF. O. W. RICHARDSON, D.Sc., F.R.S.

RELATIVITY is the revolutionary movement in physics which has caught the public eye, perhaps because it deals with familiar conceptions in a manner which for the most part is found pleasantly incomprehensible. But it is only one of a number of revolutionary changes of comparable magnitude. Among these we have to place the advent of the quantum. The various consequences of the electronic structure of matter are still unfolding themselves to us, and are increasing our insight into the most varied phenomena at a rate which must have appeared incredible only a few decades ago.

The enormous and far-reaching importance of the discoveries being made at Cambridge by Sir Ernest Rutherford cannot be over-emphasised. These epoch-making discoveries relate to the structure and properties of the nuclei of atoms. At the present time we have, I think, to accept it as a fact that the atoms consist of a positively charged nucleus of minute size, surrounded at a fairly respectful distance by the number of electrons requisite to maintain the structure electrically neutral. The nucleus contains all but about one-two-thousandth part of the mass of the atom, and its electric charge is numerically equal to that of the negative electron multiplied by what is called the atomic number of the atom, the atomic number being the number which is obtained when the chemical elements are enumerated in the order of the atomic weights; thus hydrogen = 1, helium = 2, lithium = 3, and so on. Consequently the number of external electrons in the atom is also equal to the atomic number. The evidence, derived from many distinct and dissimilar lines of inquiry, which makes it necessary to accept the foregoing statements as facts, will be familiar to members of this Section of the British Association, which has continually been in the forefront of contemporary advances in physical science.

The diameters of the nuclei of the atoms are comparable with one-millionth of one-millionth part of a centimetre, and the problem of finding what lies within the interior of such a structure seems at first sight almost hopeless. It is to this problem which Rutherford has addressed himself by the direct method of bombarding the nuclei of the different atoms with the equally minute high-velocity helium nuclei (alpha-particles) given off by radioactive substances, and examining the tracks of any other particles which may be generated as a result of the impact. A careful and critical examination of the results shows that hydrogen nuclei are thus expelled from the nuclei of a number of atoms such as nitrogen and phosphorus. On the other hand, oxygen and carbon do not eject hydrogen under these circumstances, although there is evidence in the case of oxygen and nitrogen of the expulsion of other sub-nuclei whose precise structure is a matter for further inquiry.

The artificial transmutation of the chemical elements is thus an established fact. The natural transmutation has, of course, been familiar for some years to students of radio-activity. The philosopher's stone, one of the alleged chimeras of the mediæval alchemists, is thus within our reach. But this is only part of the story. It appears that in some cases the kinetic energy of the ejected fragments is greater than that of the bombarding particles. This means that these bombardments are able to release the energy which is stored in the nuclei of atoms. Now, we

[1] Abridged from the presidential address delivered to Section A (Mathematics and Physics) of the British Association at Edinburgh on September 9.

know from the amount of heat liberated in radioactive disintegration that the amount of energy stored in the nuclei is of a higher order of magnitude altogether, some millions of times greater, in fact, than that generated by any chemical reaction such as the combustion of coal. In this comparison, of course, it is the amount of energy per unit mass of reacting or disintegrating matter which is under consideration. The amounts of energy which have thus far been released by artificial disintegration of the nuclei are in themselves small, but they are enormous in comparison with the minute amounts of matter affected. If these effects can be sufficiently intensified there appear to be two possibilities. Either they will prove uncontrollable, which would presumably spell the end of all things,[2] or they will not. If they can be both intensified and controlled then we shall have at our disposal an almost illimitable supply of power which will entirely transcend anything hitherto known. It is too early yet to say whether the necessary conditions are capable of being realised in practice, but I see no elements in the problem which would justify us in denying the possibility of this. It may be that we are at the beginning of a new age, which will be referred to as the age of sub-atomic power. We cannot say; time alone will tell.

Thermionic Emission.

At the Manchester meeting of the Association in 1915 I had the privilege of opening a discussion on thermionic emission—that is to say, the emission of electrons and ions by incandescent bodies. I recall that the opinion was expressed by some of the speakers that these phenomena had a chemical origin. That view, I venture to think, is one which would find very few supporters now. It is not that any new body of fact has arisen in the meantime. The important facts were all established before that time, but they were insufficiently appreciated, and their decisiveness was inadequately realised.

It may be worth while to revert for a moment to the issues in that controversy, already moribund in 1915, because it has been closely paralleled by similar controversies relating to two other groups of phenomena—namely, photo-electric emission and contact electro-motive force—which, as we shall see, are intimately connected with thermionic emission. The issue was not as to whether thermionic emission may be looked upon simply as a type of chemical reaction. Such an issue would have been largely a matter of nomenclature. Thermionic electron emission has many features in common with a typical reversible chemical reaction such as the dissociation of calcium carbonate into lime and carbon dioxide. There is a good deal to be said for the point of view which regards thermionic emission as an example of the simplest kind of reversible chemical action, namely, that kind which consists in the dissociation of a neutral atom into a positive residue and a negative electron, inasmuch as we know that the negative electron is one of the really fundamental elements out of which matter is built up. The issue in debate was, however, of a different character. It was suggested that the phenomenon was not primarily an emission of electrons from the metallic or other source, but was a secondary phenomenon, a kind of by-product of an action which was primarily a chemical reaction between the source of electrons and some other material substance such as the highly attenuated gaseous atmosphere which surrounded it. This suggestion carried with it either implicitly or explicitly the view that the source of power behind the emission was not the thermal energy of the source, but was the chemical energy of the postulated reactions.

This type of view has never had any success in elucidating the phenomena, and I do not feel it necessary at this date to weary you with a recital of the facts which run entirely counter to it, and, in fact, definitely exclude it as a possibility. They have been set forth at length elsewhere on more than one occasion. I shall take it to be established that the phenomenon is physical in its origin and reversible in its operation.

Establishing the primary character of the phenomenon does not, however, determine its nature or its immediate cause. Originally I regarded it as simply kinetic, a manifestation of the fact that as the temperature rose the kinetic energy of some of the electrons would begin to exceed the work of the forces by which they are attracted to the parent substance. With this statement there is, I think, no room for anyone to quarrel, but it is permissible to inquire how the escaping electrons obtain the necessary energy. One answer is that the electrons have it already in the interior of the substance by virtue of their energy of thermal agitation. But thermal agitations now appear less simple than they used to be regarded, and in any event they do not exhaust the possibilities.

We know that when light of short enough wave-length falls on matter it causes the ejection of electrons from it—the so-called photo-electric effect. Since the formula for the radiation emitted by a body at any given temperature contains every wave-length without limitation, there must be some emission of electrons from an incandescent body as the result of the photo-electric effect of its own luminosity. Two questions obviously put themselves. Will this photo-electric emission caused by the whole spectrum of the hot body vary as the temperature of the incandescent body is raised in the way which is known to characterise thermionic emission? A straightforward thermodynamic calculation shows that this is to be expected from the theoretical point of view, and the anticipation has been confirmed by the experiments of Prof. W. Wilson. Thus the autophoto-electric emission has the correct behaviour to account for the thermionic emission. The other question is: Is it large enough? This

[2] To reassure the nervous I would, however, interpolate the comforting thought that this planet has held considerable quantities of radio-active matter for a very long time without anything very serious happening so far as we know.

is a question of fact. I have considered the data very carefully. There is a little uncertainty in some of the items, but when every allowance is made there seems no escape from the conclusion that the photo-electric effect of the whole spectrum is far too small to account for thermionic emission.

This question is an important one, apart from the particular case of thermionic emission. The same dilemma is met with when we seek for the actual *modus operandi* of evaporation, chemical action, and a number of other phenomena. These, so far as we know, might be fundamentally either kinetic or photochemical or a mixture of both. (I am using the term photochemical here in the wide sense of an effect of light in changing the composition of matter, whether the parts affected are atoms, groups of atoms, ions, or electrons.) For example, the approximation about boiling points known as Trouton's rule is a fairly obvious deduction from the photochemical point of view. The photochemical point of view has recently been put very strongly by Perrin, who would make it the entire *motif* of all chemical reaction, as well as of radio-activity and changes of state. In view of the rather minor part it seems to play in thermionic emission, where one would *a priori* have expected light to be especially effective, this is probably claiming too much for it, but the chemical evidence contains one item which is certainly difficult to comprehend from the kinetic point of view. The speed of chemical decomposition of certain gases is independent of their volume, showing that the decomposition is not due to molecular collisions. The speed does, however, increase very rapidly with rising temperature. What the increased temperature can do except increase the number and intensity of the collisions, factors which the independence of volume at constant temperature show to be without effect, and increase the amount of radiation received by the molecules, is not too obvious. It seems, however, that, according to calculations by Langmuir (Journ. Amer. Chem. Soc., vol. 42, p. 2190, 1920), the radiation theory does not get us out of this difficulty; for, just as in the ordinary photoelectric case, there is nothing like enough radiation to account for the observed effects. It seems that in the case of these mono-molecular reactions the phenomena cannot be accounted for either by simple collisions, or by radiation, or by a mixture of both, and it is necessary to fall back on the internal structure of the decomposing molecule. This is complex enough to afford material sufficient to cover the possibilities; but, from the point of view of the temperature energy relations of its parts, it cannot at present be regarded as much more than a field for speculation.

Contact Electricity.

A controversy about the nature of the contact potential difference between two metals, similar to that to which I have referred in connection with thermionic emission, has existed for over a century. In 1792 Volta wrote: "The metals . . . can by themselves, and of their own proper virtue, excite and dislodge the electric fluid from its state of rest." The contrary position that the electrical manifestations are inseparably connected with chemical action was developed a few years later by Fabroni. Since that time electrical investigators have been fairly evenly divided between these two opposing camps. Among the supporters of the intrinsic or contact view of the type of Volta we may recall Davy, Helmholtz, and Kelvin. On the other side we have to place Maxwell, Lodge, and Ostwald. In 1862 we find Lord Kelvin ("Papers on Electrostatics and Magnetism," p. 318) writing: "For nearly two years I have felt quite sure that the proper explanation of voltaic action in the common voltaic arrangement is very near Volta's, which fell into discredit because Volta or his followers neglected the principle of the conservation of force." On the other hand, in 1896 we find Ostwald ("Elektrochemie, Ihre Geschichte und Lehre," Leipzig, 1896, p. 65) referring to Volta's views as the origin of the most far-reaching error in electrochemistry, which the greatest part of the scientific work in that domain has been occupied in fighting almost ever since. These are cited merely as representative specimens of the opinions of the protagonists.

Now, there is a close connection between thermionic emission and contact potential difference, and I believe that a study of thermionic emission is going to settle this little dispute. In fact, I rather think it has already settled it, but before going into that matter I would like to explain how it is that there is a connection between thermionic emission and contact potential difference, and what the nature of that connection is.

Imagine a vacuous enclosure, either impervious to heat or maintained at a constant temperature. Let the enclosure contain two different electron-emitting bodies, A and B. Let one of these, say A, have the power of emitting electrons faster than the other, B. Since they are each receiving as well as emitting electrons, A will acquire a positive and B a negative charge under these circumstances. Owing to these opposite charges A and B will now attract each other, and useful work can be obtained by letting them come in contact. After the charges on A and B have been discharged by bringing them in contact, let the bodies be quickly separated and moved to their original positions. This need involve no expenditure of work, as the charges arising from the electron emission will not have had time to develop. After the charges have had time to develop the bodies can again be permitted to move together under their mutual attraction, and so the cycle can be continued an indefinite number of times. In this way we have succeeded in imagining a device which will convert all the heat energy from a source at a uniform temperature into useful work.

Now, the existence of such a device would contravene the second law of thermodynamics. We are therefore compelled either to deny the principles of thermodynamics or to admit that there is some fallacy as to the pretended facts in the foregoing argument. We do not need to hesitate between these alternatives, and we need only look to see how the alleged behaviour of A and B will need to be modified in order that no useful work may appear. There are two alternatives. Either A and B necessarily emit equal numbers of electrons at all temperatures, or the charges which develop owing to the unequal rate of emission are not discharged, even to the slightest degree, when the two bodies are placed in contact.

The first alternative is definitely excluded by the experimental evidence, so I shall proceed to interpret the second. It means that bodies have natural states of electrification whereby they become charged to definite potential differences whose magnitudes are independent of their relative positions. There is an intrinsic potential difference between A and B, which is the same, at a given temperature, whether they are at a distance apart or in contact.

Admitting that the intrinsic potentials exist, a straightforward calculation shows that they are intimately connected with the magnitudes of the thermionic emission at a given temperature. The relation is, in fact, governed by the following equation. If A and B denote the saturation thermionic currents per unit area of the bodies A and B respectively, and V is the contact potential difference between them at the absolute temperature T, then $V = kT/e \log A/B$, where k is the gas constant calculated for a single molecule (Boltzmann's constant), and e is the electronic charge.

I have recently, with the help of Mr. F. S. Robertson, obtained a good deal of new information on this question from the experimental side. We have made measurements of the contact potential difference between heated filaments and a surrounding metallic cylinder, both under the high-vacuum and gas-free conditions which are now attainable in such apparatus, and also when small known pressures of pure hydrogen are present. As is well known, both contact potentials and thermionic emission are very susceptible to minute traces of gas, but we find that under the best conditions as to freedom from gas there is a contact potential of the order of one volt between a pure tungsten filament and a thoriated filament. We also find that changes of a similar magnitude in the contact potential difference between a thoriated tungsten filament and a copper anode take place when the filament is heated. These changes are accompanied by simultaneous changes in the thermionic currents from the filament, and we find that the change in the contact potential calculated from the change in the currents with the help of the foregoing equation is within about 20 per cent. of the measured value. Considering the experimental difficulties, this is a very substantial agreement. Whilst the evidence is not yet as complete as I hope to make it, it goes a long way towards disproving the chemical view of the origin of contact potential difference.

From what has been said you will realise that the connection between contact potentials and thermionic emissions is a very close one. I would, however, like to spend a moment in developing it from another angle. To account for the facts of thermionic emission it is necessary to assume that the potential energy of an electron in the space just outside the emitter is greater than that inside by a definite amount, which we may call w. The existence of this w, which measures the work done when an electron escapes from the emitter, is required by the electron-atomic structure of matter and of electricity. Its value can be deduced from the temperature variation of thermionic emission, and, more directly, from the latent heats absorbed or generated when electrons flow out of or into matter. These three methods give values of w which, allowing for the somewhat considerable experimental difficulties, are in fair agreement for any particular emitter. The data also show that in general different substances have different values of w. This being so, it is clear that when uncharged bodies are placed in contact the potential energies of the electrons in one will in general be different from those of the electrons in the other. If, as in the case of the metals, the electrons are able to move freely they will so move until an electric field is set up which equilibrates this difference of potential energy. There will thus be an intrinsic or contact difference of potential between metals which is equivalent to the difference in the values of w and is equal to the difference in w divided by the electronic charge.[3]

Photo-electric Action.

We have seen that there is a connection on broad lines between thermionic emission and both contact potentials on one hand and photo-electric emission on the other. The three groups of phenomena are also related in detail and to an extent which up to the present has not been completely explored. In order to understand the present position, let us review briefly some of the laws of photo-electric action as they have revealed themselves by experiments on the electrons emitted from metals when illuminated by visible and ultra-violet light.

Perhaps the most striking feature of photoelectric action is the existence of what has been called the threshold frequency. For each metal whose surface is in a definite state there is a definite frequency n_0, which may be said to determine the entire photo-electric behaviour of the metal. The basic property of the threshold frequency n_0 is this: When the metal is illuminated by light of frequency less than n_0 no electrons are emitted, no matter how intense the light may be. On the other hand, illumination by the most feeble light of frequency greater than n_0 causes some emission. The frequency n_0 signalises a sharp and absolute discontinuity in the phenomena.

Now let us inquire as to the kinetic energy of the electrons which are emitted by a metal when illuminated by monochromatic light of frequency,

[3] This statement is only approximately true. In order to condense the argument certain small effects connected with the Peltier effect at the junction between the metals have been left out of consideration.

let us say, n. Owing to the fact that the emitted electrons may originate from different depths in the metal, and may undergo collisions at irregular intervals, it is only the maximum kinetic energy of those which escape which we should expect to exhibit simple properties. As a matter of fact, it is found that the maximum kinetic energy is equal to the difference between the actual frequency n and the threshold frequency n_0 multiplied by Planck's constant h. In mathematical symbols, if v is the velocity of the fastest emitted electron, m its mass, e its charge, and V the opposing potential required to bring it to rest,

$$eV = \frac{1}{2}\ m\ v^2 = h\ (n - n_0).$$

From this equation we see that the threshold frequency has another property. It is evidently that frequency for which kinetic energy and stopping potential fall to zero. This suggests strongly, I think, that the reason the electron emission ceases at n_0 is that the electrons are not able to get enough energy from the light to escape from the metal, and not that they are unable to get any energy from the light.

The threshold frequencies have another simple property. If we measure the threshold frequencies for any pair of metals, and at the same time we measure the contact difference of potential K between them, we find that K is equal to the difference between their threshold frequencies multiplied by this same constant h divided by the electronic charge e.

These results, as well as others which I have not time to enumerate, admit of a very simple interpretation if we assume that when illuminated by light of frequency n the electrons individually acquire an amount of energy hn. We have seen that in order to account for thermionic phenomena it is necessary to assume that the electrons have to do a certain amount of work w to get away from the emitter. There is no reason to suppose that photo-electrically emitted electrons can avoid this necessity. Let us suppose that this work is also definite for the photoelectric electrons and let us denote its value by hn_0. Then no electron will be able to escape from the metal until it is able to acquire an amount of energy at least equal to hn_0 from the light—that is to say, under the suppositions made—until n becomes at least as great as n_0. Thus n_0 will be identical with the frequency which we have called the threshold frequency, and the maximum energy of any electron after escaping will be $h\ (n - n_0)$.

The relation between threshold frequencies and contact potential difference raises another issue. We have seen that the contact potential difference between two metals must be very nearly equal to the difference between the amounts of work w for the electrons to get away from the two metals by thermionic action, divided by the electronic charge e. The photo-electric experiments show that the contact electromotive force is also nearly equal to the differences of the threshold frequencies multiplied by $^h/_e$. It follows that the photo-electric work hn_0 must be equal to the thermionic work w to the same degree of accuracy. The photoelectric and thermionic works are known to agree to within about one volt. To decide how far they are identical needs better experimental evidence than we have at present. The indirect evidence for their substantial identity is stronger at the moment than the direct evidence.

I do not think that the complete identity of the thermionic work w and the photo-electric hn_0 is a matter which can be inferred *a priori*. What we should expect depends to a considerable extent on the condition of the electrons in the interior of metals. We cannot pretend to any real knowledge of this at present; the various current theories are mere guesswork. Unless the electrons which escape all have the same energy when inside the metal we should expect the thermionic value to be an average taken over those which get out. The photo-electric value, on the other hand, should be the minimum pertaining to those internal electrons which have most energy. The apparent sharpness of the threshold frequency is also surprising from some points of view. There seems to be scope for a fuller experimental examination of these questions.

I have spoken of the threshold frequency as though it were a perfectly definite quantity. No doubt it is when the condition of the body is or can be definitely specified, but it is extraordinarily sensitive to minute changes in the conditions of the surface, such as may be caused, for example, by the presence of extremely attenuated films of foreign matter. For this reason we should accept with a certain degree of reserve statements which appear from time to time that photo-electric action is some parasitic phenomenon, inasmuch as it can be made to disappear by improvement of vacuum or other change in the conditions. What has generally happened in these investigations is that something has been done to the illuminated surface which has raised its threshold frequency above that of the shortest wave-length in the light employed in the test. Unless they are accompanied by specific information about the changes which have taken place in the threshold frequency, such statements are of little value at the present stage of development of this subject.

Light and X-rays.

One of the great achievements of experimental physics in recent years has been the demonstration of the essential unity of X-rays and ordinary light. X-rays have been shown to be merely light of particularly high frequency or short wave-length, the distinction between the two being one of degree rather than of kind. The foundations of our knowledge of X-ray phenomena were laid by Barkla, but the discovery and development of the crystal diffraction methods by v. Laue, the Braggs, Moseley, Duane, and de Broglie have established their relations with ordinary light so clearly that he who runs may read their substantial identity. The actual gap in the spectrum of the known radiations between light and X-rays is also rapidly disappearing. The longest stride into the region beyond the ultra-violet was made by Lyman with the vacuum grating spectroscope which he developed. For a time Prof. Bazzoni and I held the record in this direction with our determination of the short wave limit of the helium spectrum, which is in the neighbourhood of 450 Ångstrom units. More recently this has been passed by Millikan, who has mapped a number of lines extending to about 200 ngstrom units—that is to say, more than four octaves above the violet limit of the visible spectrum. I am not sure what is the longest X-ray which has been measured, but I find a record of a Zinc L-ray by Friman (*Phil. Mag.*, vol. 32, p. 494, 1916) of a wave-length of 12·346 Ångstrom units. There is thus at most a matter of about four octaves still to be explored. In approaching this unknown region from the violet end the most characteristic property of the radiations appears to be their intense absorption by practically every kind of matter. This result is not very surprising from the quantum point of view. The quantum of these radiations is in excess of that which corresponds to the ionising potential of every known molecule, but it is of the same order of magnitude. Furthermore, it is large enough to reach not only the most superficial, but also a number of the deeper-seated electrons of the atoms. There is evidence, both theoretical and experimental, that the photo-electric absorption of radiation is most intense when its quantum exceeds the minimum quantum necessary to eject the absorbing electron but does not exceed it too much. In the simplest theoretical case the absorption is zero for radiations the frequencies of which lie below the minimum quantum, rises to a maximum for a frequency comparable with the minimum, and falls off to zero again at infinite frequency. This case has not been realised in practice, but, broadly judged, the experimental data are in harmony with it. On these general grounds we should expect intense absorption by all kinds of matter for the radiation between the ultra-violet and the X-ray region.

The Botanic Gardens, Victoria, Cameroons Province, Nigeria.

HIS Excellency the Governor of Nigeria, Sir Hugh Clifford, G.C.M.G., in a remarkable address to the Nigerian Council,[1] which is deserving of careful study by those interested in our West African colonies, directed attention to the neglected condition of the Victoria Botanic Gardens in the recently acquired Cameroon Province, and stated that at his request the Assistant Director of the Royal Botanic Gardens, Kew, was about to visit Nigeria for the purpose of advising the Government "as to the action that should be taken for their restoration and future maintenance." We learn from the *Kew Bulletin*, No. 6, issued in September last, that Captain A. W. Hill has returned from his mission, and fully endorses the remarks made by the Governor as to the beauty and value of these gardens.

To quote from His Excellency's address:—

> The Botanical Gardens at Victoria compare in everything save size with their prototypes at Buitenzorg in Java and Peradeniya in Ceylon. They contain a fine and varied collection of trees and plants and shrubs which have been brought together from every part of the tropics; and, in spite of their close proximity to the sea, the soil in them appears to be abundantly fertile. A special feature of these gardens is a stream of water, crystal clear, that patters noisily over a bed of pebbles. . . .
>
> It would be a lasting discredit to this Government, I consider, if it were to neglect to repair the damage which the war has already unhappily inflicted upon these lovely and valuable gardens.

The gardens, we learn, cover an area of some 200 acres, and are provided with a good laboratory, a herbarium, and museum building, as well as a building which served the purpose of an agricultural school. All these are in a very fair state of repair, and are only awaiting the time when they can be restored to their proper functions. The site is admirably adapted to garden purposes, since the soil is a highly fertile decomposed volcanic rock. There are some steep hills, commanding fine views either across the bay or to the lofty Cameroon Mountain, but there is also a considerable tract of more or less level ground, so that it is possible to cultivate useful economic plants under varied tropical conditions. Connected with these gardens were the experimental plots of tea and cinchona at Buea, situated at an altitude of 3300–3600 ft., on the slope of the Cameroon Mountain. Photographs of these plantations are given in the Bulletin, and though now in a very neglected condition, they show that the cultivation of these products is a practical proposition in the Cameroon Province. High-level stations are thus a necessary adjunct to the gardens.

The importance of the Victoria Botanic Gardens and substations, with the laboratory and other buildings, where mycological, chemical and entomological research can be carried out, can best be realised when it is pointed out that the lower slopes of the Cameroon Mountain are covered by extensive plantations of such economic plants as cocoa, coffee, Hevea and Funtumia rubber, kola, bananas, oil palms, etc. The Cameroon Province thus differs essentially from Nigeria proper, where large plantations are rare and widely separated. In Nigeria fungus and insect diseases are not able to spread far, since

[1] Nigerian Council, Address by the Governor, Sir Hugh Clifford, December 29, 1920. See especially pp. 184–86 and 208–11.

there are dense tracts of forest or bush which act as a barrier; the native plantations also are usually small. In the Cameroon Province the plantations are more or less continuous, so that the risk of the spread of disease is ever present, and the prosperity of the plantations depends very largely on the maintenance of an adequate scientific staff.

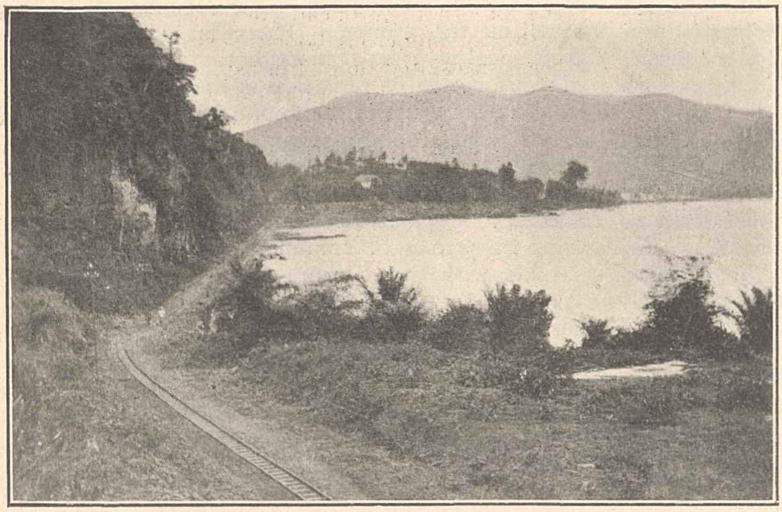

FIG. 1.—Ambas Bay, showing the seaward face of the Victoria Botanic Gardens which cover the promontory on which Government House can be seen crowning the summit. View looking to the south.—The trolley line from Victoria to Bota (the starting-point of the Buea Railway) is seen running at the foot of the cliff, which is the highest point of the gardens at the Bota end. The Limbe river, which traverses the gardens, enters the sea near the end of the promontory.

It is no doubt unfortunate for many reasons that the Cameroon Province, with the noble Cameroon Mountain, explored as long ago as December, 1861, by Sir Richard Burton and Mr. G. Mann, lies at one end of Nigeria, while Lagos and the headquarters of the Nigerian Agricultural Department at Ibadan lie far away near the Western border. Except by sea, communication between Ibadan and Victoria is at present well-nigh impossible, so that the proper development of the Victoria Gardens as a centre for research in connection with or under the control of the Agricultural Department of Nigeria, if this should be deemed essential, affords problems of considerable adminstrative difficulty.

While desiring to urge very strongly that the Victoria Gardens should be restored and maintained as a botanic garden fully equipped for tropical research in problems of soil chemistry, mycology, entomology, and plant-breeding, we would point out that research of this character belongs to a scientific institution, such as the gardens should be, rather than to an agricultural department, the function of which is purely technical and is concerned in the main with investigation and instruction.

The Victoria Gardens could be made the main centre for research in West Africa, and would be able to furnish results of immense value to the various agricultural departments; but we would urge that it should be established rather in connection with the Agricultural Department of Nigeria than under its direct control.

Reference has been made to the building which served as an agricultural school, and we would lay stress on the importance of such a school for the training of native agriculturists in a province like the Cameroons, with its large plantations. The value of such schools has been demonstrated in the West Indies and elsewhere, and with plantations demanding a large amount of skilled native labour a school attached to a scientific institute can scarcely fail to produce results of very great benefit.

The perusal of the narrative under review strengthens the conviction which we formed on reading His Excellency's address, that "it would be a lasting discredit" were we "to neglect to repair the damage" which the gardens have suffered and, we may add, were we to neglect the magnificent opportunity afforded us, with our great West African responsibilities, of maintaining them as a centre of scientific research in the tropics.

FIG. 2.—Pineapple plantation in the Victoria Botanic Gardens on the east side of the Limbe river.

Obituary.

DR. F. W. PASSMORE.

WE regret to announce the death of DR. FRANCIS WILLIAM PASSMORE at his home at Bexley Heath on Saturday, October 29. Dr. Passmore began his training with Dr. B. H. Paul. In those days London was probably the largest market in the world for cinchona bark, and Dr. Paul acquired no small reputation as a "quinologist." After five years in Dr. Paul's laboratory Passmore proceeded to Wurzburg, where he worked under Emil Fischer about the time the latter began his classical investigation of the sugars. He published three papers with Fischer on the formation of acrose from formaldehyde, the phenylhydrazides of acids derived from sugars, and on the synthesis of higher homologues of *d*-mannose.

On his return to London Passmore became an assistant at the Pharmaceutical Society's Research Laboratory, then recently started under Prof. W. R. Dunstan as director, with whom he contributed a paper to the Transactions of the Chemical Society on the formation and properties of aconine, the basic hydrolytic product of the highly toxic alkaloid aconitine. If one may judge from the four papers in which Passmore had collaborated up to this time, he would have made a valuable addition to the small band of workers who have devoted attention to the chemistry of natural products in this country.

The death of his father made it necessary for him to take up more lucrative work, and he joined the late Mr. H. Helbing as a consultant and analyst. His success as an expert witness led to his being constantly employed in patent cases involving chemical questions of all kinds, but he retained his interest in drugs, and from time to time published notes, arising out of his professional work, on such subjects as wool-fat, eucalyptus oils, salicylic acid, chloroform, coal-tar disinfectants, and potassium bromide. These notes were for the most part concerned with standards of purity and methods of analysis, and were written in collaboration with his partner.

Passmore was also interested in the manufacture of saccharin, and devoted some attention to processes for the production of synthetic camphor, but it is as a consultant that his frank and engaging personality will be chiefly missed.

DR. OSCAR MONTELIUS.

BY the death of Dr. Oscar Montelius at Stockholm on November 4 the study of the prehistory of Europe has suffered a grievous loss.

Gustaf Oscar Augustin Montelius was born in Stockholm in 1843. He was attracted to the study of archæology at an early age. His first paper on the subject was published as long ago as 1869. An accomplished linguist—he seemed equally at home in most European languages—and the master of a ready pen, throughout a period of more than fifty years he was a constant contributor to the scientific journals both of his own and of other European countries, as well as the author of numerous books, several of which have been translated into English. Notwithstanding the volume of his published works, it is safe to say that not one word of his writings is not deserving of careful consideration. Of these his "Primitive Civilisation in Italy" is the most considerable, and probably will also be the most enduring. Montelius was well known personally in this country, and had contributed papers to *Archaeologia* and the Journal of the Royal Anthropological Institute, and in 1904, at the Cambridge meeting of the British Association, which he attended as a distinguished guest, he read a paper before Section H on "The Origin of the Lotus Ornament." His greatest and most lasting service to archæology lay, beyond question, in his investigation of the Bronze-age culture upon lines which enabled him to formulate a systematic scheme of chronology for that period.

Montelius was for many years a director of the State Museum of Sweden. He was a fellow of the Swedish Academy, and an honorary fellow of many European societies. In 1913 thirty-seven archæologists of European reputation, representing ten different countries, united to do him honour in a handsome memorial volume presented to him on his seventieth birthday.

WE regret to announce the death of MR. E. WINDSOR RICHARDS, on Saturday, November 12, at ninety years of age. Mr. Richards started his career at the age of twenty-three as an assistant engineer with his brother at Tredegar Iron Works, thus beginning a connection with the iron and steel industry which he maintained throughout his life. While still a young man, he was appointed chief engineer at the Ebbw Vale Steel Works, where he designed and constructed a special blast furnace for the production from Somerset spathic ore of spiegeleisen, which until that time had been imported from Germany. In 1876 Mr. Richards became general manager, and later chairman and director, of Messrs. Bolckow, Vaughan and Co., of Middlesbrough, where, in co-operation with Thomas, the basic method of steel manufacture was successfully launched. In recognition of his services to the iron and steel industry, Mr. Richards was awarded in 1884 the Bessemer gold medal of the Iron and Steel Institute, of which ten years later he became president. He was also a past-president of the Institution of Mechanical Engineers and of the Cleveland Institution of Engineers.

THE death is announced of PROF. SHERIDAN DELÉPINE, professor of public health and bacteriology in Manchester University, and director of the public health laboratories of the university, which occurred on November 13 last, at the age of sixty-six years.

We learn with regret of the death, which occurred recently, of Tadeusz Godlewski, professor of physics and formerly rector of the Technical High School, Lemberg (Lwów), Poland.

It is announced that Mr. John Macalister Dodds, fellow and formerly tutor of Peterhouse, Cambridge, died on November 13 at the age of sixty-three years.

We regret to announce the death on Sunday, November 13, at the age of eighty-one years, of Sir C. Douglas Fox, past-president of the Institution of Civil Engineers.

Notes.

H.M. the King has approved of the following awards this year by the president and council of the Royal Society: A Royal medal to Sir Frank Dyson, Astronomer Royal, for his researches on the distribution and movement of the stars; and a Royal medal to Dr. F. F. Blackman, for his researches on the gaseous exchange in plants and on the operation of limiting factors. The following awards have also been made by the president and council: The Copley medal to Sir Joseph Larmor, for his researches in mathematical physics; the Davy medal to Prof. Philippe A. Guye, for his researches in physical chemistry; and the Hughes medal to Prof. Niels Bohr, for his researches in theoretical physics.

The memorial tablet to the late Lord Rayleigh executed by Mr. Derwent Wood, R.A., is now complete, and is being placed in the position selected for it in the north transept of Westminster Abbey, between the memorials to Sir Humphrey Davy and Dr. Thomas Young. The Dean of Westminster has arranged for the unveiling ceremony to be held on Wednesday, November 30, the anniversary day of the Royal Society, at 2 p.m. Sir Joseph Thomson, as chairman of the memorial committee, will represent the University of Cambridge and the Royal Society.

The Stockholm correspondent of the *Morning Post* announces that the Nobel prize for chemistry for 1920 has been awarded to Prof. Walter Nernst, of Berlin University. The prizes for chemistry and physics for 1921 have been reserved for next year.

In a discussion in the House of Lords on November 10 the Marquess of Crewe voiced the complaint of teachers and students of science that the Safeguarding of Industries Act and the German Reparation (Recovery) Act had had the effect of hampering research and the teaching of science. The former act imposed high penalties on professors and education authorities generally who were forced to purchase materials abroad—materials which would never be produced in this country; the latter caused considerable delay in getting German books. It was a foolish policy, he urged, to discourage that research upon which the prosperity of the country so largely depended for the sake of the small amount of revenue extracted from underpaid professors and underfed students. Viscount Haldane suggested that a licence should be given by the Research Department or the Board of Education for getting the things required for research. The excellence of German scientific goods was due to the workman's spirit and tradition, and British research could not wait while British workmen were imbued with these attributes. In reply Viscount Peel stated that the Government were prepared neither to issue licences nor to grant import exemptions to educational institutions. It might be possible, however, to remove from the schedule articles which could not be produced in this country. He undertook to place the whole subject before the Minister of Education. In a leader in the *Times* of November 14 it is pertinently remarked, as evidence of the aloofness of the State from science, that "the interpellations on this scientific question were addressed to the Minister of Transport," who undertook to refer it, not to the Royal Society—"at one time the natural adviser of the Government on scientific matters"—but to the Minister of Education.

The annual council meeting of the National Union of Scientific Workers was held at the University of London Club on November 12. The retiring president, Prof. L. Bairstow, in his address, referred to the friendships formed with kindred organisations as an indication of the solid progress the union had made in its development as an element in the life of the scientific community. While the union's aims were in part economic with immediate objects, the consideration of effects to be produced by a higher idealism had claimed the greater share of attention. The Royal Commission on Awards to Inventors provided a striking example of the contrast in methods of treatment between the independent worker and the salaried worker. In the statement it presented to the Interdepartmental Committee on Patents the union had suggested that the latter method was the proper basis of treatment for all. The union should now make preparations for the collection of material ready for the next occasion on which revision of the patent law occurs. Prof. Bairstow quoted from the Press reports of the preliminary findings of the "Geddes" Committee on Economy, which indicate that the War Research Departments were threatened by the "axe." This was folly, for the greatest economies depend on research and education. Everything depended on the interpretation of the word "research"; much of the money allocated to research was actually expended on technical development. Most scientific workers regard the war period as a lean time for scientific research while agreeing that it was one of intense application of science. Prof. Bairstow concluded by expressing the hope that scientific workers would seek for representation before Parliament by one of themselves. Dr. A. Griffith, of the Royal Aircraft Establishment, was elected president for the ensuing year, and Prof. J. Stanley Gardiner, of Cambridge, president of the research council.

THE Advisory Committee for the Meteorological Office, Edinburgh, met in Edinburgh on November 4, under the presidency of Dr. G. C. Simpson, Director of the Meteorological Office. This was the first meeting of the Committee since the completed organisation under the Air Ministry. The Committee is composed of representatives of the Fishery Board for Scotland, the Board of Agriculture, the Scottish Board of Health, the Scottish universities, the Royal Society of London, the Royal Society of Edinburgh, and the Royal Meteorological Society (with which the Scottish Meteorological Society is now amalgamated). Dr. Crichton Mitchell, the superintendent of the Edinburgh Meteorological Office, was also present. After paying a tribute to the memory of the late Dr. W. S. Bruce, the Director, in a brief historical statement, explained how the former relations between the Government and the Scottish Meteorological Society had gradually led to the establishment in Edinburgh of a Scottish branch of the Meteorological Office, by which the important voluntary work previously carried out by the society would henceforth be controlled. A description of the work now being developed was given, including an account of the observatories, telegraphic reporting stations, climatological stations, and rainfall stations. In the discussion which followed the applications of meteorology to fisheries, agriculture, and public health were considered, and various suggestions were made as to the possibility of closer and more fruitful co-operation between the Meteorological Office and these public bodies. Perhaps the most immediately practical point brought forward was the question of issuing a daily weather report in Edinburgh. A demonstration of this was carried out successfully during the recent meeting of the British Association.

MONTPELLIER, where the President of the French Republic, M. Millerand, has just unveiled a monument to the great satirist Rabelais, boasts one of the oldest universities. Its botanical gardens, in which the statue has been erected, is the oldest in France, and for more than two hundred years it has possessed an Academy of Sciences. On two occasions, in 1530 and in 1536, Rabelais was a student of medicine there, and to him was due the introduction into France of the melon, the artichoke, and the carnation. Though best known for his "Gargantua" and "Pantagruel," Rabelais, like his contemporary Paracelsus, was versed in all the learning of his day. The Montpellier Academy of Sciences was founded mainly through the efforts of the astronomers Plantade and de Clapies, and the inauguration took place on May 12, 1706, the day on which Plantade and de Clapies watched a total eclipse of the sun, the first eclipse of modern times of which the accounts are in any way full and precise. Plantade was a lawyer by profession, de Clapies a retired soldier and an engineer. Both were natives of Montpellier. De Clapies died in 1740, and the following year Plantade expired suddenly when making scientific observations on the Pic du Midi. Montpellier was also the home of Balard, who taught in the School of Pharmacy and, while botanising in the neighbouring salt marshes, studied the crystallisation of salts, which led him in 1826 to the discovery of bromine, for which our Royal Society awarded him a Royal medal. Soon after this Balard succeeded Thénard at Paris, and it was in his laboratory at the Ecole Normale that Pasteur, then his assistant, made his epoch-making discoveries in tartaric acid. Another eminent chemist connected with Montpellier was Gerhardt, who occupied the chair of chemistry from 1844 to 1848.

WE congratulate our contemporary, *The Electrician*, on the celebration of its diamond jubilee last week. During the past sixty years it has minutely recorded the growth of the numerous applications of electricity, and the record contained in its pages settles, both from the scientific and the technical point of view, many questions of priority. It is interesting to find that Faraday was one of its contributors. In 1862 he published a paper on "Electrical Illumination in Lighthouses." In 1861 telegraphy, the only practical application of electricity, was in private hands. The earliest telegraph was erected on the London and North-Western railway between Euston and Chalk Farm so far back as 1837 by Cooke and Wheatstone, but the lack of the means of making accurate measurements of the new quantities involved hampered progress. The important paper on "The Measurement of Electrical Quantities," published by Latimer Clarke and Sir Charles Bright in *The Electrician* for 1861 was a great step in advance. It is interesting to notice that these authors call the volt the "ohma," the ampere the "galvat," and the ohm the "volta." Fifty years ago submarine cables of more than 500 miles in length were worked in one direction only. The receiving instrument was a reflecting mirror galvanometer, the signals being read out by one operator and written down by another. The operators in those days were extremely skilful. From 125 to 150 letters per minute could be transmitted. For long distances the messages were sent in sections. For example, from Gibraltar to London the message had to be "man-handled" eight times. Nowadays automatic relays do the intermediate operations at far higher speeds, and a message can be sent automatically from London to Singapore.

MR. J. S. HIGHFIELD, in his presidential address to the Institution of Electrical Engineers on November 3, discussed the education of an engineer and various important financial problems concerning the future of the industry. He impressed on engineers the importance of giving their skilled assistants and their apprentices theoretical knowledge and opportunities for improving their manual skill. Manual skill can be acquired only from hand-skilled men. In his opinion there were no unskilled trades, but, unfortunately, there were many unskilled workmen. He considered that although trade unions had done good work they had done harm by forcing the principle of standard wages and by reducing output. All progress in industry depends on the ability of the individual or firm to give part of his "profits" to new ventures. It is only when profits are adequate that facilities can be given for education and research. At the present moment profits are not being earned by the great trading community in this country. Consequently many are wanting work, and many are in distress. It is necessary that masters should instruct their men as to the conditions that will ensure their mutual well-being. Much is being done to secure a common understanding. This will doubtless lead to a co-operation between masters and men such as has not been known for years. We can then go forward with the certainty that prosperity will return.

THE next congress of the Royal Sanitary Institute will be held at Bournemouth on July 24–29, by invitation of the Mayor and Town Council.

THE *Revue Scientifique* for October 22 contains an account of the celebration of the centenaries of the great Alsatian chemists Gerhardt and Wurtz, which took place at Strasbourg on July 5 last. An account of the work of Gerhardt and Wurtz is given by Prof. Tiffeneau, of Paris.

THE issue of the Journal of the Society of Chemical Industry for October 31 contains a reasoned summary of the information which has appeared on the Oppau explosion. It is stated that many possible causes of the explosion were not taken into consideration in the report issued by the directors of the Badische company, and that an independent investigation by an expert Allied Commission is required.

THE ninety-sixth Christmas course of juvenile lectures, founded at the Royal Institution in 1826 by Michael Faraday, will be delivered this year by Prof. J. A. Fleming on "Electric Waves and Wireless Telephony." The lectures, which will be experimentally illustrated, will be given on the following days at 3 o'clock:—December 29, "Surface Waves on Liquids"; December 31, "Waves in Air"; January 3, "The Telephone"; January 5, "Electric Oscillations"; January 7, "Electric Waves"; and January 10, "Wireless Telephony."

IN addition to its ordinary programme, the Optical Society has arranged a series of special meetings to be devoted to subjects dealing with the evolution and development of various types of optical instruments. The Science Museum, Kensington, possesses a most interesting, and in many respects unique, collection of such instruments, with the characteristics of which instrument makers and users might well be more familiar. By arrangement with the museum authorities these instruments will be available at the meetings for purposes of illustration and demonstration. The first meeting of the series will be held at the Imperial College of Science and Technology on Thursday, November 24, at 7.30 p.m., when Prof. F. J. Cheshire will deal with "Polarising Apparatus." Other subjects to be discussed at future meetings include "Microscopes" (Prof. A. Pollard), "Telescopes" (Mr. D. Baxandall), and "Astronomical and Surveying Instruments" (Mr. L. C. Martin).

ALTHOUGH under the ban of the "Comstock Law," the scientific discussion of birth control is widely recognised in the United States as of great racial importance. Dr. Marie Stopes was invited by the Voluntary Parenthood League to New York to speak in the Town Hall on the subject on October 27. Following the lecture, which was enthusiastically received, a group of society leaders met the next day, subscribed sufficient funds, and organised a managing committee in order to open clinics immediately in America, following so far as possible the lines of the Constructive Birth Control Clinic founded by Dr. Marie Stopes and Mr. H. V. Roe in London this year. The position differs somewhat from that in England, for in the United States it is still legal to give clinical instruction only to persons already diseased. Those who are healthy and desire to remain healthy are not permitted this knowledge. It is, however, one step in racial advancement that the diseased should be shown how to avoid procreating their kind.

THE Ministry of Transport has issued an informal memorandum which summarises some experimental work (done at Alresford, in Hampshire) on the effect of drainage from tar-macadam roads on fish-life. Recently-tarred roads are certainly potentially dangerous. The first rain-washings must be mixed with at least an equal volume of clean water if they are not to be actively toxic to fish. Even when the dilution is several times that mentioned the effects may be prejudicial, and to be sure that no poisoning may occur the dilution must be ten to one at least. After the first washings are swept away the surface becomes less objectionable. There is evidence that storage of the drained-off water reduces its toxicity to fish-life, and it appears also that filtration through freshly cut turf may also diminish the danger. When the tar-macadam surface undergoes further severe disintegration it may again become dangerous. The experiments are still incomplete and are being continued, but the provisional results are helpful to conservators and others, and point to remedial measures in the case of valuable fisheries.

A COLD snap occurred in the weather over England during the second week of this month, and the first fall of snow for the present winter was experienced in London on the evening of November 11, whilst during the succeeding night at Greenwich the sheltered thermometer fell to 27° F., and it was 21° F. on the ground open to the sky. The mean temperature in London for the first six days of November was 49°, and for November 7–12 it was 15° colder. The ponds and ornamental waters around London were coated with ice. The first week of November is a fairly well recognised warm period in Great Britain, whilst the second week is one of Dr. Buchan's cold periods, associated with northerly winds. In 1910 November had sixteen frosty nights at Greenwich, and in the last eighty years there is only one other instance with so many, in the year 1851. In 1908 there was a short, but severe, early cold snap in November, the sheltered thermometer at Greenwich on November 10 registering 22° F., and on the grass the reading was 9° F. The coldest November at Greenwich occurred in 1871, when the mean temperature for the month was 38°. In 1890 a severe frost set in over England on November 25, the thermometer registering 18° F. in the shade on November 28, the lowest shade temperature on record for the month, and the maximum temperature for the day was only 27° F.; the frost continued practically without interruption until the end of February.

ON June 30 of this year the Manchester Museum celebrated its hundredth birthday, and in the November issue of the *Museums Journal* its keeper, Dr. W. M. Tattersall, takes occasion to give a brief history of the museum.

MR. W. BELLOWS, Tuffley Lawn, Gloucester, sends us the following extract from a letter received on November 9 from a correspondent in southern Manitoba (30 miles from the United States frontier):—"Perhaps you remember the little creek or river which runs through part of my land. A colony of beavers has built a house and dam, and, I fear, will flood my hay-land. I must apply to the Government for permission to break the dam. These creatures are increasing rapidly and will do much damage. They have now cut down a number of my trees of good size, and, if unmolested, will destroy all near. They are strictly protected; permission has to be obtained before one may be killed."

A DETAILED study of the races of Japanese domestic cattle, based on the examination of a large series of skulls, as well as on observations of the external morphology, forms the subject of a paper by Mr. Kenzo Iguchi in the Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan (vol. 9, part 5). The author concludes that the domestic cattle of Japan are not native, but have been derived from the races of cattle of North China brought over by way of Chosen on the wave of migration which carried the ancient culture of China to Japan. Discussing the origin of Chinese cattle, Mr. Iguchi supports the view that they have been derived by an uninterrupted course of domestication from the zebu of northern India, which he regards as the ancestral wild parent of all the races of eastern Asiatic cattle.

THE conservation of the wild or native fauna of any part of the world will depend primarily upon economic considerations. The ideal of preventing, for scientific reasons, the extinction of wild species, because they *are* wild and represent the native fauna, will never be reached or even considered when commercial interests are at stake. It is from this aspect first and last that the problem is viewed. This is well instanced by the publication of two articles in the Yearbook of the United States Department of Agriculture, 1920, with the contradictory titles, "Conserving our Wild Animals and Birds," and "Hunting down Stock Killers." This apparent paradox is explained by the fact that the first article advocates increased measures for the protection of those animals and birds which are of commercial value, and the second details the work that has been done in the systematic destruction of the native Carnivores which take such enormous toll annually from the stock-farms and ranches of North America. The man of science and field naturalist will learn with satisfaction of the good results already discernible from the Migratory-bird Treaty Act of 1920. He can have nothing but admiration for the splendid work which the American Government has done in the preservation of bison, elk, antelope, and deer, and will welcome any measures which will save from extinction the small fur-bearing mammals of the Northern Territories. On the other hand, he will reflect that the Carnivores are at least a virile and dominant family which the most rigorous hunting may keep in check but hardly exterminate.

THE Hugo Müller lecture delivered before the Chemical Society on June 16 last by Prof. Benjamin Moore is printed in the October issue of the Journal. Prof. Moore spoke on "Photosynthetic Processes in the Air, upon the Land, and in the Sea in Relation to the Origin and Continuance of Life on the Earth." In dealing with this wide subject an attempt was made to trace the continuity of life from the inorganic world to the highest types of organism. Radiant energy from the sun is responsible for building up simple inorganic and organic compounds, including nitrogen compounds, from the air; the nitrogen of the atmosphere may be converted into proteins. Photosynthesis occurs not merely in the region of the absorption bands of chlorophyll, but throughout the spectrum, and the chlorophyll may be a colour-screen protecting the organism from the blue and ultra-violet rays, which are prejudicial to life. Prof. Moore describes many experiments in support of his novel and interesting views.

THE description of a new dye-printing photographic process is contributed by Dr. J. M. Eder to the *British Journal of Photography* for November 4. This method is distinct from Willis's aniline process (1864), Feer's diazotype (1889), Andresen's diazotype (1895), and the primuline process of Green, Cross, and Bevan (1890). It has been patented by the Badische Anilin- und Soda-fabrik. Benzidine hydrochloride or other diamine compound is precipitated with an acid dye such as eosine, cyananthrol, Neptune-green, or quinoline-yellow, according to whether the print is to be a bright purplish-red, a dark violet, a bright green, or brown. The precipitate is mixed with manganese nitrate or a similar oxidiser and water, and coated upon paper. After exposure under a negative, fixing is done in a solution of borax or of sodium phosphate. So far pure whites have not been obtained, but the great brilliancy and variety of colour that are possible, and the good gradation and vigour of the prints, render the process, in Dr. Eder's opinion, worthy of attention.

SOME engineering uses of stainless steel, which is an alloy steel containing from 12 to 14 per cent. of chromium, are described in an illustrated article in

Engineering for October 28. The principal experiments described had for their object the determination of the suitability of the material for steam-turbine blades. In 1916 the British Thomson Co., of Rugby, fitted in one of their turbines an experimental wheel having blades of phosphor-bronze, nickel-bronze, brass, mild steel, and stainless steel. Of the four stainless steel blades inserted two were hardened and the other two were hardened and tempered. This turbine was at work from the autumn of 1916 until April, 1918, when it was opened out for the first time. All the blading was in good condition, but the stainless blades were the only ones entirely free from erosion or corrosion. The machine was put to work again and re-examined last July, when it was found that the stainless steel blades appeared to be absolutely unaffected by their service; further, the hardened and tempered blades were in as perfect condition as the hardened blades. All the other materials had suffered, some severely. Messrs. Firth and Sons fitted stainless blades 28 in. long into a turbine four or five years ago, and report that these also have given entire satisfaction. Other confirmatory experiments are described in the article. The subject is of very great importance in turbine manufacture, and it would appear from the tests that in turbine blading erosion and corrosion trouble can now be entirely eliminated.

THE new catalogue (No. 364) of important and rare books on natural history, issued by Messrs. B. Quaritch, of 11, Grafton Street, W.1, contains nearly 800 titles. Interesting items we have noticed are two volumes of the "Index Kewensis" (1885–95), an edition, published in 1836–39, of Cuvier's "Basis of the Natural History of Animals," a Settin edition of Gilbert's "De Magnete," a copy of the first edition of Darwin's "Origin of Species," and the extensive collection of English and foreign pamphlets on Diatomaceæ, from the library of the late Wynne E. Baxter.

MESSRS. LONGMANS AND CO. have in the press a new book by Prof. A. W. Stewart entitled "Some Physico-Chemical Themes," which is intended to form a connecting link between systematic text-books of physical chemistry and the original literature of the subject. Among the subjects treated of will be double and complex salts, pseudo-acids and indicators, non-aqueous ionising media, colloids, the Brownian movement, absorption, catalysis, chemical affinity, emission spectra, the determination of Avogadro's constant, the periodic law, and atomic structure.

Our Astronomical Column.

BRIGHT ASSEMBLAGE OF MORNING STARS.—Mr. W. F. Denning writes: "During the remainder of the present month there will be visible before sunrise all the brightest planets, viz., Mercury, Venus, Mars, Jupiter, and Saturn, and in addition to these objects the crescent of the Moon will be visible in the south-eastern sky from about November 25–28.

"It is only at long intervals that so large a number of interesting planets occupy positions in the heavens enabling them to be viewed at the same time. Towards the end of the month Mars, Jupiter, and Saturn will be near one another, and they will be in conjunction with the Moon on November 25. Mercury and Venus will also be near together and low in the south-eastern sky, and on November 28 they may be seen near the narrow crescent of the moon. The best time at which to view these objects will be from about 6.30 to 7 a.m. Of the planets named Venus will appear to be much the brightest, while Jupiter will rank second."

MEDIEVAL ASTRONOMICAL INSTRUMENTS IN INDIA.—Memoirs of the Archæological Survey of India (No. 12) contains a description by G. R. Kaye of some medieval instruments of beautiful workmanship now in the Delhi Museum. There are three astrolabes belonging respectively to the thirteenth, fifteenth, and seventeenth centuries. They contain planispheres on which the principal stars are delineated with such accuracy that the date of construction can be ascertained within a few years by simple measurement of longitude. The stars' names are recorded in Arabic, and a glossary of their meanings is given in the memoir. It may be noted that the name Achernar (the last of the river) is applied to the third magnitude star θ Eridani, not to the bright star, 17° further south, that now bears it.

There are also tablets on the astrolabes giving the latitudes of several towns, and other details such as the length of the longest day.

The celestial sphere is of brass 6·5 cm. in diameter; it bears the date A.H. 1087 (or A.D. 1676). In spite of the small scale, the stars' positions are so accurate that their measured longitudes led to the date 1664.

It is of interest to note that the Arabs borrowed at least three constellation names—Thaur, Qantaurus, and Qitus—from the Greek, and that they call Betelgeux and Bellatrix the right and left shoulder of Orion; in other words, they take the figure as shown on a star-map, not on a globe, as some medieval European astrologers used to do.

NOVA AQUILÆ.—It is praiseworthy that of late years a number of observers have studied novæ on their decline, long after they have ceased to be spectacular. Comparison of their ultimate with their original condition is of value as likely to afford information as to the character of the event that produced the sudden outburst. Nova Aquilæ is a particularly favourable star to take for this purpose, as a long series of photographs of the star in its pre-nova state is available. It was then of about the 10th magnitude, but seemed to be irregularly visible to the extent of half a magnitude.

Popular Astronomy for October contains, in its Variable Star Report, numerous observations of the star made last summer. Each of the following values is the mean of about eight observations:—

1921, June 8, 9·44 mag.; July 1, 9·47 mag.; July 13, 9·64 mag.; July 28, 9·60 mag.; August 6, 9·47 mag. The observations leave it an open question whether there are short-period fluctuations; if such exist, their amplitude can scarcely exceed 0·2 mag. It will be seen that the star, in three years from the outburst, has declined to within some half-magnitude of its original brightness.

British Scientific Instrument Research Association.

THE British Scientific Instrument Research Association has recently issued its third annual report, which gives a very brief account of the further development of the organisation of the association and of the researches in progress. The membership comprises some twenty-five or more of the principal instrument-making firms of the country; the director, Sir Herbert Jackson, is assisted by a scientific staff of seven members, in addition to the secretary. The present chairman of the association is Mr. Campbell Swinton.

Three years are a short time in the life of a research institution. Much of the time has, no doubt, been spent in the preliminary planning of the programme of research, in securing staff, and in providing and installing what must still be a somewhat modest equipment. It is to the credit of the staff that they have already succeeded in producing results, along more than one line of investigation, of definite value to the members of the association, and, no doubt, ultimately to the users of scientific apparatus and to science generally. The lines of work which have been mainly followed are clearly indicated by the report, though, since the knowledge acquired by a research association remains, for a time at least, confidential to its members, the details given of the results achieved are somewhat limited.

Experiments have been made in the production, on a small scale, of optical glasses of new types, directed more particularly to the provision of a substitute for alum in apochromatic lenses and some other special requirements in optical design. Information has been obtained with regard to neutral-tinted glasses of uniform spectral absorption and coloured glasses for photographic purposes, which it is hoped may lead to production on the manufacturing scale. The durability of optical glasses has been the subject of special study, and research on the viscosity of glass has been promoted, and has led to a new method of determining viscosity applicable to glass at high temperatures.

Much attention has been devoted to abrasives and polishing powders. In this work considerable success has been attained, and results of theoretical interest, as well as of practical value, have been secured. It is understood that a general account of these will be published. Cements for prisms and lenses have been investigated and some improvements are recorded. Other materials to which attention has been given are a wax mixture for use as a temporary adhesive and solders of high and of low melting point. The progress made should be of definite value to optical instrument-makers as well as in other allied industries.

The other main section of the work relates to electrical and X-ray apparatus. Probably the most notable success so far achieved by the research staff of this section has been the production of a convenient regulator of new type for X-ray tubes, which enables the tube to be "hardened" or "softened" as desired, thus considerably extending the life and usefulness of the tube. An investigation is in progress which it is hoped will lead to manufacturing improvements in the focussing of X-ray tubes. The wave-form for use in the generation of X-rays is also being studied. Other investigations which have been undertaken relate to the magnetic properties of materials used in galvanometer coils and to insulators and insulating varnishes and enamels.

Many of the research associations so far formed have few facilities for carrying out research under their own immediate control, and, in common with others, the British Scientific Instrument Research Association has devoted some portion of its funds to the promotion of investigations by other institutions and individual workers into problems of importance to its members. The National Physical Laboratory is collaborating with the association in an investigation relating to radio-luminous paint. Work of great importance to the electrical instrument-maker has been done at the laboratory in the production of a resistance material of small temperature coefficient similar to "manganin," samples of which are being supplied to the association for trial by its members under manufacturing conditions. Researches undertaken by individual investigators include the examination of liquids suitable for level bubbles, the work already mentioned on the viscosity of glass, the study of magnet steels, and questions arising out of an investigation of tissue-paper as a wrapper for polished glass surfaces. The design and construction of an integrating nephelometer may also be mentioned.

The aim of a research association must be to improve British industry and enable it to compete more successfully in both home and foreign markets by the utilisation of the most advanced scientific knowledge and methods. This implies the cordial co-operation of its members for the common good, and the extent to which this principle is brought into operation affords some measure of the advantage which the members are likely to derive from their association. The principle appears to have been adopted more fully by the British Scientific Instrument Research Association than by some others, and this is of good augury for its future success. The list of subordinate investigations with which the report concludes, due to individual inquiries, indicates how valuable the assistance of such an association may be to its component members if the director and his staff are allowed reasonable freedom in the use of their knowledge and experience to remove the difficulties met with by individual members in the course of their work and in giving advice for the improvement of their products. Investigations carried out for one of the associated firms are paid for by the firm, and thus add to the revenue of the association. The help which can be given in this manner will increase steadily in importance as the staff gains experience in dealing with the technical problems of the instrument-maker.

Arctic Medusæ.

WE have received copies of parts of the Report of the Canadian Arctic Expedition, 1913–18: the Medusæ and Ctenophora are dealt with by Dr. H. B. Bigelow, the Polychæta by Dr. R. V. Chamberlin, and, in the portion devoted to the Crustacea, the Cumacea by Dr. W. T. Calman, the Isopoda by Mr. P. L. Boone, the Amphipoda by Mr. C. R. Shoemaker, and the parasitic Copepoda by Dr. C. B. Wilson. The collection of Medusæ, which is only the second which has been made on the Arctic coast of America, comprises species well known either from some part of the North Atlantic or from its Arctic tributaries. One species only is new. Dr. Bigelow refers to the importance, especially to the oceanographer, of establishing definitely which of the Arctic Medusæ are certainly produced in those seas; for such floating buoys are sometimes of great assistance in indicating the origin, northern or southern, of the constituent waters of ocean currents. The Medusæ have the advantage, as compared with Arctic diatoms, of larger size and easy identification. Dr. Bigelow points out that there is at least one Anthomedusa, *Sarsia princeps*, which has now been recorded from so many parts of the Arctic and from currents flowing from it (*e.g.* the Labrador current), but from nowhere else, that it can safely be taken as an indicator of Arctic water. The report on the Isopoda has been extended to include other material from the Arctic, and forms a summary of our present knowledge of the Isopoda of that region. The Amphipoda reported are, for the most part, well-known Arctic species, but one—a species of Synurella—is new, and this genus is recorded for the first time in American waters. *Katius obesus*, known previously only from the Atlantic, is now reported for the first time from the Pacific. Appended to the report on parasitic Copepoda is a useful list of the species which have been recorded from the Arctic up to the present.

University and Educational Intelligence

BIRMINGHAM.—The Huxley lecture is to be delivered on November 25 by Prof. C. Lloyd Morgan, who has chosen as his subject "A Philosophy of Evolution."

CAMBRIDGE.—A congratulatory address to Dr. G. D. Liveing, for forty-seven years professor of chemistry in the University, was read by the Public Orator at the Congregation on November 5. The address was presented by the Vice-Chancellor to Dr. Liveing at St. John's College on Sunday, November 13.

Dr. J. Chadwick has been elected to a fellowship at Gonville and Caius College.

MANCHESTER.—The University has received from Messrs. Lewis's, Ltd., an offer of 1000*l.* a year for three years. A portion of this sum is to be utilised in providing scholarships each of the value of 200*l.* for one year, to encourage further study on the part of graduates who propose to enter industry and commerce. Under the proposed scheme one scholarship would be offered annually in each of the subjects, economics, commerce, and applied psychology. It is proposed that these scholarships should be open to graduates of any approved university, and that they should be awarded by the University. They will be known as the "Lewis's Scholarships in Commerce." The council has accepted the offer with gratitude. Detailed proposals for the scheme are at present under consideration, and will be announced in due course.

Mr. R. W. Palmer, of the Geological Survey of India, has been appointed senior lecturer in geology.

Mr. Stanley Wyatt, investigator to the Industrial Fatigue Research Board, has been appointed special lecturer in psychology.

MR. J. W. SCHARFF has been appointed lecturer in biology at King Edward VII. Medical School, Singapore.

THE *Times* announces that Sir Philip Magnus, member of Parliament for London University for the last sixteen years, has written to Sir Forrest Fulton, president of the London University Unionist Association, stating that, as he has entered his eightieth year, he has decided not to offer himself for re-election at the close of the present Parliament.

IT is announced that five or more commercial research fellowships of the approximate value of 500*l.* each are to be instituted by the executive council of the British Empire Exhibition, 1923. The fellowships will be identified with those towns the chambers of commerce of which obtain the highest aggregate of guarantees for the exhibition in proportion to their membership, and these bodies will also have the right of selecting the recipients. Each fellowship includes a first-class return ticket to the Dominion or Dependency to be visited, and research will be carried out under the following headings:—(1) The best means of promoting inter-Imperial trade in a selected staple industry; (2) the methods by which the forthcoming exhibition can promote this trade; (3) the potential resources in raw material of the country visited and the best means for their exploitation in the mutual interest of the producing country and Great Britain; and (4) the means whereby undeveloped resources may be adequately represented at the forthcoming exhibition and brought to the notice of the industrial and financial groups concerned. The subject for investigation will be determined by the local chamber through which the fellowship is awarded, and the fellows selected must proceed to their destinations before the end of March next. The closing date for entries for the competition is December 15, and the results will be announced on December 24.

BULLETIN No. 42, 1920, of the United States Department of the Interior, Bureau of Education, provides evidence that American colleges are suffering in the matter of staffing in much the same way as British universities and colleges, and for the same reasons. The bulletin contains reports of conferences on education for highway engineering and highway transport. The American colleges are very desirous of helping in the solution of highway problems, but they are limited in many ways, and especially in the matter of money. A large number of college faculty members are leaving because manufacturers offer higher salaries than the colleges can pay. "Under war conditions the teaching staffs were badly disorganised. Last year there was a tremendous influx of new students, and the appropriations have, in general, been far less than the enlarged needs. Salary budgets have not been revised to meet the competition of industrial engineering organisations, with the consequent loss of very many of the best qualified professors and instructors." There is a great deal more to the same effect, and the committee recommends that more ample funds must be provided from private sources, from co-operative efforts with industries, and from taxation.

WE have received two papers on "International Language in English and Ido," by Prof. Otto Jespersen, and a pamphlet on "The Auxiliary Language Ido," by M. L. de Beaufront. These papers trace the origin of Ido as a development from Esperanto, and claim that it is free from many defects to be found in the earlier artificial language. In 1907 an International Committee met in Paris to decide which artificial language was the most suitable to be introduced for international communications. After much discussion the Committee decided in principle to adopt Esperanto, but with the reservation that several changes should be made by a Permanent Commission. The changes made by this Commission were, however, not accepted by the supporters of Esperanto, so that the auxiliary language finally adopted by the Commission, instead of taking the place of Esperanto, appeared as a rival language under the name of Ido. The recent report of the Committee on an International Auxiliary Language made to the meeting of the British Association at Edinburgh recommends an invented language, and adds that Esperanto and Ido are suitable. We would suggest to the Esperantists and Idists that, instead of accentuating their differences, they should endeavour to come to an agreement upon points of difference, and thus present a united front in their campaign in favour of an artificial language.

A FURTHER communication has reached us from Mr. Cyril Crossland (see NATURE, August 4, p. 733), who expresses the view that the use of Hebrew at the Jewish University in Jerusalem is an act of exclusiveness against non-Jews. He urges that Hebrew is a dead language, and only the Zionists are working for its revival, for purely racial and political ends. As a matter of fact, Hebrew is the real living language of the Jews in Palestine. It is the language of instruction of the Jewish schools in Palestine, both elementary and secondary, and is one of the official languages of the country. It would surely be an anomaly to have a Jewish university in Palestine without Hebrew as the language of instruction. Hebrew has already been used for scientific work with great success. To urge that the use of Hebrew means excluding non-Jews is the same as urging that the use of English at a British university means excluding Frenchmen or Germans. Mr. Crossland objects to the statement that Jews are opposed to clericalism, and asks, "Then how is it they remain Jews?" We suggest that he misunderstands the meaning of the word "clericalism," which signifies the usurpation of political power by the clergy, and to this Jews are opposed everywhere. Mr. Crossland refers to the college at Beirut, where instruction is given in English, and to the fact that there are in Palestine native qualified, energetic, and patriotic medical men who can deal with the public health of the country. These facts are irrelevant. Beirut is not in Palestine. Further, public health has been grossly neglected in Palestine, and to object to this being cared for by Jews is an inadmissible attitude.

SOME of the most striking developments of recent years in the education of the medical practitioner have been concerned with the increasing realisation of the need for placing the curriculum upon a solid foundation of pure science. This has in turn reacted upon the teachers of pure science, for it has stimulated their interest in the medical student, with the result that in various universities courses in pure science have been organised with a special eye to his needs. Such a course is illustrated by a pamphlet which has reached us from the University of Melbourne, dealing with the course in elementary physics for medical students in that university. The pamphlet, which is written by Mr. E. O. Hercus, lecturer in natural philosophy, in collaboration with Prof. Laby, is entitled, "Notes on Colloidal State, the Measurement of Blood-pressure, Conservation of Energy in the Human Body." The pamphlet is not a complete syllabus—probably the authorities of Melbourne University have learned what many of our authorities at home have failed to learn—that there is no surer way to deprive university teaching of all life than by forcing it to conform to a cast-iron framework in the shape of a rigid syllabus—but it serves at least to show that the Melbourne course is both interesting and useful. The dispersed condition of matter, solutions, colloids, the processes of filtration and dialysis, the scattering of light, Brownian movement, cataphoresis, coagulation and precipitation, the measurement of blood-pressure, and the energy-changes in the animal body—these subjects are all dealt with in the Melbourne course, and every one of them is of the most immediate importance to the student of the animal body and its functions.

Calendar of Scientific Pioneers.

November 18, 1854. Edward Forbes died.—Though only thirty-nine when he died, Forbes was regarded as the leading British naturalist of the first half of the nineteenth century. He wrote important geological, botanical, and palæontological papers, and furthered the study of marine zoology. Naturalist to the *Beacon* Expedition of 1841, he became professor of botany at King's College, London, and just before his death professor of natural history at Edinburgh.

November 18, 1887. Gustav Theodor Fechner died.—After resigning the chair of physics at Leipzig, Fechner turned to the study of psychology, which he endeavoured to make susceptible to mathematical treatment. He is remembered for the useful Fechner's law.

November 19, 1910. Rudolph Fittig died.—Professor of chemistry at Tübingen, where Ramsay was one of his students, and then at Strassburg, Fittig did original work on the benzene series and made an exhaustive study of unsaturated acids and lactones.

November 20, 1751. George Graham died.—The maker of Halley's mural quadrant and Bradley's sector, "honest George Graham" was the first mechanician of his age, and to him we owe the mercurial pendulum and the dead-beat escapement. He is buried with his master, Tompion, in the nave of Westminster Abbey.

November 21, 1815. James Archibald Hamilton died.—A pioneer among Irish astronomers, Hamilton in 1790 became the first astronomer of Armagh Observatory, founded by Richard Robinson, first Baron Rokeby.

November 22, 1881. Ami Boué died.—Of French descent, but born in Hamburg, Boué studied at Edinburgh, and in 1820 published the first general account of the geology of Scotland. He played a leading part in the formation of the French Geological Society in 1830, and afterwards settled in Vienna, communicating to the Academy of Sciences there important papers on the geology of the Balkan States.

November 22, 1907. Asaph Hall died.—A contributor to many branches of astronomy, Hall achieved popular fame by his discovery on August 11 and 17, 1877, of Deimos and Phobos, the outer and inner satellites of Mars. From 1862 to 1891 he was connected with the Naval Observatory at Washington, and afterwards held a chair of astronomy at Harvard.

November 23, 1826. Johann Elert Bode died.—The founder in 1774 of the *Astronomische Jahrbuch*, fifty-one volumes of which he edited, and known for his enunciation of Bode's law, Bode was a Hamburg schoolmaster who was called to Berlin by Frederick the Great and made a member of the Academy of Sciences.

November 23, 1844. Thomas Henderson died.—The first Royal Astronomer for Scotland, Henderson previously was director of the Cape Observatory. His publication of the determination of the parallax of α Centauri was made only two months later than the publication by Bessel of the parallax of 61 Cygni. These were the first determinations of their kind.

November 23, 1864. Friedrich Georg Wilhelm Struve died.—The fourth son of a Danish professor of mathematics, Struve in 1820 became director of the Dorpat Observatory, whence he removed to Pulkowa as the chief of the famous observatory erected by Tsar Nicolas I. and opened in 1830. Under Struve, Pulkowa became not only a great centre of astronomical work, but the centre also of important geodetical operations.

E. C. S.

Societies and Academies.

LONDON.

The Royal Society, November 10.—Prof. C. S. Sherrington, president, in the chair.—A. J. **Wilmott**: Experimental researches on vegetable assimilation and respiration. XIV.—Assimilation by submerged water plants in dilute solutions of bicarbonates and of acids: an improved bubble-counting technique. The increase of "bubble rate" of carbon dioxide liberated from the cut stem of a water-plant when free acid is added to the water covering the stem is due to the effect of the acid upon carbonates present. No increase is found when soft water is used. In "bubble rate" experiments, solutions of carbonic acid and of sodium bicarbonate of known strength behave similarly.—E. G. **Young**: The coagulation of protein by sunlight.—E. G. **Young**: The optical rotatory power of crystalline ovalbumin and serum albumin.—A. R. **Ling** and D. R. **Nanji**: The longevity of certain species of yeast. Yeast cultures prepared in 1887 by the late Prof. Hansen were found to be still living. The form in which they have retained their vitality is not determined. *A. apiculatus* hibernates in the soil; since the yeast with which Hansen worked does not form endospores it may have been preserved as resting cells.—F. **Kidd**, C. **West**, and G. E. **Briggs**: A quantitative analysis of the growth of *Helianthus annuus*. Part I.—The respiration of the plant and of its parts throughout the life-cycle. The respiration of the plant was investigated (1) for calculating loss in dry-weight, due to respiration under field conditions, and, with the increase in dry-weight due chiefly to assimilation, to construct a "balance sheet" for the plant; (2) to determine effect of age of the plant (internal factor) upon its respiration, which was measured under standard conditions at weekly intervals throughout the life cycle. The amount of carbon dioxide (mgs.) per gm. dry-weight per hour produced by the respiring tissue under standard conditions is called the "respiratory index," which is a close measure of the "effective amount of respiring cell-matter." The relation between respiration and temperature (0–25° C.) was also determined. The "respiratory index" of the whole plant and of individual organs decreases throughout the life-cycle, in the case of the whole plant from 3 to about 0·3. Its fall follows closely the fall in "relative growth rate."—G. S. **Currey**: The colouring matter of red roses.

Royal Microscopical Society, October 19.—Prof. John Eyre in the chair.—Dr. L. T. **Hogben**: Preliminary account of the spermatogenesis of Sphenodon. The material of this research was preserved by Prof. Dendy. Examination of sections of testes of Sphenodon show:—(*a*) The diploid complex is markedly heteromorphic. (*b*) Synapsis is effected by parallel conjugation. (*c*) There is apparently no unpaired chromosome. (*d*) The probable number of diploid chromosomes is twenty-six. (*e*) Reptilian gametogenesis is at present an unexplored field that invites attention for the study of heteromorphic chromosome groups.

Physical Society, October 28.—Sir W. H. Bragg, president, in the chair.—S. **Butterworth**: The use of Anderson's bridge for the measurement of the variations of the capacity and effective resistance of a condenser with frequency. From an analysis of the effect of residuals and earth capacities in Anderson's inductance-capacity bridge, it is shown that if balances are obtained by balancing the bridge with *direct* currents, and making the alternating current adjustments by means of a small series resistance (s') and parallel condenser (C') in the condenser arm, then the changes required in s' and C' to hold the balance at different frequencies are equal and opposite to the variations of the effective (series) resistance and capacity of the condenser with frequency. The assumptions made are that the residual inductances and resistances of the "non-inductive" arms of the bridge are invariable with frequency, and that the resistance of the inductive arm varies as the square of the frequency. S. **Butterworth**: Notes on earth capacity effects in alternating-current bridges. An earth capacity acting at any point in the arm of a bridge may be replaced by two earth-impedances acting at the ends of the arm together with an impedance in series with the arm. By integration the result is extended to small distributed capacities. Two methods are given for the elimination of the error due to the end impedances. Complete elimination can be obtained only by the use of shields connected to the ends of the bridge arm.—F. G. H. **Lewis**: An automatic voltage regulator. Automatic voltage regulation to 0·15 per cent. may be obtained for the operation of a photometric standard lamp on an ordinary supply varying by 10 per cent. by placing the lamp across an unbalanced Wheatstone bridge, of which two opposite arms are composed of tungsten filament lamps. The increase of resistance of these lamps, when the outside voltage rises, causes a shift in the balance such that the voltage across the photometer lamp remains unaltered if the resistances in the arms be properly proportioned. The power taken is about forty times that used in the regulated circuit.—A. S. **Hemmy**: The flow of viscous liquids through slightly conical tubes. A formula is obtained by neglecting terms containing the square of the obliquity. Good agreement with viscosity found experimentally with tubes of differing degrees of conicality is observed.

Mineralogical Society, November 1.—Dr. A. Hutchinson in the chair.—Prof. H. **Hilton**: The determination of the optic axes of a crystal from extinction-angles. The problem of obtaining the positions of the optic axes of a crystal from the extinction-directions on four known faces was discussed, and it was shown from a purely geometrical point of view that the solution is unique. Their position was also found graphically as the intersection in the gnomonic projection of two cubic curves, on which any number of points can be obtained by the use of the ruler only.—W. Campbell **Smith**: Some minerals from Leadhills. Caledonite of pale blue colour and acicular habit has been frequently described in the past as aurichalcite. Examination of all available specimens of so-called aurichalcite from this locality showed that all were caledonite of this acicular habit. The optical properties were found to agree with those of caledonite of the normal habit. It was shown that in caledonite the plane of the optic axes is parallel to (010) and the acute bisectrix is perpendicular to (100), and not as stated in Dana and other text-books. Other remarks referred to gold, linarite, minium, and the rare mineral eosite.—Dr. J. **Drugman**: An example of porphyry-quartz from the Esterel Mountains (France) twinned on the face (10$\bar{1}$2). This twin-law in quartz has previously been observed only by Q. Sella in 1858, and has been regarded as doubtful. An example of it has been found amongst the porphyritic crystals in the "blue porphyry" of the Esterel Mountains. A distinction is made between the twins of low-temperature rhombohedral α-quartz and those of hexagonal β-quartz (stable at a temperature above 575° C.).—Dr. L. J. **Spencer**: Biographical notices of mineralogists recently deceased, with an index of those previously published in the *Mineralogical Magazine*.

PARIS.

Academy of Sciences, November 2.—M. Georges Lemoine in the chair.—A. **Blondel**: Conditions of starting and of resonance of an alternator feeding a long high-tension line, with or without receiver.—M. **Riquier**: The complete families of integral figures of a system of partial differential equations of the first order, and the application of their properties to the theory of any differential systems.—J. Andrade was elected correspondant for the section of mechanics in succession to the late M. Vallier.—C. E. **Brazier**: The variation of the velocity of ascent of pilot-balloons with altitude. Theoretically, neglecting hydrogen losses and assuming that india-rubber preserves its elasticity, the velocity of ascent should increase regularly with the altitude; actually, the velocity is a maximum near the ground, decreases up to a height between 500 and 1500 metres, and then increases slowly up to 8 or 9 km. Various possible explanations of these facts are discussed.—P. and M. **Richard**: The general problem of aviation. The system of equations utilised by engineers in the design of aeroplanes is simply the analytical expression of the laws of similitude of aerodynamics. Experience in construction has hitherto been the only guide in fresh development. The authors give three equations, partly based on experience and partly on the laws of similitude, which may be used in place of those in current use. Some applications of these equations are indicated.—M. **Gevrey**: Linear partial differential equations admitting a single family of imaginary characteristics.—B. **Gambier**: Conformable correspondence between two surfaces, with conservation of the lines of curvature and of the absolute value of the ratio of the principal radii of curvature.—K. **Ogura**: The extension of a theorem of Liouville to the field of gravitation.—M. **Mercier**: The measurement of the velocity of propagation of electric waves along metallic wires. When a system of electrical oscillations is propagated along two parallel wires, they give rise to a system of nodes and loops. The velocity is known if simultaneous measurements are made of the wave-length and the period of the oscillations. The distance between the nodes can be determined with an accuracy of the order of one in a hundred thousand. The frequencies were measured on absolute value by the method of Abraham and Bloch. The velocities can be determined with an accuracy exceeding 1 in 10,000.—P. **Dejean**: The demagnetising field and paramagnetism.—C. **Raveau**: Is there a resolution of common salt in presence of a non-congruent solution submitted to evaporation?—M. and Mme. A. **Lassieur**: The rapid electro-analysis of brass. The copper is deposited in a sulphuric-nitric acid solution. A minimum amount of nitric acid is employed, and this is reduced to ammonia by electrolysis previous to the determination of the zinc.—J. **Martinet** and A. **Haehl**: The *m-m'*-dinitrodiphenylsulphone.—P. **de Sousa**: Some remarkable rocks from Angola. Nine complete analyses of these rocks are given and compared with two earlier analyses of rocks from the same district published by A. Holmes.—P. **Glangeaud**: The complexity of the volcanic massif of Cantal and the true nature of the Puy Mary. The author has been led to form a different opinion on the constitution of the Puy Mary from that currently held, and regards it as a true volcanic dome afterwards covered up by its products, and later uncovered by erosion.—C. **Lepierre**: A new type of mineral water: nitrate waters. Nitrates usually exist in waters in traces only, but an analysis of the water from Ericeira, Portugal, shows that nearly 19 per cent. of the total mineral matter in solution consists of nitrates. Of the various hypotheses as to the possible source of the nitrate, that of the nitrification of organic matter agrees best with the observed facts. —M. **Romieu**: The cytological and micro-chemical study of the red-blood corpuscles in the cœlom of *Terebella lapidaria*.—L. **Boutan**: The nucleus of fine pearls. The qualities of the surface of fine pearls are quite uninfluenced by the presence of a nucleus in the interior.—M. **Bodansky**: The distribution of zinc in the organism of the fish. Two fishes were selected, the catfish, *Ailurichtys marinus*, known to contain unusually large proportions of zinc, and the red snapper, *Lutjanus aya*, containing proportions of zinc normally present in animal tissues. The organs of these were dissected out and the amount of zinc in each determined. In the red snapper the maximum proportion of zinc was found in the spleen (43·5 mgr. per kg.) and liver (55·5 mgr. per kg.), with a minimum (2·3) in the muscles. In the catfish the minimum amount (8·1 mgr. per kg.) was also in the muscles, but the maximum was found in the gills (102·5 mgr. per kg.).—A. **Berthelot** and Mlle. E. **Ossart**: Researches on the micro-organisms producing acetone. Besides the active anaerobic organisms of A. Fernbach capable of utilisation on the industrial scale, there exist in Nature many other micro-organisms, both aerobic and anaerobic, capable of producing small quantities of acetone, and it is possible that some of these may penetrate and develop in the intestinal canal.—C. **Levaditi** and S. **Nicolau**: Immunity in neurotropic ectodermoses.—M. and Mme. G. **Villedieu**: The toxicity of metals for yeasts and moulds. In these experiments sheets of metal instead of the usual metallic salts were employed, the same nutrient solution being used in all cases. Starting with the least toxic, the metals came out in the following order: mercury, copper, zinc, iron, and magnesium, the last-named being the most toxic.—A. **Lumière** and H. **Couturier**: The desensibilisation of anaphylactised animals by means of several antigens. The results of the experiments detailed are not in accord with the view that vaccination by one antigen confers immunity against others. The anaphylaxy is really specific.—Mlle. Marthe **Giraud**, G. **Giraud**, and G. **Barès**: The hæmoclasic crisis due to the penetrating X-rays.

ROME.

Reale Accademia nazionale dei Lincei, June 3.—V. Volterra, vice-president, in the chair.—Papers by fellows:—C. **Somigliana**: Depth of glaciers, ii. A mathematical determination of the form of profile of the section of the glacier in terms of observations of its rate of flow at the surface.—F. **Severi**: Integrals of first species belonging to an algebraic surface, vi.—C. **De Stefani**: Fossil sponges, vii. The localities are the Crocetta group, the Palazzo Doria, and Rio Gea. —B. **Grassi**: Can malaria be transmitted directly by Anopheles? In three experiments a patient suffering from malaria was bitten by Anopheles which were afterwards allowed to attack a healthy subject. In each case they filled themselves and emitted a drop of blood, and it was evident that the conditions were favourable to inoculation, but the individuals who underwent the experiment remained immune.—A. **Stefani**: Physiology of nerves and nerve-centres (to be published later).—G. **Bruni** and E. **Romani**: Mechanical action of certain vulcanising accelerants of rubber. In this paper the authors have developed a general theory of the accelerative action of an important group of organic agents, both sulphurous and non-sulphurous.—Papers communicated through fellows:—J. **Pérès**: "Sur les fonctions permutables" (in French).—M. **De Angelis**: Crystalline forms of tri-methylphloretin,

$$C_6H_2O_3(CH_3)_3\cdot CO\cdot CH(CH_3)\cdot C_6H_4OH.$$

—E. **Sereni**: Biochemistry of preparations from the central system of the frog.—An address was presented to Prof. Ernesto Mancini in commemoration of the fortieth anniversary of his nomination to the office of Chancellor of the Academy.

June 5.—Special meeting attended by the King.—The following prizes were awarded:—Royal prize for mathematics to Prof. Guido Fubini, of Turin; Royal prize for social and economic sciences to Prof. Gino Arias, of Genoa. Of the two prizes offered by the Minister of Public Instruction for physics and chemistry, one is awarded to Prof. Eligio Perucca and the other divided between Prof. Giuseppe Crestani and Mario Tenani. Two similar Ministerial prizes for philology are divided between Profs. Carlo Calcaterra, Massimo Lenchantin, De Gubernatis, Alfonso Omodeo, and Augusto Rostagni. The Carpi prize is awarded to Dr. Enrico Carano for his work on the embryology of Asteraceæ; the Sella prize to Dr. Antonio Sellerio, of Palermo; and the prize of the Morelli Institute to Dr. Camillo Ausenda. Prof. G. Vitelli gave an address on the composition of Homeric poems, and congratulatory addresses were exchanged with the British Academy.

June 19.—F. D'Ovidio, president, in the chair.—Papers by fellows:—G. **Castelnuovo**: Abelian functions, iv.: Applications to algebraic series of groups on a curve.—C. **Somigliana**: Depth of glaciers, iii. Determination of the profiles corresponding to expressions for the surface velocity of the second and third degrees as functions of the lateral co-ordinate.—F. **Severi**: Integrals of the first series of an algebraic surface, vii.—L. **De Marchi**: Thermal gradient and vertical acceleration in the atmosphere. In this paper the author investigates the vertical motion of the air as dependent on temperature conditions, condensation of raindrops, and other causes, and gives numerical values for the estimated velocity and acceleration under given assumed conditions. Apart from its meteorological significance, this investigation has an important bearing on another application which is, and has for a long time been, awaiting systematic study. While the vertical velocities of the air in the author's paper fall short of the values that would be necessary to maintain a bird in continuous horizontal gliding flight, they certainly suggest that under different conditions upward air-currents may be set up which are sufficient for the sustentation of gliding birds. Such conditions one would expect to occur in a country where the earth's surface is exposed to the action of tropical sunshine in daytime and is cooled at night by radiation in a cloudless sky. It is much to be hoped that the author's work will pave the way for further study of this interesting question.—C. **De Stefani**: Fossil sponges, viii. The localities under examination are at Crocetta, Casa Bisognaschi, and under the Casa Doria.—Communicated by fellows:—L. **Brusotti**: Small variation of a real algebraic plane curve.—G. De A. **D'Ossat**: Solubility of leucite in agricultural soil. These investigations show that leucite is not only soluble in water, but when mixed with soil it gives rise to reactions capable of liberating potash in considerable quantities—a result of great importance in its application to agriculture, as it is calculated by Washington that in Italy nine billion tons of potash contained in volcanic rocks are capable of being rendered available by this method.

The following papers were received during the vacation:—Papers by fellows:—C. **Somigliana**: Depth of glaciers, iv. (4th order profiles).—O. M. **Corbino**: Effect of magnetic field on heat conduction.—B. **Grassi**: A biological race of Anopheles which do not attack man; a very singular case of anophelism and paludism without malaria. In 1906 Prof. Giacomo Rossi, of the Higher School of Agriculture at Portici, directed attention to Orti di Schito (between Torre Annunziata and Castellamare) as an example of anophelism without malaria. The author on visiting the district found a "truly phenomenal" abundance of both *A. claviger* and *A. maculipennis*, sometimes rising in clouds at sunset and literally swarming in pigsties; on the other hand, malaria had been unknown for years. This result is now explained by the discovery that in this particular district the Anopheles never attack human beings. Observations extending over several visits both by the author and his assistants showed no case of anyone being bitten by the Anopheles, except when almost forced to do so by being previously kept in a state of starvation. On the other hand, the inhabitants of Schito were frequently bitten by Culex. The author suggests that this peculiar biological race of Anopheles acquired their present habits during a period (about 1860–70) when large flocks of cattle were kept in the marshy districts with very few men in charge of them.—Prof. B. **Morpurgo**: Consequences of nephrectomy in Siamese moles.—O. M. **Corbino**: Theory of Thomson effect.—G. **Bruni** and C. **Pelizzola**: Presence of manganese in grey rubber and cause of "tackiness" (*peciosità*). Analysis of various rubbers showed that good examples contained only an average of 0·16 milligram of manganese in 100 grams of rubber. In examples presenting strong uniform tackiness the proportion of manganese was 20 milligrams per 100 grams, while in intermediate cases, where the tackiness was slight and irregular, the proportion was usually from 1 to 3·75 milligrams per 100 grams. It thus appears probable that the decomposition of the rubber is in part due to the action of the manganese as an oxidising agent, this action being cyclic.—The following papers were communicated through fellows:—G. **Abetti**: Determination of longitude by wireless telegraphy.—E. G. **Togliatti**: Varieties of three dimensions and fourth order that are loci of at least infinity-squared lines.—Dr. B. **Peyronel**: *Menispora microspora*, n. sp., one of the Hyphomycetæ with mesoendogenous conidia. A new fungus forming minute spots on the bark of the chestnut, remarkable for the mode of formation of its conidia.—F. **Sibirani**: Bertrand's curves.—A. **Tanturri**: New expression of Bernoulli's numbers.—G. **Abetti**: Comparison between visual and photographic observations of nebulæ. In 1876–79 a number of drawings of nebulæ were made by G. Tempel at Arcetri with an Amici equatorial of 28-cm. aperture and 5·29 metres focal length. The author compares nine of these with photographs made by Pease with the 60-in. reflector of Mount Wilson. The agreement is very marked, thus confirming the accuracy of the drawings, but there appears evidence of relative displacements of the stars and nuclei in the interval between the observations, attributable to proper motions.—G. **Stefanini**: Geology of Cyrenaica, ii.—E. **Perucca**: Measure of differences of contact potential by the Lippmann-Pellat method.—M. **La Rosa**: Conductivity and thermo-electric power in a magnetic field on the electron theory.—G. **Agamennone**: The world's earthquakes in 1916. Taking as starting point H. H. Turner's British Association report, the author tabulates statistics showing how many of the "large" earthquakes were observed at each of the five Italian stations of Rocca di Papa, Moncalieri, Padua, Montecassino, and Valle di Pompei for each month of 1916.—Dr. J. C. **Cortini**: *Tylomyces gummiparus*, n. sp., the prototype of a new genus of hyphomycetes, i. This fungus was found on some specimens of carnation that were attacked by Fusarium, and the author refers it to the family Dematiaceæ, section Phragmosporæ. The paper is illustrated by figures.—C. **Artom**: Cytological data on the tetraploidism of *Artemia salina* from the district of Margherita di Savoia, in Apulia. A development arising from a previous investigation, in which the author found that the Artemias from eighteen different localities were separable into two distinct groups, differing in the size of the nuclei of their intestinal cells.

Books Received.

Fundamental Catalogue of 1846 Stars for the Equinox 1900, from Observations made at the Royal Observatory, Cape of Good Hope, during the years 1912–1916, under the Direction of S. S. Hough. Pp. xxx+38. (London: H.M. Stationery Office.) 10*s.* net.

More Hunting Wasps. By J. H. Fabre. Translated by A. T. de Mattos. Pp. viii+376. (London: Hodder and Stoughton, Ltd.) 8*s.* 6*d.* net.

The Wonder Book of Science. By J. H. Fabre. Pp. 287. (London: Hodder and Stoughton, Ltd.) 8*s.* 6*d.* net.

Fluoreszenz und Phosphoreszenz im Lichte der Neureren Atomtheorie. By P. Pringsheim. Pp. viii+202. (Berlin: J. Springer.) In Germany, 48 marks; in England, 144 marks.

Modern Electrical Theory. By Dr. N. R. Campbell. (Cambridge Physical Series.) Supplementary Chapters. Chapter xv: Series Spectra. Pp. viii+110. (Cambridge: At the University Press.) 10*s.* 6*d.* net.

An Introduction to Psychology. By S. S. Brierley. Pp. viii+152. (London: Methuen and Co., Ltd.) 5*s.* net.

Exploration of Air: Out of the World North of Nigeria. By A. Buchanan. Pp. xxiv+258. (London: J. Murray.) 16*s.* net.

The Practical Chemistry of Coal and its Products. By A. E. Findlay and R. Wigginton. Pp. 144. (London: Benn Bros., Ltd.) 12*s.* 6*d.*

Modern Gasworks Practice. By A. Meade. Second edition, entirely re-written and greatly enlarged. Pp. xii+815. (London: Benn Bros., Ltd.) 55*s.*

Verhandelingen van Dr. P. Zeeman over Magneto-Optische Vershijnselen. Pp. xvi+341+14 plates. (Leiden: E. Ijdo.)

Annales de l'Observatoire Météorologique Physique et Glaciaire du Mont Blanc. Publiées sous la direction de J. Vallot. Tome vii. Pp. vi+240. (Paris: G. Steinheil.)

Diary of Societies.

THURSDAY, NOVEMBER 17.

ROYAL HORTICULTURAL SOCIETY, at 10—6.—International Potato Conference.

ROYAL SOCIETY, at 4.30.—Major P. A. MacMahon and W. P. D. MacMahon: The Design of Repeating Patterns.—Prof. J. W. Nicholson: A Problem in the Theory of Heat Conduction.—Prof. C. H. Lees: The Thermal Stresses in Spherical Shells Concentrically Heated.—R. A. Fisher: The Mathematical Foundations of Theoretical Statistics.—F. P. White: The Diffraction of Plane Electromagnetic Waves by a Perfectly Reflecting Sphere.—Prof. C. V. Raman and G. A. Sutherland: The Whispering Gallery Phenomenon.

LINNEAN SOCIETY OF LONDON, at 5.—Capt. A. W. Hill: Account of an Expedition to the Cameroons and Nigeria in 1921.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5 (Annual General Meeting).—S. Banach: An Example of an Orthogonal Development whose Sum is Everywhere Different from the Developed Function.—A. C. Dixon: Expressions and Functions Reduced to Zero by the Operator sinh $D-cD$.—H. Hilton: Plane Curves of Degree $2n$ with Tangents having bi-n-point Contact—C. Krishnamachary and M. Bhimasena Rao: A Table of Values of 30 Eulerian Numbers, based on a new method.—L. J. Mordell: The Number of Solutions in Positive Integers of the Equation $yz+zx+xy=n$.—G. Pólya: Sur les séries entières à coefficients entières.—H. J. Priestley: Some Applications of Integral Equations to the Theory of Differential Equations.——W. F. Sheppard: Inverse Correspondence of Differences and Sums.—T. Stuart: The Parametric Solutions and Minimum Numerical Solutions of $x^4+y^4+z^4=u^4+v^4$.—R. Vythynathaswamy: Generating Regions of a Quadric in Space of n Dimensions.—B. M. Wilson: Proofs of some Formulæ enunciated by Ramanujan.

ROYAL SOCIETY OF MEDICINE (Dermatology Section), at 5.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—Col. F. Searle: Requirements and Difficulties of Air Transport.

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.—H. F. Collins: The Igneous Rocks of the Province of Huelva and the Genesis of the Pyritic Orebodies.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—E. S. Byng: Telephone Line Work in the United States.

CHEMICAL SOCIETY, at 8.—H. Burton and J. Kenner: The Influence of Nitro-groups on the Reactivity of Substituents in the Benzine Nucleus. Part. V., Heteronucleal Dinitro-derivatives.—F. Challenger and J. F. Wilkinson: Organo-derivatives of Bismuth. Part V., The Stability of Halogen, Cyano-, and Thiocyano-derivatives of Tertiary Aromatic Bismuthines.—F. Challenger and L. R. Ridgway: Organo-derivatives of Bismuth. Part VI., The Preparation and Properties of Tertiary Aromatic Bismuthines and their Interaction with Organic and Inorganic Halogen Compounds.—O. Silberrad: Researches on Sulphuryl Chloride. Part I., Influence of Catalysts: A Convenient Method of Chlorinating Benzine.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at London School of Tropical Medicine), at 8.15.—Laboratory Meeting.

FRIDAY, NOVEMBER 18.

ROYAL HORTICULTURAL SOCIETY, at 10.30—1.30.—International Potato Conference.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botanical Lecture Theatre, Imperial College of Science and Technology), at 3.—Dr. E. J. Butler and others: Discussion: Meteorological Conditions and Disease.

INSTITUTE OF TRANSPORT (Graduates' and Students' Section) (at Royal Society of Arts), at 5.—J. P. Thomas: The Operation and Development of Urban Electric Railway Services.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 5.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Dr. E. H. Salmon: The Machinery of Floating Docks.

JUNIOR INSTITUTION OF ENGINEERS, at 7 (Annual General Meeting).

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 8.—J. D. Johnston: Photography in Relation to the Graphic Arts.

ROYAL SOCIETY OF MEDICINE (Electro-therapeutics Section), at 8.30.—Dr. F. Daels: (1) Histological Pictures of the Curing of Uterine Baso-cellular Epithelioma. (2) The Use of Drainage Tubes in the Irradiation of the Pelvis with Radium.—Dr. G. Fildes: Further Remarks on the Potter-Bucky Diaphragm.

SATURDAY, NOVEMBER 19.

BRITISH MYCOLOGICAL SOCIETY (in Botany Lecture Theatre, University College), at 11.—Dr. G. R. Bisby: The Use of Fungicides on Potatoes in North America.—Dr. W. Brown: The Growth of Fungi in Cultures.—W. N. Edwards: An Eocene Microthyriaceous Fungus from Mull, Scotland.—Dame H. C. I. Gwynne-Vaughan: The Grouping of the Simpler Ascomycetes.—Dr. A. S. Horne: Fungi from a Diseased Hevea Stem.

PHYSIOLOGICAL SOCIETY (at St. Thomas's Hospital), at 4.—J. N. Langley: Sweat Secretion.—W. E. L. Brown: An Independent Determination of the Value of "n" in Hill's Equation.—T. Lewis, C. C. Iliescu, and A. M. Wedd: A Paradoxical Effect of Vagal Stimulation upon the Auricles.—D. Noel Paton: The Significance of Digestion Leucocytosis.—F. R. Fraser: The Reaction of Human Blood in Cardiac and Renal Disorders by the Colorimetric Method.—A. V. Hill: The Maximum Work of Human Muscles.—A. V. Hill and J. C. Bramwell: The Velocity of the Pulse Wave.—Miss D. V. Atkinson: The Osmotic Pressure of Hæmoglobin in Blood.—E. C. Dodds and T. I. Bennett: Some New Observations on Diabetes Mellitus.—J. H. Burn: The Relation of Nerve Supply to Sweating produced by Pilocarpine.—J. Mellanby: Experimental Dyspnœa.

MONDAY, NOVEMBER 21.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—A. J. Hainsworth and others: Hydro-electric Power.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Meeting), at 7.—J. Harrison: Some Thoughts on Motor-cycle Engine Design.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—Dr. F. W. Thomas: An Indian Doctrine of Perception and Error.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—G. H. Widdows: School Design.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—J. M. Wordie: Jan Mayen: An Old Arctic Volcano.

TUESDAY, NOVEMBER 22.

ROYAL SOCIETY OF MEDICINE (Medicine Section) (at St. Thomas's Hospital), at 4.45.

ZOOLOGICAL SOCIETY, at 5.30.—Dr. A. Smith Woodward: Exhibition of a Fossil Human Skull from Broken Hill, North Rhodesia.—Dr. C. F. Sonntag: Contributions to the Visceral Anatomy and Myology of the Marsupialia.—C. W. Hobley: The Fauna of East Africa and its Future.—H. Matsumoto: *Megalohyrax*

Andrews and *Titanohyrax*, g.n.: A Revision of the Genera of Hyracoids from the Fayûm, Egypt.
WOMEN'S ENGINEERING SOCIETY (at 26 George Street, W.1), at 6.15.—Miss Mary Abbott: Women and the Conquest of the Air.
QUEKETT MICROSCOPICAL CLUB, at 7.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—A. C. Braham: Demonstration of the Latest Developments and Improvements in the Carbro Process.
INSTITUTE OF INDUSTRIAL ADMINISTRATION, at 7.30.—H. Lesser: Unemployment Insurance for Individual Firms.
SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall, Strand), at 8.—Dr. Marie Stopes, the Mayor of Islington, A. Harrison, and others: Resolution in Connection with Unemployment and Birth Control.
SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group), AND INSTITUTION OF MECHANICAL ENGINEERS (at Institution of Electrical Engineers).—J. H. West: The Claude Synthetic Ammonia Process and Plant.

WEDNESDAY, NOVEMBER 23.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—R. P. White: Do We Neglect the Industrial Skin Sufferer?
ROYAL SOCIETY OF MEDICINE, at 5.—Dr. G. Monod: Syphilis of the Stomach. To be followed by Sir Berkeley Moynihan, Dr. C. Bolton, Dr. A. F. Hurst, Prof. McNee, H. Paterson, J. Sherren, and A. J. Walton.
GEOLOGICAL SOCIETY OF LONDON, at 5.30.—W. K. Earle: The Lower Carboniferous Rocks of West Cumberland.—W. G. St. J. Shannon: A Composite Sill at Newton Abbott (Devon).
ROYAL SOCIETY OF ARTS, at 8.—Prof. J. A. Fleming: The Coming of Age of Long-distance Wireless Telegraphy and Some of its Scientific Problems (Trueman Wood Lecture).

THURSDAY, NOVEMBER 24.

ROYAL SOCIETY, at 4.—Special General Meeting to consider the Annual Report of Council. At 4.30.—*Probable Papers*.—K. Sassa: (1) Observations on Reflex Responses to the Rhythmical Stimulation in the Frog. (2) The Effects of Constant Galvanic Currents upon the Mammalian Nerve-muscle and Reflex Preparations.—E. Ponder: The Hæmolytic Action of Sodium Glycolate.—Dorothy J. Lloyd and C. Mayes: The Titration Curve of Gelatine.—D. H. de Souza and J. A. Hewitt: Idio-Ventricular Periodicity.
CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Dr. C. Hay-Murray: Phrenology as an Aid to Education.
CONCRETE INSTITUTE, at 7.30.—E. F. Etchells: Presidential Address.
OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—Prof. F. J. Cheshire: Polarising Apparatus.
ROYAL MICROSCOPICAL SOCIETY (Metallurgical Section), at 7.30.—C. W. Hawksley and P. Swift: Various Types of Vertical Illuminators.
ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30.—Discussion on Renal Function Tests.—*Short Opening Papers* by J. J. Everidge, J. S. Joly, J. B. Macalpine, Dr. MacLean and C. Nitch, Dr. M. Wallis and G. Ball. To be followed by Sir Cuthbert Wallace, Dr. L. Brown, F. Kidd, Dr. Marrack, G. E. Neligan, A. E. Webb-Johnson, and A. C. Morson.

FRIDAY, NOVEMBER 25.

ROYAL SOCIETY OF ARTS (Dominion and Colonies and Indian Sections, Joint Meeting), at 4.30.—A. H. Ashbolt: An Imperial Airship Service.
PHYSICAL SOCIETY OF LONDON (at Imperial College of Science and Technology, at 5.—Hygrometry: Dr. E. Griffiths, F. J. W. Whipple, Principal Skinner, W. Watts, Dr. G. A. Shakespear, Prof. A. M. Tyndall, H. G. Mayo, and Prof. A. P. Chattock. Followed by a discussion to be opened by Sir Napier Shaw.
ROYAL SOCIETY OF MEDICINE (Study of Disease in Children Section), at 5.—Miss Eva Morton: Report on a Fatal Case of Bullous Eruption.
INSTITUTION OF PRODUCTION ENGINEERS (at Institution of Mechanical Engineers), at 7.30.—A. F. Guyler: Drawings and Production.
JUNIOR INSTITUTION OF ENGINEERS, at 8.—G. F. Shotter: Electromagnetic Instruments: Problems in their Design and Construction.
ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8.—Dr. J. P. Kinloch: Metabolism in Fevers.

PUBLIC LECTURES.

(A number in brackets indicates the number of a lecture in a series.)

THURSDAY, NOVEMBER 17.

UNIVERSITY COLLEGE, at 5.—Prof. J. E. G. De Montmorency: The Background of Non-European Feudalism (3).
IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.30.—W. Bateson: Recent Advances in Genetics (3).
BIRKBECK COLLEGE, at 7.30.—Prof. F. Soddy: The Bearing of Physical Science on Economics (2).

FRIDAY, NOVEMBER 18.

UNIVERSITY COLLEGE, at 4.30.—Dr. J. C. Drummond: Nutrition (6).
IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.30.—Dr. J. D. Falconer: The Wonders of Geology (Swiney Lectures) (6).
UNIVERSITY COLLEGE, at 8.—Prof. G. Dawes Hicks: Our Knowledge of the Real World (3).

MONDAY, NOVEMBER 21.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.30.—Dr. J. D. Falconer: The Wonders of Geology (Swiney Lectures) (7).
KING'S COLLEGE, at 5.30.—Dr. W. R. Ormandy: Liquid Fuel Engines (3).

TUESDAY, NOVEMBER 22.

KING'S COLLEGE, at 5.30.—Prof. H. Wildon Carr: The Modern Scientific Revolution and its Meaning for Philosophy (7); The Pragmatic Theory of the Intellect.—Dr. W. Brown: Psychology and Psycho-therapy (6).

WEDNESDAY, NOVEMBER 23.

KING'S COLLEGE, at 4.30.—Dr. C. Da Fano: Histology of the Nervous System (7).
SCHOOL OF ORIENTAL STUDIES, at 5.—Miss Alice Werner: The Swahili Poem on the Ascension of the Prophet.
UNIVERSITY COLLEGE, at 5.—Prof. G. Elliot Smith: The Evolution of Man (1).
IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.30.—Dr. J. D. Falconer: The Wonders of Geology (Swiney Lectures) (8).

THURSDAY, NOVEMBER 24.

UNIVERSITY COLLEGE, at 2.30.—Miss M. A. Murray: Ancient Survivals in Modern Egypt.
UNIVERSITY COLLEGE, at 5.—Prof. J. E. G. De Montmorency: Feudalism in India (4).
BARNES HALL (1 Wimpole Street, W.1), at 5.15.—Prof. E. C. Van Leersum: Dietetics and Public Health (Chadwick Lecture).
IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.30.—W. Bateson: Recent Advances in Genetics (4).
KING'S COLLEGE, at 5.30.—H. W. Fitz-Simons: Bridge Construction (4).

FRIDAY, NOVEMBER 25.

UNIVERSITY COLLEGE, at 4.30.—Dr. J. C. Drummond: Nutrition (7).
IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.30.—Dr. J. D. Falconer: The Wonders of Geology (Swiney Lectures) (9).
UNIVERSITY COLLEGE, at 8.—Prof. G. Dawes Hicks: Our Knowledge of the Real World (4).

SATURDAY, NOVEMBER 26.

UNIVERSITY COLLEGE, at 10.30.—Prof. Karl Pearson: Fallacies (Lectures for Teachers).

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