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Industrial Science.

THE appearance of the eighth annual report of the Department for Scientific and Industrial Research brings with it the reminder that time passes, and tells of much useful work performed. As usual, the report is divided into three sections: the report of the Committee of Council, the report of the Advisory Council of the Committee, and a summary of the work of the Research Boards and Committees of the Department with numerous appendices. The first section, in the main a formal résumé of the work done, records with apparent satisfaction a reduction of the estimates by some 20,000*l.*, a regrettable fact, in spite of the urgent need for economy, for wise expenditure in the application of science to present conditions might easily result in savings of far greater amount. After reference to the valuable work of the co-ordinating research boards established to connect the work of the scientific departments in the various services, both together and also with university and other scientific activities, the report directs attention to the fact that the Research Associations, supported out of the Million Fund, are approaching the end of the five years for which grants were made, and states the policy which, on the advice of the Advisory Council, has been adopted. "It must not be assumed," the report continues, "that further financial assistance will be recommended in every case. There will have to be ample proof that the industry is unable immediately to shoulder the entire responsibility, and further aid will only be given if the industry concerned is prepared to make a rapidly increasing effort towards complete responsibility."

Another direction in which the committee has taken an interesting step in its task of co-ordinating the scientific activities of the government departments is in the promotion of a joint exhibit at the British Empire Exhibition next year. After various consultations it has been agreed that there should be a central building in which the government departments concerned will arrange their exhibits, working in conjunction with a committee organised by the Department of Overseas Trade, while the Royal Society, financed by a grant from funds allocated by government, has assumed responsibility for an exhibit illustrating recent advances in pure science.

The report also records the fact that the French Government has established under the Minister of Public Instruction an *Office National des Recherches Scientifiques et Industrielles et des Inventions*, having objects much resembling those of the Department.

Turning now to the report of the Advisory Council, the ground covered is very extensive, the Research

Associations, the co-ordinating boards, the research boards, the National Physical Laboratory, the various other research institutions, and the organisation controlling grants to individual workers, are all passed in review. On the whole the record is one of continuous progress. Difficulties have been overcome and advances made in many directions. The Fuel Research Board has been weakened by the retirement of Sir George Beilby, who has for seven years guided its activities "and laid the foundations of a structure of new knowledge of great significance for the health and industrial welfare of this country." Dr. Lander succeeds him as director, while Sir Richard Threlfall becomes chairman of the Board. The gratifying fact is recorded that, at the International Conference on Radio-Telegraphy at Brussels last year, the programme of work prepared for the British delegates by the Radio Research Board found a ready acceptance as the basis of international research.

The appointment of Sir William Bragg to the Fullerian professorship at the Royal Institution is noted, and the arrangements by which he is to have the help of a staff of skilled assistants are referred to. Both he and the Advisory Council are to be congratulated on this; we may look forward to the Royal Institution and the Davy-Faraday Laboratory becoming the birthplace of a series of discoveries no less notable than those which have already made its name famous in the annals of science.

The committee which, in co-operation with the railway companies, has been set up under the chairmanship of Sir Alfred Ewing to investigate the stresses on railway bridges due to moving loads, has undertaken a difficult but important task. The weight and speed of trains have increased many fold since most of our bridges were built. Stress conditions are much more serious, the large factor of safety designed for is much reduced, and, while there may be no grounds for anticipating serious risks, investigation and fuller knowledge are urgently needed.

Growth of another kind is indicated by the purchase of land at Teddington for extensions of the National Physical Laboratory and other government institutions.

Only in one section is the note less assuring. After describing generally the scheme under which the Research Associations were established, the report of the Council continues: "The anticipations made at the inception have failed to be realised owing in large measure to industrial events since that date." The Associations were started during the last year of the War, four being founded before November 1918. It was hoped that they would be a flourishing product of the boom which was to follow and to last for five years at least. This hope has not been fulfilled; the boom lasted two years, during which period seventeen associations came into existence. Since 1920, a period of intense depression, only one has been added to the list. The five years for which the grants were made are now coming to an end; funds are running out. The Associations are financed from the Million Fund, and the question comes, What is to be done? Few if any really can stand alone; what is their record? Is it sufficiently promising to justify further State assistance even if it be possible to find the money? The Advisory Council has considered the facts, and, while realising that "the five years of grant appear likely to be insufficient in many cases to fulfil the original hopes of the scheme," has decided that there is no justification for continuing the original contracts. Existing agreements, therefore, are to be terminated at the end of the quinquennial period; should any association apply for a further grant, the case will be considered on its merits and an inquiry will be made into the circumstances. New grants may as the result of this be made, but in no case, it is held, should the grant extend for more than an additional five years.

The position is a difficult one; the circumstances of the past three years have been such that the scheme has not had a fair chance. What will the chances be in the next five years? The inquiries to be set on foot will throw some light on this question, and the plan proposed is probably the best that can be devised. But there are other difficulties, as the report points out. Scientific inquiry is coming to be recognised more and more as the basis on which advance in industry rests, while the calls of industry are no small inducement to science to advance. But co-operation in industrial investigation is novel. In Germany, in pre-War days, great firms could maintain their staffs of skilled workers; the same is possible in America now; but there are few concerns in England so large and so flourishing as to bear the expense of a private research laboratory. Such can probably be counted on the fingers of one hand; the Brown-Firth laboratories, the G.E.C. works at Wembley, and the laboratories of Barr and Stroud are well-known examples. Such firms do not participate in the work of the Associations; and among those who do the differences of position are very marked. By some the need of scientific inquiry is fully grasped: others have scarcely realised it. Some through long experience have gained a store of useful practical knowledge; why should they share it with others less happily placed? We give much, we gain little, they may not unnaturally say; wherein do we profit?

Yet we find that where there have been mutual trust and confidence; where each member of an Association

has been willing to give of his best, anxious to improve the common stock of knowledge and to profit by the new knowledge placed at his disposal by the research staff, the Association has prospered most; the firms which knew most have learnt more, and it has not been a question of giving everything, receiving nothing. Time only can solve the question. We may be allowed to hope that, as the welfare of its citizens depends on the prosperity of a State as a whole, so the advances of industrial science will benefit the whole industry, and not least those who by previous knowledge and experience are most able to profit it by them.

Popular Astronomy.

(1) *The Star People.* By Gaylord Johnson. Pp. xi+107. (London: Methuen and Co., Ltd., n.d.) 4*s.* 6*d.* net.

(2) *The Vault of Heaven: An Introduction to Modern Astronomy.* By Sir Richard Gregory. Second edition, rewritten. Pp. vii+202. (London: Methuen and Co., Ltd., 1923.) 6*s.* net.

(3) *The Heavens and their Story.* By Annie S. D. Maunder and E. Walter Maunder. Pp. 357. (London: The Epworth Press, n.d.) 4*s.* net.

(4) *The Kingdom of the Heavens: Some Star Secrets.* By Charles Nordmann. Translated by E. E. Fournier d'Albe. Pp. 262. (London: T. Fisher Unwin, Ltd., 1923.) 12*s.* 6*d.* net.

THE practically simultaneous appearance of four books, all written mainly with the object of making available the fundamental truths of astronomy, demonstrates alike the eagerness of the public to be informed and the willingness of those qualified by experience to minister to this praiseworthy curiosity. Naturally, there is much repetition; the same facts, or many of them, appear in each of the several volumes, but the method of presentation varies according to the assumed intelligence of those addressed.

(1) In the first, Mr. Gaylord Johnson addresses an audience of children and adopts kindergarten methods with the object of teaching them how to recognise and identify the constellations. The method is novel and, if it prove successful, we imagine that the ability of the teacher, the gift of creating interest in what is unfamiliar, the power of rapidly comprehending the direction of a child's thoughts, and the art of giving it expression will play as great a part as the ingenuity exhibited by the author of the scheme. Mr. Johnson's book may act as a stimulant, but against one danger we may utter a word of warning—the attempt to recollect too many stars and their delineations. This is an error into which we think the author has fallen. Many of the stars depicted are too faint, some of the fourth and lower magnitudes being included. Such faint stars might be allowed in groups, as in the Pleiades, but for isolated stars it is doubtful whether any below the second should be included. But adherence to such a rule would have prevented the drawing of the outline of the constellation figures, and this feature is naturally relied upon to increase the interest of the children.

(2) A second edition of "The Vault of Heaven" has long been needed. This early work from Sir Richard Gregory has been a warm favourite with the writer of this notice, who has lent it to many students anxious to become acquainted with the plan of the solar system and the constructive machinery of the stellar universe. Whether from politeness or conviction, all have expressed approval, and it is to be hoped that another generation will find equal pleasure with the contents.

This new edition, written up to date, serves a further purpose to those who have read the earlier. They will learn what has been accomplished by the improvements in the construction of instruments, and the continuous application of these potent engines of research to the study of the heavens. Spectroscopy and photography have advanced by leaps and bounds in the interval, and much information that was hoped for, but seemed outside the reach of human effort, has become part of the general stock of knowledge. The drift of the stars through space, the dimensions of the whole stellar universe, the growth and decay of worlds, with much else that invited speculation, have become certainties, and a new set of problems lies before the astronomers of the future, though it must be admitted some of the older and apparently simpler problems still stand tantalisingly on the border-land of the unknown, and individual judgment may interpret the evidence as temperament dictates. Among these may be placed the "canals" of Mars and the theories built on them, the varying appearances on the lunar surface, which Prof. W. H. Pickering and others have noted to recur with a regularity that betokens a cosmic cause. Concerning the correct interpretation of the observations, Sir Richard Gregory preserves a judicial attitude, presenting the evidence impartially, and leaving the verdict to the decision of instructed opinion. The class for whom the book is intended is clearly indicated, and this class should benefit from the well-arranged and accurate contents.

(3) We confess that we have read this book with no small measure of surprise, for it is apparently put forward as a recent compilation. It bears no date, and there is no suggestion that it is a reprint of an ancient work. But such well-informed authors could not, if the work were new, refer in the preface to the late Sir W. H. M. Christie as the Astronomer Royal, and afterwards

in the text discuss the possibility of Halley's comet being seen at its return in 1910, so that we can only conclude that it is not new. The book is intended for those who are unacquainted with astronomy, and in the early chapters is traced the method by which the ancients, unassisted by telescopes or measuring apparatus, may have gleaned their notions of astronomy. The plan is not original, but is well thought out, and suggests one of the most desirable methods of obtaining an insight into the geometry of the earth's surface. Later, the sun and planets are described as they are seen in a telescope, and the plan becomes that of ordinary descriptive astronomy. One of the authors is chiefly responsible for the discussion of the influence of sun-spots on the earth's magnetism, but we do not find the argument convincing, and additional facts have been brought to light that are not mentioned. In the concluding section reference is made to the stellar universe, but the more recent facts connected with its structure and dimensions are necessarily excluded.

(4) When so many authors are eager to put the facts of descriptive astronomy before an English public, there does not seem room for a translation. But Dr. Nordmann's work deserves a welcome reception, for it differs in some essential points from the ordinary popular treatise. His object, he tells us, is "to relate some of the marvels which the heavens have revealed to us lately. I shall speak not to instruct or amuse, but to produce thoughts, and even dreams, if I can." He bids us to expect neither the commonplaces of numerical detail nor the inane vapourings evoked by the study of the skies. Nevertheless, we are allowed to study the sun, though the magnetic and electric influences it exerts are insisted upon more than the grosser and obvious service of a centre of attraction, or the dispenser of light and heat. Similarly, the question of the habitability of the planets acquires more interest than the puzzling red spot on Jupiter, or the canals of Mars, which latter are distinctly pronounced a mirage. Thence we proceed to the stars, and are taught how to measure the distance that separates them from us. A most instructive study, clear and logical, is given of the theories of star drift, of island universes, giant and dwarf stars, and the general views that obtain of the stellar cosmos. But our author must indulge in a final paradox. He finds it in the rotation of the earth. He furnishes a dozen "proofs" that the earth turns on its axis and fearlessly faces the consequences of accumulation. The conclusion drawn is: that the earth turns and the earth does not turn are, kinematically speaking, equally true. "It is simply more convenient to suppose that the earth turns." But these be difficulties that cannot be explained in a small space.

Oceanography.

Founders of Oceanography and their Work: an Introduction to the Science of the Sea. By Sir William A. Herdman. Pp. xii + 340 + 29 plates. (London: E. Arnold and Co., 1923.) 21*s.* net.

AT the meeting of the British Association in Liverpool last September, it was mentioned that a new book on oceanography, by Sir William Herdman, had just been published. To the circle of marine workers this was something of an event, and now that the volume is before us we see that our anticipations concerning it are realised in full. In the preface—a section eminently worthy of attention in itself, and by no means to be skipped—we are informed that the book is based upon a course of about twenty public lectures given in 1919-20, while Sir William held, for the first year, the newly established chair of oceanography at the University of Liverpool. This at once explains the structure of the book and the arrangement of the subject matter, which differs from that of the ordinary text-book. The author's opening words are, "This is not a text-book of Oceanography," and he proceeds to express his doubts as to whether the time is yet come in oceanography to write "the comprehensive text-book drawing conclusions from various branches of science—ranging from astronomy to biology." In this the author is probably right, quite apart from the fact that there is scarcely a man at the moment who could do it satisfactorily.

Sir William Herdman's book may best be characterised as a series of oceanographical essays, more or less independent one of another, and dealing with persons and themes, for the most part those in which the author is himself specially interested, or in regard to which he possesses first-hand knowledge.

The book contains seventeen chapters and an appendix. Of these, the first six or seven are devoted to some of the leading lights of oceanography, their life and work, especially Edward Forbes, Wyville Thomson, John Murray, Alexander Agassiz, Prince Albert of Monaco, and Dr. Anton Dohrn. The last ten chapters deal with various oceanographical subjects, namely, hydrography, ocean currents (the Gulf Stream), submarine deposits, coral reefs and islands, luminescence in the sea, plankton—its nature, investigation, variations, and problems—applied oceanography, the sea-fisheries, and food-matters in the sea.

In these many and diverse fields the author proves himself an admirable guide—one who understands the art of making the subject interesting to his readers. The book is one of great freshness and charm, much of which is due to the impress of the author's personality; it bears throughout the mark of his own keen interest

in the science to which his life has been so zealously devoted. As a consequence, the book is never dull, even when treating of somewhat more recondite themes, and in many parts the presentment attains a degree of interest positively absorbing. Moreover, the treatment of the subject matter is sober and objective, as indeed one has a right to expect from an authority of so much knowledge and experience. We are struck not only by the author's enthusiasm for the problems themselves and for their extensive scope, but also by his practical recognition of their limitations; we feel safe in his guidance, because we feel he has the faculty of estimating values, of discriminating between the essential and the unessential. The author never attempts to conceal the limitations of our present knowledge; but he believes in the great future of oceanography, in the wealth of stimulating discovery which the science, still in its youth, has yet in store for mankind; and he contrives to inspire his readers with the same faith. But, like the practical man he is, he sees also that oceanography has other and more direct tasks before it in the service of humanity. He realises that it is this and this alone which can help us to exploit—or husband—the treasures of the sea better than we are able to do at present; that oceanography, as he aptly puts it, will help man in the future to become "less of a hunter, and more of a farmer of the sea."

The author has had the good fortune to come into personal contact with some of the greatest oceanographers; and he tells of them, giving his impression of their personalities in a most attractive manner. We are led to realise how much the influence of these men, especially Sir Wyville Thomson and Sir John Murray, meant to the author himself, and we should be grateful that he has not consigned his impressions to oblivion, but enabled younger generations of oceanographers to partake, as it were, in some degree in the life and happenings of the days when modern marine research was first created.

It is out of the question here to enter upon any detailed appreciation of the individual sections of Sir William Herdman's book; but if any parts should be noted as particularly valuable, they are chapters like the two on Wyville Thomson and John Murray, and the three on plankton and food-matters in the sea; the hydrographical sections, on the other hand, scarcely come up to the same level. For the rest, adverse criticism must be directed not so much towards what the book contains as to what it does not.

There are not a few writers who regard oceanography as being merely the study of physical and chemical conditions in the sea. Sir William Herdman is not one of these. To him, the biology of the sea is as much oceanography as are its physics, chemistry, and geology. I am entirely of the same opinion. On the other hand, I cannot but feel that hydrography has here been rather left out in the cold. Two chapters (viii. and ix.) out of seventeen, and 37 pages out of 329. This seems rather scant measure, even for those more interested in the biological side, and even granting that hydrographical observations occur here and there in the other chapters.[1] Also, the extensive work which has been carried out during the last thirty years by national and international investigations of the sea, in procuring information as to the food fishes, their development and life-histories, might, I think, have been found deserving of fuller and more particular treatment. The same applies to several institutions the principal task of which consists in working at the practical application of oceanography; in a book strongly emphasising the importance of this side of the work, they might have deserved special mention, whether for their particular organisation, or as having been of fundamental value to the methods of applied oceanography.

Nevertheless, though we might thus have wished for more, the author gives us, even without it, very much indeed, and there is every reason to congratulate him on the publication of this book. It is generally known that Sir William Herdman has furthered the advance of oceanography in his own country. In this book, he has not only set up a handsome monument to himself, but also—and this will doubtless please him more—has proved himself an excellent advocate for his young science of oceanography, both within and beyond the boundaries of Great Britain. JOHS. SCHMIDT.

Preventive Medicine.

An Introduction to the Practice of Preventive Medicine. By Prof. J. G. FitzGerald, assisted by Prof. Peter Gillespie and H. M. Lancaster. Pp. xx+826. (London: Henry Kimpton, 1923.) 37*s.* 6*d.* net.

THIS is the first "full-dress" Canadian text-book of preventive medicine, so far as we know, which has seen the light; and it is a happy augury of the future of public health in our sister country that so complete a book founded largely on Ontario experience should be practicable.

Dr. FitzGerald, the professor of hygiene and preventive medicine in the University of Toronto, has, with the assistance of several collaborators, focussed a vast mass of important information bearing on preventive medicine and public health, from which British

[1] Apropos of hydrography—one pious wish from a non-British reader: that one could but have those Fahrenheit degrees converted into Centigrade in all oceanographical works, British included. British workers seem to be able to reckon equally well with either—in the present work, for example, the temperatures are noted in Fahrenheit in one place, in Centigrade in another; but to the rest of us, Fahrenheit is an enormous disadvantage. I hope this heartfelt cry may find its way to British ears and hearts.

hygienists may gather many useful suggestions for improved practice.

Preventive medicine as the subject of a text-book is a title possessing some ambiguity, and one looks to the chapter headings and sub-headings to ascertain in what sense the words are used. In actual fact the contents of the words are very nearly identical with what in England is known as hygiene and public health, though this was scarcely to be anticipated. Public health more generally means that part of applied hygiene which has been introduced into the administrative machinery of our central and public-health authorities, while hygiene, although almost synonymous with preventive medicine, in most books on the subject has a more limited connotation.

The fact that a book on hygiene and public health should be called "An Introduction to the Practice of Preventive Medicine" is evidence of the expanding scope of public-health activities, which are increasingly embracing every phase and age of life. This beneficent intrusion of medicine—on its preventive side—is the subject of Prof. FitzGerald's suggestive first chapter, in which he forecasts the arrival of a time when it will no longer be said that "he was so sick he had to have a doctor," but when the physician will be engaged to keep his patient well, by supervision and advice. In view of this, extensive increases of our present services for safeguarding childbearing and childhood, and for periodical examinations at subsequent ages in life, are anticipated. The difference between insurance for medical purposes and prevention is aptly indicated in the words that the monetary and medical benefit may be used wisely or unwisely in the patient's *efforts to regain, not to maintain his health.*

Subsequent chapters deal with measures for the prevention of communicable diseases, each of some twenty or more diseases being discussed in some detail. Special space is given to the newly adopted measures for securing immunity against diphtheria by the administration of an antitoxin-toxin; and it would appear that by this means, guided by the Schick test, we have available a possibility of depriving diphtheria of all its power to kill and injure.

The chapter on tuberculosis contains much valuable information, but the statistics are not very skilfully presented. The essential point is pressed home that success cannot attend anti-tuberculosis efforts unless private physicians take an active part in the campaign, and constitute themselves leaders in the effort to protect human beings against excessive dosage of infection, whether from consumptives or from infected cows' milk.

The preventive aspects of pneumonia, of cerebro-spinal meningitis, and of acute poliomyelitis are stated; and although these diseases remain among the least controllable of communicable diseases, much useful guidance is given.

Under the heading of smallpox an interesting account is given of an outbreak in Ontario in 1920–21, comprising 5078 cases with only 24 deaths. The low case mortality in this outbreak is similar to that experienced in many parts of America; and cases of a similar type have occurred occasionally in England. In other parts —usually traceable to an Eastern source in Europe, or to a Mexican source in America—the ordinary severe type of smallpox has occurred. In both types of the disease there is evidence of the protective effect of vaccination. It would appear that the mild type—which usually breeds true—is a definite mutation of the disease.

The chapter on venereal diseases gives a useful summary of its subject. The author, while non-committal on self-medication as a prophylactic, strongly urges medical treatment to any patient at the earliest possible moment after exposure to infection.

Considerable space is devoted to disinfection. Current disinfection during the course of an attack of diphtheria or scarlet fever is recognised as important, and considerable detail is given as to terminal disinfection when an attack is over. For these diseases, however, it is now recognised that, given thorough domestic cleansing, terminal gaseous or liquid disinfection of rooms does not diminish the number of recurrences of infection. The part of the book dealing with general hygiene gives full information as to water supplies, milk, foods, diet, and domestic and community sanitation, on which no special comment is needed. We note, however, that while the importance of movement of air in making the air of a room hygienic is not disputed, it is also pointed out that in conditions of overcrowding active ventilating may increase the danger of infection, by increasing the striking distance of particulate infective material, whether as dust, or as spray derived from coughing, etc.

The chapter on vital statistics contains a few minor errors. In England and Wales the geometrical method of estimating inter-censal populations is no longer adopted. No attempt is made to assess the relative value of the various tests employed in determining the health conditions of a community. Special chapters deal with the subjects of maternal and infant mortality, school hygiene, public-health clinics, and industrial hygiene, but these do not call for special comment.

On p. 673 are given interesting particulars of the amount spent per capita per annum in the various American States on health administration. The "health appropriation" varies from 30·8 cents in Pennsylvania to 2·1 cents in Texas, these sums being divisible among the following subdivisions of the Public Health Department—Engineering, Communi-

cable Diseases, Laboratory, Vital Statistics, Child Hygiene, Venereal Diseases. This table is followed by a valuable table by Dr. Chapin giving the relative value or "marks" of different branches of public-health work. It will surprise some English administrators to find plumbing and nuisances credited with 20 marks out of a total of 1000, while control of nostrums is given 50 marks, educational measures 80, and anti-tuberculosis work 140. There is much to be said for this American apportionment of merit. A number of appendices give details as to industrial hygiene, the employment of children, form of report of an industrial nurse, the Workmen's Compensation Act, housing, etc.

The book can be recommended as containing a review of recent information on most branches of preventive medicine, which would be most difficult to obtain elsewhere, except by reference to many documents.

Our Bookshelf.

Les Phénomènes thermioniques. Par Eugène Bloch. (Recueil des Conférences-Rapports de Documentation sur la Physique. Vol. 4, 1re Série, Conférences 9, 10. Édité par la Société *Journal de Physique*.) Pp. 111. (Paris: Les Presses universitaires de France, 1923.) 10 francs.

ELECTRIC conductivity and other effects produced in the neighbourhood of hot bodies are generally called "thermionic" phenomena. The author gives an interesting and clear account of several of the laws in connexion with effects that have recently been discovered by O. W. Richardson and others. In spite of the great progress that has been made, there is no indication that this mine of research is approaching exhaustion. New practical applications are being continually found. Thermionic valves are now being made by hundreds of thousands for use in radio communication, radiography (X-ray work), and for rectifying alternating currents. Notwithstanding the great practical use that is made of thermionic phenomena, we are still far from seeing how they explain contact difference theories or thermo-electricity. In particular, the theory of thermionic emission in gases gives rise to great difficulties. We have still to explain many apparent experimental contradictions. The serious study of ionisation potentials and of resonance founded on thermionic emissions has barely begun. As time elapses the theoretical field becomes more complex, but the possibilities of valuable discoveries become greater.

The Outline of the World To-Day. Edited by Sir Harry Johnston and Dr. L. Haden Guest. (To be completed in about 24 fortnightly parts.) Part 1. Pp. 40. (London: George Newnes, Ltd., 1923.) 1s. 2d. net.

THERE should be a demand for a work of this nature, which aims at giving "a clear and definite impression of the immense variety of the life and romance, the natural beauties and treasures, of other lands." The first issue contains the greater part of the section dealing with France, and is copiously illustrated with well-chosen photographs, colour plates, and coloured maps by Bartholomew. The letterpress is vivid, accurate, and sufficiently critical to give it value, but there is little attempt to describe or explain the scenery, and the maps have the defect of showing no physical features. Some attention to physical geography would not be amiss. There is no indication of the arrangement of the work except that it will "concentrate on the interesting side of nations and their lives, dealing with mankind at home . . . their joys and pleasures, their sports, their pageants, and their ideals." The authors of the various articles are not stated, but the names of the editors are sufficient guarantee that high authorities will be chosen. So far as can be judged from the first number, the work should prove of value in spreading a knowledge of the ways of other nations and encouraging an understanding of their ideals and ambitions.

The Banyankole: the Second Part of the Report of the Mackie Ethnological Expedition to Central Africa. By the Rev. John Roscoe. Pp. xii+176+31 plates. (Cambridge: At the University Press, 1923.) 15s net.

IN the second volume of the report of the Mackie Ethnological Expedition to Central Africa, Mr. Roscoe again deals with an immigrant nomadic pastoral people, ruling an earlier, or original, agricultural group. The Bahuma belong to the same stock as the neighbouring Baganda and Bakitara, but represent an earlier settlement in the Lake region. They are even more strict than the Bakitara in the observance of milk customs, and owing to their repugnance to intermarriage with their serfs, who lived on vegetable food, they are racially purer than most pastoral peoples of this area. Apart from the description of the ritual of the milk, which necessarily occupies a position in the book commensurate with its prominence in the life of the people, Mr. Roscoe's minute account of the Banyankole is a piece of work the value of which to the ethnologist it is difficult to overestimate. Not only is the culture he describes rapidly passing away, but also it embodies—as for example in its totemic system and belief in the reincarnation of members of the royal family in the forms of various animals—elements which are of great importance in the study of the development of custom and belief.

The Unconscious Mind: a Psycho-Analytical Survey. By Dr. S. Herbert. Pp. vii+230. (London: A. and C. Black, Ltd., 1923.) 6s. net.

THE output of psycho-analytic literature is always on the increase. This volume is an attempt to give a systematic account of the Unconscious on Freudian lines; and it follows the usual plan upon which such works are written, containing considerable illustration of theory from case-histories, examples of myth, wit, art, and the like. There is a good chapter on "Theories of the Unconscious," in which the leading views are stated and criticised with—naturally enough—a strong Freudian bias. On the whole, "The Unconscious Mind" is a simple and straightforward presentation (so far as the subject-matter permits of simplicity and straightforwardness) of the doctrine of the Viennese school; and can be recommended for the literary form of its presentation as well as for being—what it claims to be—"a general outline of our knowledge of the nuconscious, as hitherto ascertained."

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Dutch Pendulum Observations in Submarines.

DR. F. A. VENING MEINESZ, commissioned by the Dutch Geodetic Committee to make pendulum observations on board the Submarine K II of the Royal Dutch Navy during the voyage from Holland to Java (see NATURE of September 15, p. 393), has sent particulars of his observations from Gibraltar, Tunis, and Alexandria.

The beginning of the voyage was extremely disappointing because of the bad weather. For the first five days the sea was continually very rough. The rolling of the ship amounted to 30° to each side, and the pitching to 8 metres; the nights had to be spent strapped to the berths. It was a very rough experience for the first stay on board a seagoing vessel.

After passing Portland Bill in the English Channel, an attempt was made to take observations. Submerged to a depth of 20 metres, the rolling still amounted to ¾° to each side, which made observations impracticable. At length, off the Portuguese coast, the weather cleared and it became calmer, but the long swell continued. On September 24 an inquiry was made again into the movements of the submerged ship. The greatest angle of inclination caused by the pitching amounted at the sea-surface to 1°, the rolling to 6° to each side. At a depth of 30 metres, and while the vessel was going in the direction of the swell, the inclination caused by the pitching was at most ¾°, which by the use of the horizontal rudder could be reduced to less than ¼°; but as the rolling was still 1¼° to each side, observations were practically impossible.

Notwithstanding the considerable rolling of the ship, the amplitudes of the pendulums appeared to vary fairly regularly. The principal impediment was the circumstance that the rays from the electric lamp, reflected by the mirrors of the pendulums, went beyond the edge of the film. The actual trouble was therefore of an incidental nature. This induced Dr. Vening Meinesz to devise an arrangement for suspending the whole apparatus from a horizontal axis to be placed lengthwise in the ship in order to neutralise the rolling. He supposed that it would be possible to get this constructed at the workshops of the Royal Navy at Gibraltar.

On September 26, between Cape St. Vincent and Cadiz, the sea was very smooth, and for the first time observations were crowned with success, as at a depth of 25 metres the movements were very small. The first observation was made in a place where the sea was 110 metres deep, the second where it was 480 metres deep. During the second observation the direction of the course was taken successively W.E. and E.W., to test the effect of the speed of the ship on the intensity of gravity, first mentioned by Eötvös.

On the afternoon of September 28, Gibraltar was reached, and immediately Dr. Vening Meinesz took steps for the construction of the suspension apparatus. All the assistance desired was kindly given by the British authorities. The time being very limited, it was necessary to carry on the work day and night without intermission.

During the stay at Gibraltar the observations were worked out, and they proved to be very successful. The discrepancies of the observations showed the accuracy to be greater than was expected from the preliminary observations at the Helder. The effect of the speed of the ship was clearly indicated by the diagrams; the speed could even be derived from these with a difference of but ½ mile from the true value.

On October 3, a few hours before leaving Gibraltar, the suspension apparatus was fitted up on board the submarine. I am glad to express thanks to the British authorities at Gibraltar, who so readily contributed to the realisation of Dr. Vening Meinesz's project.

During the passage between Gibraltar and Tunis, the arrangement proved to be satisfactory in every respect. Although the rolling amounted to 2° to each side, observations were easily practicable. A stay at Tunis, where the submarine arrived on October 7, was again used by Dr. Vening Meinesz for the preliminary computation of his observations. One of these gave the value of g for a sea-depth of 2500 metres with a difference of only 0·003 cm. sec.$^{-2}$ from the theoretical value, which indicates complete isostasy.

Tunis was left on October 13, and Alexandria was reached on October 18; the sea being generally very smooth, observations were made without any difficulty. The Eötvös effect was tested again; the deduced speed of the ship differed only 0·3 mile from the true value.

It appears from the diagrams that the accuracy of the deduced period of oscillation in favourable circumstances may be about 1/1,000,000, and that in a rough sea there is little fear of the divergences exceeding 1/100,000. We must wait, however, for the complete computations before a positive statement will be possible.

It should also be mentioned that the rate of the chronometer was controlled by using the rhythmic time-signals of the Eiffel Tower.

On October 31 the squadron, consisting of the mother ship *Pelikaan* and the three submarines, left Suez; it will touch at the ports of Aden, Colombo, and Sabang, and arrive at Batavia about the middle of December. Dr. Vening Meinesz will carry out observations in the Red Sea and the Indian Ocean, and will ultimately determine, with the invar pendulums, the intensity of gravity at a few stations in Java.

From the results already obtained it may be concluded that, by the method of Dr. Vening Meinesz, investigations of the intensity of gravity by pendulum observations can be realised on the parts of the earth covered by the ocean with almost the same accuracy as on continents and islands. For the study of isostasy, and of Wegener's hypothesis of floating continents, observations in submarines, especially between the coast and the deep sea, will be of the greatest value.

J. J. A. MULLER.

Zeist, November 7.

The True Relation of Einstein's to Newton's Equations of Motion.

THE equations of a space-time geodesic or Einstein's general equations of motion of a free particle are, in usual symbols,

$$\frac{d^2x_\iota}{ds^2}+\left\{\begin{matrix}\alpha\beta\\ \iota\end{matrix}\right\}\frac{dx^\alpha}{ds}\frac{dx_\beta}{ds}=0,\ \iota=1,\ 2,\ 3,\ 4. \quad . \quad (1)$$

In order to show their relation to Newton's equations of motion, which may be written

$$\frac{d^2\xi_i}{dt^2}=\frac{\partial\Omega}{\partial\xi_i},\ i=1,\ 2,\ 3, \quad . \quad . \quad . \quad (N)$$

Einstein considers the special case of slow motion in a weak gravitation field, *i.e.* such that the metrical tensor components g_{ik} differ but little from their Galileian values. Then, neglecting squares, etc., of these small differences and also their derivatives with respect to x_4 (quasi-stationary field), Einstein easily obtains the Newtonian equations as a first approximation, with $\Omega = -\frac{1}{2}c^2 g_{44}$ as the classical potential of the gravitation field. This treatment of the question is repeated, so far as I know, by all exponents of Einstein's theory.

Now, as has recently occurred to me, the true relation of Einstein's equations to those of Newton is of a much more intimate nature, and remains valid, no matter how strong the field and how much space deviates from Euclidean behaviour.

In fact, the frame most natural to adopt for an interpretation of the complicated equations of motion (1) of a particle being clearly its own *rest-system*, let x_1, x_2, x_3 be the space-coordinates of the particle in such a system (the latter, of course, to play its part during an infinitesimal time and to be replaced successively by others and others). Moreover, let for convenience the origin of x_1, etc., be taken at the particle itself. Then, at any instant, $x_i = dx_i/ds = 0_{(i=1,2,3)}$, and equations (1) will reduce to $ds^2 = g_{44}dx_4^2$ and the three equations

$$\frac{d}{dt}\left(\frac{1}{\sqrt{g_{44}}}\frac{dx_i}{dt}\right) = -\frac{c^2}{\sqrt{g_{44}}}\left\{\begin{matrix}44\\ i\end{matrix}\right\}, \quad . \quad . \quad (2)$$

where $dt = dx_4/c$, the fourth equation being already utilised. Now, with i, k reserved for 1, 2, 3,

$$\left\{\begin{matrix}44\\ i\end{matrix}\right\} = g^{ik}\left(\frac{\partial g_{4k}}{\partial x_4} - \frac{1}{2}\frac{\partial g_{44}}{\partial x_k}\right) + \frac{1}{2}g^{i4}\frac{\partial g_{44}}{\partial x_4}.$$

The coordinates can always be chosen so as to make $g^{41} = g^{42} = g^{43} = 0$. This means a frame not spinning relatively to the stars. In these coordinates then, or in such a rest-platform of the particle,

$$\left\{\begin{matrix}44\\ i\end{matrix}\right\} = -\frac{1}{2}g^{ik}\frac{\partial g_{44}}{\partial x_k},$$

and since the x_i can now always be measured along the principal axes of the operator or matrix g^{ik} (when also $g^{ii} = 1/g_{ii}$), we have

$$\left\{\begin{matrix}44\\ i\end{matrix}\right\} = -\frac{1}{2g_{ii}}\cdot\frac{\partial g_{44}}{\partial x_i},$$

no more to be summed over i, of course. These values substituted in (2) give, with $g_{ii} = -a_{ii}$, and since $x_i = dx_i/dt = 0$,

$$\frac{d^2(\sqrt{a_{ii}}x_i)}{dt^2} = -\frac{c^2}{2}\frac{\partial g_{44}}{\sqrt{a_{ii}}\partial x_i}. \quad . \quad . \quad (3)$$

Now, the space-line element of our platform being

$$dl^2 = a_{11}dx_1^2 + a_{22}dx_2^2 + a_{33}dx_3^2,$$

$\sqrt{a_{11}}dx_1$, etc., are the length elements $d\xi_1$, etc., measured along the axes precisely as in (N), and the right-hand member of (3) expresses the gradient of $\Omega = -\frac{1}{2}c^2 g_{44} +$ const. With a proper choice of the constant, $g_{44} = 1 - 2\Omega/c^2$.

We thus see that, *in the rest-system of the free particle, the general relativistic equations* (1) *become identical with the Newtonian equations of motion, rigorously, i.e.* whether the gravitation field is weak or not ($2\Omega/c^2$ a small fraction of unity or not), and no matter how strongly the platform-space differs from a homaloidal or Euclidean space.

This simple investigation is here given not merely because it seems to put the general equations (1) into an interesting and familiar light, but also because it vindicates the rights of the Newtonian equations of motion.

LUDWIK SILBERSTEIN.

129 Seneca Parkway, Rochester, N.Y.,
September 19.

The Influence of Barometric Pressure on the Specific Gravity of the Surface Water in Indian Seas.

IT has for many years been recognised that any alteration in barometric pressure over a wide expanse of water produces concomitant changes in the surface level, and Prof. J. W. Gregory (*Scottish Geographical Magazine*, 1909, vol. xxv. p. 316), when discussing the level of the sea, pointed out that "the sea in an area beneath high air pressure has its surface pushed downwards and the displaced water rises in the adjacent areas." Since the waves of increased barometric pressure occur at approximately the same time of day in each degree of longitude, it follows that each succeeding elevation and depression of the surface level of the sea travels across the ocean like a wave from east to west. In the region of India the barometric pressure normally exhibits in every twenty-four hours a double rise and fall with maxima at approximately 9.45 A.M. and 10.30 P.M. and minima at 3.30 A.M. and 4.30 P.M.

Investigations of the specific gravity (σ_0) of the surface water of Indian seas have revealed a daily double oscillation that occurs simultaneously with, and must, I think, be due to, the alterations of barometric pressure. This oscillation of specific gravity is, however, only clearly seen in the open sea, because in inshore waters it is obscured by other changes due to tidal flow, etc. During the voyage from Bombay to Port Blair, Andaman Islands, in October 1921, a four-hourly record of the specific gravity of the surface water and the barometric pressure was carefully kept, and the results obtained are shown in Fig. 1. This shows very clearly the way in which, as the barometric pressure falls, the specific gravity of the surface water rises, and vice versa, the two curves alternating with one another.

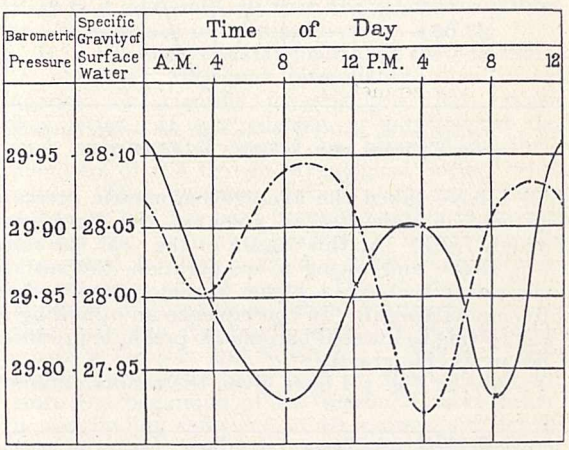

FIG. 1.—Average specific gravity of the surface water and simultaneous barometric pressures during a voyage from Bombay to the Andaman Islands in October 1921.
The continuous line shows the specific gravity, and the dotted line the barometric pressure, in each of the three figures.

A variation in the specific gravity of the surface water such as this might be due to (*a*) lateral horizontal movements of masses of water, or (*b*) an upwelling of water from a deeper level. If the latter cause is the true one, then the effect of changes in barometric pressure should be found to depend on the relative specific gravity of the surface water and of water immediately underlying the surface layer. In October, following on the effects of the south-west monsoon, the upper-level water will be diluted and have a lower specific gravity than that immediately below,

and hence an upwelling of deeper water due to a fall in barometric pressure should cause a rise in specific gravity, as seen above.

In Fig. 2, I have given the results obtained in the Bay of Bengal and the Laccadive Sea during the months January and February 1923. It is now found that the oscillation of barometric pressure and specific gravity synchronise with each other. (In this and in Fig. 3, as I have no records made on board

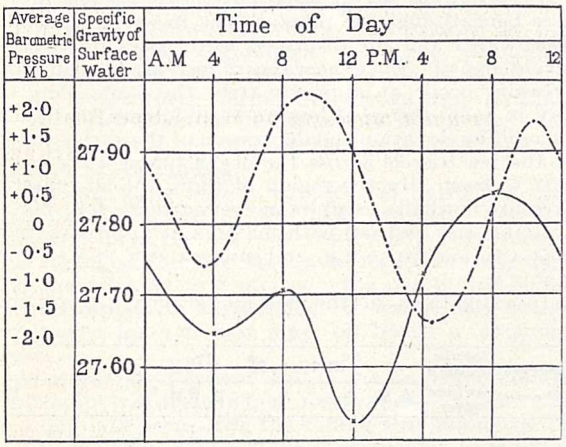

FIG. 2.—Average specific gravity of surface water and average barometric pressure in Indian waters in January and February 1923

ship, I have taken the average barometric pressure registered in Calcutta, as given in the Barometer Manual, 1919.) At this season of the year the rainfall is slight, and, owing to evaporation, the surface layer tends to have a higher specific gravity than water underlying it. In consequence an upwelling of water, owing to lowered barometric pressure, produces a fall in specific gravity.

Finally, in Fig. 3, I have given the results obtained

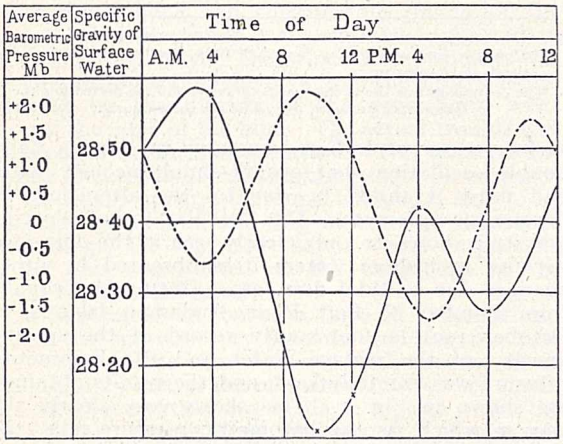

FIG. 3.—Average specific gravity of surface water and average barometric pressure off the west coast of India in May 1923.

off the west coast of India in May 1923. The south-west monsoon had already set in, and there had been a considerable amount of rainfall in the region under investigation since the middle of April. In consequence the surface layer of water had again become diluted, and we now get a return to the condition found in the month of October, *i.e.* a rise of barometric pressure causing a fall in salinity, and a reduction in the pressure being accompanied by a rise due to the upwelling of denser water from below.

Unfortunately, I have no records taken during the month of August, but, judging from the results of the above observations, we should expect to find a fall in barometric pressure accompanied by a rise of specific gravity of surface water, owing to the effect of the monsoon rain in diluting the uppermost levels.

I hope at some future date to be able to publish the full details of my observations, but, as the matter appears to me to be one of considerable interest, I have taken this opportunity of publishing a preliminary note of my results.

R. B. SEYMOUR SEWELL,
Surgeon-Naturalist to the Marine Survey of India.
The Indian Museum, Calcutta.

Spectral Series in the Oxygen Group.

IN the spectrum of oxygen there occur two types of series,—triplet series, and the so-called "singlet" series. The terms associated with the former type are designated by Fowler ("Report on Series in Line Spectra") as *ms*, *mp*, and *md*, while those associated with the latter type are designated as *mS*, *mP*, and *mD*.

One of us (Hopfield) has recently found a number of new oxygen lines occurring in the ultra-violet (NATURE, September 22, p. 437). These appear as fourteen triplets, and for their representation only fifteen different terms are needed. Fourteen of these are previously *known* singlet terms of oxygen (1*S* to 7*S*, 2*D* to 7*D*, and 1*s*). The fifteenth is a new triplet term, of larger frequency value than any previously known oxygen term. Each of the fourteen triplets represents, on the Bohr theory, the transition from some known singlet energy level to the new triplet level. The nomenclature just given has been used in all previous communications and is identical with that of Fowler, a point apparently not made clear, since the editor of NATURE added a note to the letter of September 22, saying that the *S*, *P*, and *D* terms did not correspond to Fowler's terms of the same designation.

The fourteen oxygen terms include only *S* (or *s*) and *D* terms, and this leads to the conclusion that the new energy level corresponds to a *P* (or *p*) term. Whether it is a *P* or *p* term is not at once evident. Since the known *mp* terms of oxygen are triple, while the *mP* terms are single, the suggestion was made by one of us (Birge) that the new level be designated op_{123}. In fact, the spectral diagrams devised by Brackett and Birge (*Physical Review*, 21, 710, 1923, and Jour. Optical Society of America, now in the press) predict this level at precisely the position found. But it appears, as mentioned in the letter of September 22, that in the *op*-1*s* triplet the op_1-1*s* component is definitely lacking, and a similar phenomenon was later found in the case of the corresponding new sulphur triplets which are discussed in the same communication. Since the 1*s* portion of the op_1-1*s* designation is known to be correct, and since the known 1*s*-*mp* series of oxygen and of sulphur consist always of triplets, the theory of inner quant numbers leads inevitably to the conclusion that *op* is *not* the correct designation of the new triple level. Hence the designation has been changed to oP_{123}. An assignment of inner quant numbers to the various terms, according to Sommerfeld's method, then leads immediately to the prohibition of the oP_1-1*s* component, by the Selective Principle. The inner quant numbers in the case of the triple *oP* term run in a direction opposite to the usual, in keeping with the "inverted" character

of the new triplets, mentioned in the letter in NATURE of September 22. Again following Sommerfeld (*Ann. d. Physik*, 70, 32, 1923) it is concluded that in the oxygen group the terms labelled by Fowler as *mS* are single, while the *mP* terms are triple, and the *mD* terms quintuple, just as in the case of chromium, which is in the same column of the periodic table. Accordingly the so-called "singlet" series of oxygen are really of a complex nature, a fact that has already been suggested by others (see Fowler, *loc. cit.*, p. 166), while in general the series spectra of the oxygen group are similar to those of chromium, as far as complexity of terms is concerned.

As already noted, similar triplets were found in sulphur, while independently the diagrams by Brackett and Birge had been used to predict the position of most of these new lines, the agreement in all cases being within the limits of error. The diagrams also allow the identification of some of the other new lines. In particular, the diagrams indicate that the triplets called, in the letter in NATURE of September 22, o*P*-3*D* and o*P*-4*D* are in reality o*P*-2*S* and o*P*-3*S* respectively, while those called o*P*-2*S* and o*P*-3*S* remain unidentified. In addition, the λ5279 narrow triplet of sulphur has been identified as 1*S*-2*P*. All these points, as well as more general questions, are fully discussed elsewhere by one of us (Birge, "Spectral Series of Divalent Elements," Jour. Optical Society of America, now in the press). One of the conclusions of that paper, derived from a study of the spectral diagrams already mentioned, is that the possible triple levels of the oxygen group, o*P* and o*p*, while having different sets of inner quant numbers, running in opposite directions, have nevertheless the same average numerical magnitude. But for some unknown reason the o*P* (valence) level represents a more probable condition, and o*p* does not actually exist. Similarly, in the case of the elements of the second column of the periodic table, the non-appearing o*s* level coincides numerically with the 1*S* valence level.

J. J. HOPFIELD.
R. T. BIRGE.

University of California,
Berkeley,
October 16.

Identification of Pure Organic Compounds.

IN his review of Mulliken's "Identification of Pure Organic Compounds," vol. iv., on p. 581 of NATURE of October 20, your reviewer surely does the author an injustice. Perhaps he is unacquainted with the earlier volumes, as I am, at present, with the latest—that under review. But I can testify to the great value of volumes i. and ii., and have used them regularly for the last two years. In identifying the components of commercial dyestuffs and similar work, Mulliken's methods are far less troublesome and time-expending than the classical method described by your reviewer, and aptly termed by Mulliken in his preface "the Method of the Empirical Formula." I have never experienced failure in preparing a characteristic derivative by following Mulliken's prescriptions, working with quantities of about $\frac{1}{10}$ gram. In fact, his beautifully neat methods for manipulating small quantities deserve to be more widely known, and, in my opinion, it is a matter for regret that your review will prevent this.

W. A. SILVESTER.

Research Department,
British Dyestuffs Corporation, Ltd.,
Blackley, Manchester.

I WELCOME Mr. Silvester's statement, and am glad to hear that Mulliken's methods are appreciated and found useful in technical organic chemistry. In these matters it is only possible to speak from one's own experience, and, as a research organic chemist and teacher of thirty years' standing, I should not dream of allowing my research students to learn to rely on Mulliken's methods. I adopt this attitude, not because his methods are bad or inaccurate, but because they are incomplete, and an extension of his system to meet all requirements would be impracticable. J. F. T.

Amanita muscaria on Hampstead Heath.

THE letter from Dr. O. Rosenheim in NATURE of October 27, p. 622, would doubtless cause astonishment to many mycologists. *Amanita muscaria* is one of the commonest toadstools, and is to be found amongst almost any clump of birch trees in this country, consequently being a common sight in woods and on commons near London. The association between fungus and tree, moreover, is so constant that it is not unlikely that the mycelium is one of those concerned in forming birch mycorrhiza.

It is, however, the statement that there is difficulty in obtaining this and presumably other common agarics for scientific investigation that occasions this letter. If any chemist or physiologist desire such specimens, I should be pleased to circulate members of the British Mycological Society to that effect. That common species even are sometimes not to be had has been brought forcibly to my notice during the past two seasons. *Lactarius vellereus* was asked for last year at a time when, normally, the season is on the wane. Though the fungus had appeared in quantity in July and August—the season that year was abnormally early—it was exceedingly scarce in October and November. This year, though many mycologists have been on the look-out for it since the beginning of the season, I have heard of no one finding sufficient to fill a vasculum, let alone the promised hampers; *Amanita mappa*, on the contrary, has been so amazingly abundant everywhere that pantechnicons could have been loaded with it.

It should be emphasised also that toadstools have their due season, the majority appearing some time during the period after summer rains until autumn frosts, and consequently it is not possible to provide fresh material of a given agaric all the year round.

J. RAMSBOTTOM.

British Museum (Natural History),
South Kensington, S.W.7,
November 3.

Insecticides.

I AM interested in the question raised in NATURE of October 27, p. 622, as to the efficacy of camphor in preventing moths, and the apparent absence of experimental evidence on the subject. May I suggest that the whole matter of "insecticides" needs investigation. Daily we see upon advertisement hoardings the most alarming pictures, showing the truly devastating effects of popular insecticides on every known and unknown species of the insecta. I have had an opportunity of testing the truth of these statements, and I am profoundly disillusioned.

At the beginning of the rainy season in India my bungalow became in a few days infested with thousands of fleas, which had hatched in the floor matting.

They are smaller than *Pulex irritans* and do not bite so severely. Scores of them marched up my legs as I sat in pyjamas. I bought some tins of that best-known of "insect powders." I covered my legs with it. It had no effect whatever. The fleas bit and jumped with undiminished zest. Before taking steps to rid the bungalow entirely of the creatures, I took a dozen of them, and placed them in an empty biscuit box, and another dozen in a box containing a layer a quarter of an inch thick of the powder. In twenty-four hours the fleas in both boxes were all alive; some were resting actually on the deadly powder. I also shared with many in the trenches the bitter experience that these insect powders had no effect on lice. LP. DE COSTOBADIE.

Mottram, nr. Manchester,
November 5.

LEST the good work of American entomologists should be ignored by default, may I direct the attention of your correspondent on the above subject (October 27, p. 622) to two valuable papers recording the results of definite experiments planned against clothes moths? The first, by E. W. Scott, W. S. Abbott, and J. E. Dudley, appeared in 1918 as Bull. 707 of the U.S. Department of Agriculture, "Results of Experiments with Miscellaneous Substances against Bed-bugs, Cockroaches, Clothes Moths, and Carpet Beetles"; the second, "Clothes Moths and their Control," by E. A. Back, appeared in July last as Farmers' Bulletin, No. 1353, of the same Department. These papers contain a mass of information regarding the relative effects and best methods of employing very many different substances against clothes moths belonging to species found in Britain; and curiously enough, in view of the experience of your correspondents, both papers agree in regarding naphthalene in good condition as "one of the safest and best materials for protecting fabrics against moth injury," although it must be used in moderately tight receptacles so that the fabrics remain in a naphthalene-permeated atmosphere. Camphor used in the same way is said to be almost as effective, its fumes killing all stages of clothes moths. JAMES RITCHIE.

The Royal Scottish Museum, Edinburgh,
November 6.

MY own experience of clothes moths in museums extends over many years, and I regret that I cannot agree with "E. E. A." in NATURE of October 27, p. 622, that paper is a barrier. The clothes moth "fauna" of Britain is changing. At one time the chief pests were moths belonging to the genus Tinea, which are animal feeders, attacking furs, feathers, wool, silk, etc. To-day the most dangerous pest is *Œcophora* (or *Acompsia*) *pseudospretella*, which, according to Meyrick, was first introduced about 1840. This species eats both animal and vegetable substances. I know it as a disastrous guest of neglected herbaria, preying indifferently on the dried plants or on the paper; and I have observed that it has perforated and penetrated the newspaper coverings of mounted birds and mammals. Fabre, apparently, was unacquainted with this species when he stated that paper is a sure barrier. Pseudospretella certainly prefers slightly damp surroundings, and is known to be a lover of cool climates; it is extremely abundant in London, and is much more conspicuous than any species of Tinea. Perhaps it is not yet established in central or southern France.

Without making any careful experiments, I have believed that naphthalene scattered in cases keeps moths away to some extent. It is not unusual to find a single larva in a store box of mounted insects in circumstances which suggest that the parent has insinuated the egg through a crevice. The larvæ are immune from many well-known insecticides. Fuming with hydrocyanic gas has no effect. The fumes of chloroform cripple the larvæ for a few days; but in a week or so they become active again, and may probably complete their metamorphoses. Drenching with motor spirit is also useless. Larvæ dropped in a strong solution of naphthalene, and then dried until they are thickly encased with a crystal coat, begin to crawl about when the naphthalene is sufficiently evaporated to give freedom of action to the segments. Bisulphide of carbon, in my experience, kills the larvæ.

Bisulphide of carbon, a week or two ago, proved useless in dealing with a small colony of "Museum Beetles"; but drenching the specimen (a mounted bird) with motor spirit appears to have been successful. I take this beetle to be *Ptinus germanus*, described as "scarce" in Cox's "Handbook of Coleoptera," the only work available here at the moment. *Ptinus fur* is the better-known species. Probably the latter insect will require different handling. My own experience of the mites belonging to the genus Glyciphagus is that hydrocyanic gas has no effect, although it is advised by high authority for these disagreeable pests. Like many other "insects," they withstand drenching in petrol, and the only remedy is successive fumings with sulphur dioxide—a plan not always possible in varied collections. A really comprehensive work on museum (and household or warehouse) insects would be very welcome. The losses in stored collections, although for obvious reasons kept secret, are certainly great. This is due not always to neglect, but to the curator's faith in one or other of the well-known insecticides.

I have been told (and certainly credit the tale) that constant vigilance is needed to protect stocks of "Insect Powder" from the ravages of some sort of warehouse pest. Yet this powder, when pure, is very useful indeed in collections, in spite of its comparatively high cost and its messy qualities. Crude experiments on my own part suggest that a mixture of equal parts of borax, sulphur, insect powder, and naphthalene might be scattered or otherwise used as a deterrent. I have tried plunging valuable and delicate specimens, such as mounted butterflies and pressed plants, in a solution of celluloid in amyl acetate. When dry, a thin and perfectly invisible "size" of celluloid is left behind. The specimens are thus protected from damp and fungi, and are probably safe from mites also.

An example of the work of Œcophora can here be described. About two years ago a duplicate stuffed wheatear was placed in a glass cupboard, faintly illuminated, and distinctly damp. Three months ago, in clearing out the cupboard, I found that the bird had lost its skin entirely; even the horny rhamnotheca of the beak, and the scales of the feet, had disappeared. Nothing remained except the wires, the bones, and the stuffing; and, strange to say, the stuffing was neither tow nor cotton wool, but waste silk. I have known Œcophora larvæ feeding on a Chinese "joss stick," a compound of resins used as incense, and have found one in an excavation in a "vegetable ivory" nut. In the latter case no other insects were visible, and everything pointed to the moth caterpillar as the culprit.

FREDK. J. STUBBS.

Oldham Corporation Museum.

A Suggested Modification of "Proton" to "Prouton" as a Memorial to William Prout.

THE amazing advances in our knowledge of the composition and structure of matter achieved during the past few decades constitute an important, if not quite final, step toward the establishment of the essential unity of the physical universe.

In reviewing the epoch-making work of J. J. Thomson, whose electrical theory of matter underlies all recent developments in this field, with that of Rutherford, Ramsay, Soddy, Aston, and others in England and elsewhere, one should not be unmindful of the contribution made over a century ago by his compatriot, William Prout, an early apostle of unity.

To all students of chemistry Prout's hypothesis, published in 1816, to the effect that all of the elements are formed from hydrogen by some process of condensation or grouping, has been familiar by reason of the stimulus it has afforded to accurate experimental work. Relegated for many years to the limbo of discarded theories, it has at last emerged to increased plausibility. Although of necessity less specific than the hydrogen-helium theory of Harkins, it is correspondingly simpler, and equally valid if the helium atom, with its four protons and four electrons, be regarded as an intra-atomic polymeride or condensation product of hydrogen. However intricately the more densely populated communities of protons and electrons may be arranged in the heavier atoms, the one proton and one electron of the atom of hydrogen certainly constitute the "first pair" in the chemical Garden of Eden, or present the first stage in the upward evolution of the elements.

In recognition of the genius and insight of William Prout it is suggested herewith that the name "proton" recently assigned to the unit charge of positive electricity, be modified, with some small sacrifice of etymological accuracy, to "prouton," a term with distinctive historical connotation.

ARTHUR WESLEY BROWNE.

Cornell University,
Ithaca, N.Y., U.S.A.

An Uncommon Type of Cloud.

IN NATURE of November 17, p. 725, Dr. Lockyer puts forward a suggestion as to the physics of the formation of "mammato-cumulus" cloud, namely, that it is formed by descent of moist air into colder air below, when there is a reversed vertical temperature gradient, in the same way that "cumulus" clouds are formed by an ascent of warm air (when there is a normal temperature gradient) into colder air above.

Any satisfactory explanation of the formation of this type of cloud would be welcome, but surely "cumulus" clouds are formed by the *adiabatic cooling* when moist air rises to a place where the atmospheric pressure is lower. The general decrease of temperature upwards is only necessary to make such ascent of air possible. A descent of air, such as Dr. Lockyer suggests, must be accompanied by adiabatic warming, since the pressure is increased whatever the general vertical temperature gradient may be. It is true that some cloud might be formed by the mixing which might occur at the surface of separation between two masses of nearly saturated air at different temperatures, but this would not be expected to form the dense globules of cloud actually seen with this type of cloud formation.

G. M. B. DOBSON.

Robinwood, Boar's Hill, Oxford,
November 17.

IN my letter which appeared in NATURE of November 17 I referred to Mr. Arthur Clayden as "the late," when actually he is very much alive. How I came to make this error I cannot understand, but I was most probably thinking of Mr. Clayden as the *late* Principal of the University College, Exeter, and so made the mistake. I much regret the error, and shall be glad if this correction of it can appear in an early issue of NATURE.

WILLIAM J. S. LOCKYER.

Norman Lockyer Observatory,
Sidmouth, S. Devon,
November 20.

National Certificates in Chemistry.

I HAVE observed on page 610 of NATURE for October 27 a reference to the scheme of examinations for national certificates in chemistry.

The writer of the article, upon the basis of an expression of opinion commencing with the word "apparently," proceeds to criticise something on which he is not fully informed. The scheme *is* "designed to secure all the advantages of internal examinations and of reasonable freedom in the arrangement of the courses of work to meet local conditions and needs," and the writer need not fear that there is any truth in the suggestion that before courses of study are recognised they are modified or mutilated by the Board of Education.

So far as national certificates in chemistry and the courses leading thereto are concerned, the Board acts only in conjunction with the Institute of Chemistry.

The experience of the first two examinations for such certificates has amply demonstrated the usefulness of the scheme. No complaint of bureaucratic intervention has been submitted either to the Board or to the Institute.

So far from insisting on "that machine-like uniformity beloved by bureaucrats," the examination papers have, in fact, been set either by the local schools or by their own affiliated groups—such as the Union of Lancashire and Cheshire Institutes.

The view of the writer as to the need of "some measure of central control and to some sound and official organisation" is incontestable: those desiderata are precisely those which the scheme is designed to attain.

RICHARD B. PILCHER,
Registrar and Secretary.

Institute of Chemistry,
30 Russell Square, London, W.C.1,
November 13.

MR. PILCHER will know that before an educational institution can submit candidates for national certificates the course of study proposed must be approved by the Board. This, of course, is absolutely necessary and desirable, but it is at this stage that modifications may be suggested by the Board—the alternative to acceptance being refusal to place the institution concerned on the approved list. I do not suppose for one moment that modifications of courses proposed are not necessary sometimes, but I do suggest that the trend of the modifications is towards uniformity of syllabuses.

I have no suggestions to make, at present, on the actual conduct of the examinations, and I know that the papers are set by the local schools and assessed by gentlemen whose work is not questioned. My reference was made distinctly to the pre-recognition stage, and I can assure Mr. Pilcher that I did not write without some knowledge.

I would also point out that I was referring to complete courses of work—including subjects ancillary to the main subject, and covering a period of from three to five years.

THE WRITER OF THE ARTICLE.

Zoological Bibliography.

REFERRING to my letter on this subject in NATURE of November 3, p. 652, I am asked to state that the recommendation that the size of the publications of scientific societies should, if possible, be demy octavo, originated with a committee of the British Association on the size of periodicals, not with that on Zoological Bibliography and Publication; and that this was also the recommendation of the Corresponding Societies' Committee at Liverpool.

T. SHEPPARD.

The Museums, Hull.

THE British Association Committee on Zoological Bibliography and Publication desires me to emend a statement in the friendly and welcome letter which Mr. T. Sheppard has addressed to you on behalf of the Corresponding Societies' Committee (NATURE, November 3, p. 652). The recommendation that the format of a society's publication should be demy octavo (approximately, $9 \times 5\frac{3}{4}$ in., or $22{\cdot}5 \times 14{\cdot}5$ cm.) does not occur in the last report of my Committee or in any of its previous reports.

If that recommendation was made either by the Corresponding Societies' Committee or by the Conference of Delegates from those societies, it will doubtless have been transmitted to the Council of the British Association, and will presumably be communicated by that body to the Committee which it has appointed to report on such questions.

Meanwhile I am to add that my Committee already has a different proposal of the same nature laid before it, and that it will report on the subject in due course.

The only recommendation by the Conference of Delegates of which I have received information is as follows: "To urge the adoption by scientific societies of the bibliographical recommendations contained in the current Report of the Zoological Publications Committee."

May I request those who may desire a copy of the Committee's last report to address themselves to me at the Natural History Museum, London, S.W.7, and not to the Secretary of the British Association.

F. A. BATHER,
Secretary.

November 12.

A Standard System for Scientific and Technical Publications.

THE enormous amount of current scientific and technical literature is a matter of common remark. It goes to swell an ever-increasing accumulation, of which a large portion, comprising research data, observations, measurements of values, and so forth, remains of permanent value. The various published indexes serve to keep account of it, but the labour required to make a comprehensive review over any range of recorded fact is considerable, and will steadily increase as time goes on. With the view of alleviating such labour I have worked out in detail an organised publication system, as specified below in two parts.

1. *The Standard Page Size Scheme.*—A certain suitable size should be nominated as the standard page size, and be adopted generally for scientific and technical publications, except for special reason to the contrary. The size would be chosen by experts, and would be some compromise between a small magazine size and a book size.

2. *The General Encyclopædia Scheme.*—Standard size publications of booklet and pamphlet form to be perforated at a standard spacing for filing on the ring-book, or other similar system. Each of such publications to have a word or phrase, descriptive of the contents, printed on the top right-hand corner of the front page, so that by this "cyclopædic phrase" such publications can be filed in alphabetical order. In the case of periodicals, each important article should begin at a right-hand page, and occupy a whole sheet or set of sheets, the space left over being left blank, or filled with advertisements or small matter. The periodicals should be so bound that such articles can be withdrawn without mutilation; the standard perforation and cyclopædic phrases should be provided as for pamphlets.

Upon the adoption of the system, pamphlets and articles withdrawn from periodicals would be filed in an orderly and compact collection in covers of book size, in alphabetical order, or order of classification as desired. But I specially argue that the system would permit of a variety of arrangements of great service to those who desire to make any review over recorded fact. Only certain classes of periodicals need conform to the system, in order to derive the main advantages of it, and existing indexing arrangements need not be upset by it.

The above will give only the roughest idea of the system; it has many modifications, and there are very many considerations to be taken into account. But I am prepared to go into precise details with any committee set up to consider the system from a general scientific point of view. Such a committee might, for example, be appointed by the British Association. I shall also be glad to supply an account of the system to any person specially interested.

J. F. POWNALL.

20 Watery Lane, Merton Park,
London, S.W.20.

A Fossil Caddis-case.

ATTENTION has frequently been directed of late to the extraordinary persistence in time of various insect structures, as shown by fossils. It might be assumed that the reactions and instincts of insects were similarly ancient, and of this we have a certain amount of actual proof, as in the case of some of the ants, the remains of which are so abundantly preserved in Baltic amber. When I was recently in Vladivostok, Dr. A. Kryshtofovich showed me some curious insect cases found fossil in the Tertiary rocks at Posiet, a locality in Siberia close to the border of Korea. One of these cases, which he gave me, proves on examination to be that of a caddis-fly of the genus Phryganea, quite similar to the modern *Phryganea grandis*. It is composed of pieces of *Sequoia langsdorfii*, which are arranged side by side in the usual spiral fashion, and are about 5 mm. long and 1·2 mm. wide, the case itself being 7 mm. wide. The species represented by these cases may be called *Phryganea Kryshtofovichi* n. sp. (Fig. 1). The cases from the Miocene of Oeningen in Baden, long ago named *Phryganea antiqua* by Heer, do not belong to this genus. The true Phryganea case is quite a specialised structure, with a definite spiral arrangement, which we now see to have been evolved long ago, the Posiet beds being Lower Miocene or probably earlier. In the insect-bearing beds on the Kudia River, Siberia, N. lat. 46°, I secured a wing of Phryganea, which will be described elsewhere.

FIG. 1. — *Phryganea Kryshtofovichi* case.

T. D. A. COCKERELL.

University of Colorado, Boulder,
Colorado, Oct. 10.

Hormones.[1]

By Prof. E. H. STARLING, C.M.G., F.R.S.

IN the dedication to his work, Harvey compares the heart to the sovereign king, and throughout he continually recurs to what we should now describe as the "integrative function" of this organ. In virtue of the circulation which it maintains, all parts of the body are bathed in a common medium from which each cell can pick up whatever it requires for its needs, while giving off in return the products of its activity. In this way each cell works for all others —the lungs supply every part with oxygen and turn out the carbon dioxide which it produces, the alimentary canal digests and absorbs for all, while the kidneys are the common means of excretion of the soluble waste products of the body. Changes in any one organ may therefore affect the nutrition and function of all other organs, which are thus all members one of another. But, in addition to enabling this community of goods, the circulation affords opportunity for a more private intercourse between two or at any rate a limited number of distant organs.

It is now eighteen years since I directed attention to the chemical messengers or hormones which are employed by the body for this purpose. As an illustration of the method by which they work, I adduced the example of carbonic acid gas, which is the product of all cellular activity and at the same time has a specific excitatory effect on the respiratory centre, so that the respiratory movements keep pace with the needs of the whole body for oxygen. The typical hormone, however, is a drug-like body of definite chemical composition, which in a few cases is actually known, so that the substance has been synthesised outside the body. It is more or less diffusible, and may even withstand without alteration the temperature of boiling water. It is generally easily oxidisable in a neutral or alkaline medium, so that after its production it does not remain long in the blood; it delivers its message and is then destroyed. Each specific hormone is manufactured by a group of cells and turned into the blood, in which it travels to all parts of the body, but excites definite reactions in one or a limited number of distant organs. The production and action of these substances are continually going on in the normal animal. They are necessary to health, and their production in excess or in deficit gives rise to disease and maybe to death.

Typical of all hormones is secretin, a substance produced in the epithelial cells lining the upper part of the small intestine when these come in contact with weak acid, so that it is set free in normal circumstances by the passage of the acid chyme from the stomach into the duodenum. Directly it is produced it is absorbed into the blood and travels round to the pancreas, to the liver, and to the intestinal glands, in all of which it excites secretion. By means of this chemical reflex the arrival of the products of gastric digestion in the small intestine evokes within a couple of minutes the secretion of the three juices the co-operation of which is necessary for completing the work of digestion and solution of the food, already begun in the stomach. It is probable that this mechanism is but one of a whole chain of chemical reflexes responsible for the orderly progression of the various stages in the digestion of food.

These hormones may apparently be formed by any kind of tissue. In many cases a gland which has, in the evolutionary history of the race, poured its secretion by a duct into the alimentary canal or on to the exterior, loses its duct and becomes a ductless gland, the secretion being now transferred either immediately or through the lymphatics into the blood stream. In either case these chemical messengers may be formed from masses of cells which have at no time had a glandular structure and may be modified nervous tissue, germinal tissue, or some part of the mesoblast.

As a type of the ductless gland derived from one with an external secretion the most familiar example is the thyroid. The physiological action of its internal secretion and the morbid results of its excess or deficiency, affecting tissue growth and development, metabolism, and mentality, are familiar to all. In recent years the active substance has been actually isolated, and its constitution determined, by Kendal, who has shown that it is an iodine derivative of an amino-acid, tryptophane. It seems almost a fairy tale that such widespread results, affecting every aspect of a man's life, should be conditioned by the presence or absence in the body of infinitesimal quantities of a substance which by its formula does not seem to stand out from the thousands of other substances with which organic chemistry has made us familiar.

Although we do not yet know their constitution, the chemical messengers associated with the reproductive organs are possibly even more marvellous in the influence they exert on the different parts and functions of the body. The effects of castration have been the subject of observation almost from the beginnings of civilisation, but it is only during the last few years that definite proof has been brought forward showing that these effects are due to the removal of chemical messengers normally produced in the testes. The whole differentiation of sex, and the formation of secondary sexual characters, are determined by the circulation in the blood of chemical substances produced either in the germ cells themselves or, as seems more probable, in the interstitial cells of the testis and ovary, which themselves are probably derived from the germ cells of the embryo. Thus it is possible by operating at an early age to transfer male into female and *vice versa*. Removal of the ovaries from a hen causes the assumption of male plumage; the removal from a young cock of the testes and their replacement by the implantation of ovaries cause a disappearance of the comb and the assumption of the plumage of the hen. Each animal as concerns its general build and colour has a neutral form which, as has been shown by Pézard, results from the extirpation of either testes or ovaries. In fowls the neutral form, as judged by the plumage, approximates the male, whereas in sheep the neutral form resembles the female. There is no question that, by the

[1] From the Harveian Oration, entitled "The Wisdom of the Body," delivered before the Royal College of Physicians of London on St. Luke's Day, October 18.

implantation of ovaries or testes into the fœtus at a sufficiently early age, one could produce the whole development of the internal and external genitalia corresponding to the sex of the gland implanted.

It is worthy of note that these sex characters affect also the mentality and the reactions of the animal, although they are quite independent of any nervous connexions. Here, as in the case of the thyroid, the functions of the central nervous system in their highest manifestations depend on the circulation in the blood of chemical substances or hormones. The wonderful development that takes place in the female after conception to fit her to nourish the fœtus as well as the young child, is also due to hormones, produced in some cases perhaps in the ovaries, in other cases in the product of conception itself.

We owe to Schafer the knowledge of the internal secretion of the medulla of the suprarenal bodies. As Cannon has pointed out, this secretion is poured into the blood during conditions of stress, anger, or fear, and acts as a potent reinforcement to the energies of the body. It increases the tone of the blood vessels, as well as the power of the heart's contraction, while it mobilises the sugar bound up in the liver, so that the muscles may be supplied with the most readily available source of energy in the struggle to which these emotional states are the essential precursors or concomitants.

Wonderful, too, is the influence exerted by the secretions of the pituitary body. This tiny organ, which was formerly imagined to furnish the mucus to the nasal cavities, consists of two lobes which have different internal secretions. That produced by the anterior lobe seems to influence growth, excess producing gigantism or acromegaly, while deficiency leads to retarded growth and infantilism. The posterior lobe, which in aspect would seem but a small collection of neuroglia, nevertheless forms one or more substances which, circulating in the blood, have the most diverse influences on various parts of the body. They cause contraction of the uterus and of the blood-vessels (these are possibly two distinct substances); they may increase or diminish the flow of urine; they affect the excretion of chlorides by the kidney; and, according to Krogh, their constant presence in the blood is essential for maintaining the normal tone of the capillaries. In the frog the post-pituitary hormone is responsible for the protective adaptation of the colour of the skin to the environment, an adaptation which is effected by retraction or expansion of the pigment cells or chromatophores of the skin; and, if we may accept Kammerer's conclusions, the pituitary hormone which is poured into the blood for this purpose affects the germ cells themselves, so that individuals born of parents that have lived in light or dark surroundings are correspondingly light or dark—a real transmission of acquired peculiarities, effected not by the gemmules of Darwin, but by the influence of a soluble diffusible hormone on the germ plasm.

In the multiplicity and diversity of the physiological effects produced by these various chemical messengers, one is apt to lose sight of the fact that we are here investigating one of the fundamental means for the integration of the functions of the body. These are not merely interesting facts which form a pretty story, but they are pregnant of possibilities for our control of the processes of the body and therewith for our mastery of disease. Already medical science can boast of notable achievements in this direction. The conversion of a stunted, pot-bellied, slavering cretin into a pretty, attractive child by the administration of thyroid, and the restoration of normal health and personality to a sufferer from Graves's disease by the removal of the excess of thyroid gland, must always impress us as almost miraculous. In the same way we may cure or control for the time being diabetes insipidus by the injection of the watery extract of the posterior lobe of the pituitary body. The latest achievement in this direction is the preparation by Banting and Best in Canada of the active principle normally formed in the islets of the pancreas, and the proof that the diabetic condition in its severest forms can be relieved by its subcutaneous administration.

In my Croonian Lectures I asserted that, if a mutual control of the different functions of the body be largely determined by the production of definite chemical substances in the body, the discovery of the nature of these substances will enable us to interpose at any desired phase in these functions, and so to acquire an absolute control over the workings of the human body. I think I may claim that, in the eighteen years that have since elapsed, we have made considerable progress towards the realisation of this power of control which is the goal of medical science. But there still remain much to be done and many difficulties to be unravelled, and it may be worth our while to consider along what lines researches to this end must be directed.

There are no doubt many hormonic relationships of which at present we are unaware, since every year research adds to their number. But assuming we know that such and such an organ produces an internal secretion which is necessary for the normal carrying on of a given function or functions, we may desire to diminish or enhance its effects in a patient or to replace it when it seems to be entirely lacking. There seem to be three possible methods by which we medical men can interpose our art in the hormonic workings of the body.

(1) In the first place, we may find what is the effective stimulus to the production of the hormone, and, by supplying this, increase its production by the responsible cells. For example, we know that by the administration of acid, or at any rate by increasing the passage of weak acid from the stomach to the duodenum, we can enhance the production of secretin and so of pancreatic juice and the other juices. Probably, therefore, when we give dilute acids to assist gastric digestion we are setting into motion the whole chain of reflex processes in the alimentary canal, and the chief value of our administration may be its effect on the pancreas. But in a large number of cases we do not yet know what is the effective stimulus to the production of these internal secretions. In the case of the adrenals we know the secretion can be augmented through the central nervous system and the splanchnic nerve under the influence of emotions or of lack of oxygen, but we have no knowledge of the factors determining the production of the pituitary hormones or of insulin by the islets of Langerhans, and this

condition of ignorance extends to most of the other ductless glands.

In some cases deficient production of a hormone may be due to the absence from the food and drink of some necessary constituent. Thus iodine is essential to the formation of the specific secretion of the thyroid gland (iodothyrin). If iodine be entirely absent from the drinking water and the soil, so that it is not contained even in minute quantities in the vegetable food grown in the district, the thyroid undergoes hyperplasia—in vain an endeavour to make bricks without straw, to produce its proper hormone without iodine. This seems to be the cause of the great prevalence of simple goitre in certain districts—especially in Switzerland and in parts of the United States. It has been shown that goitre can be practically eliminated from these districts by the occasional administration of small doses of iodine or iodides (Marine, Lenhart, Kimbull, and Rogoff). These results were communicated in 1917 to Dr. Klinger of Zürich, and as a result of his experience the Swiss Goitre Commission has recommended the adoption of this method of goitre prevention as a public health measure throughout the entire State. Already great progress has been made in the abolition of this disease from the country. Thus the incidence of goitre among all the school children of the canton of St. Gallen has been reduced from 87·6 per cent. in January 1919, to 13·1 per cent. in January 1922.

(2) Where a disordered condition is due to diminished production of some specific hormone we may extract the hormone from the corresponding gland or tissue in animals. It is characteristic of these hormones that, so far as we know, they are identical throughout all the classes of vertebrates, and it is possible that they may be found far back in the invertebrate world. This method is easy when, as in the case of the thyroid, the active principle is stored up in the gland and is unaltered by the processes of digestion, so that we can obtain all the curative effects of the hormone if we administer dried thyroid by the mouth. We have no evidence that any other of the hormones with which we are acquainted partake of this resistance to digestion, so that to produce their specific effects they have to be introduced by subcutaneous injection —a great drawback when the administration has to provide for the constant presence of a small concentration of the hormone in the blood and tissues. In the case of insulin, for example, it seems necessary to repeat the injection every twelve hours to obtain any continuity of action, and the same thing probably applies to the pituitary extract, while in the case of the genital hormones no trustworthy effect has been obtained except by the actual implantation of the organ from an animal of the same family.[2]

[2] In my Croonian Lectures in 1905 I reported some experiments made in conjunction with Dr. Lane-Claypon, in which I had produced hypertrophy of the mammary glands in virgin rabbits, and in some cases actual secretion of milk, by the daily subcutaneous injection of the filtered watery extract of young rabbit fœtuses. Similar results were obtained by Foà. But a weak point in these experiments was that the ovaries had not been previously extirpated. Ancel and Bouin have shown that in the rabbit the mere rupture and discharge of a Graafian follicle, with the subsequent growth of a corpus luteum, are sufficient to cause hypertrophy of the mammary glands (the effective hormone presumably having its seat of manufacture in the luteal cells). It seems possible, therefore, that the effect of our injections may have been on the ovaries, and that the growth of the mammary glands was only a secondary and indirect result. I do not therefore now regard our experiments as conclusive.

We may, however, look forward to the day when the chemical constitution of all these hormones will be known, and when it may be possible to synthesise them in any desired quantity. We may then be able to overcome the inconvenience of subcutaneous injection by giving relatively colossal doses by the mouth, or we may be able to modify their constitution to a slight extent so as to render them immune to the action of digesting fluids, without affecting their specific action on the functions of the body.

(3) The ideal, but not, I venture to assert, the unattainable, method will be to control, by promotion or suppression, the growth of those cells, the function of which is to form these specific hormones. Though this method seems at present far from realisation, the first steps in this direction have already been taken. It must be remembered that the power of controlling growth of cells involves the solution of the problem of cancer. Here the experiments on the growth of normal cells outside the body have shown that they can be stimulated to vie with cancer cells in the rate of their growth, or can be inhibited altogether according to the nature of the chemical substances with which they are supplied. We know that the growth of certain cells, such as those of the mammary gland or of the uterus, is excited by specific chemical substances produced in the ovary or fœtus; and we may be able to find specific substances or conditions for any tissue of the body which may excite growth which is retarded, or diminish growth when this is in excess.

It may be that in some cases purely mechanical interference will suffice. Thus in experiments by Steinach and others it has been found that ligature of the vas deferens close to the testis, while causing atrophy of the seminiferous cells, brings about overgrowth of the interstitial cells, which, as we have seen, are chiefly responsible for the hormones determining the secondary sexual characters. Among these secondary sexual characters must be classed the whole of a man's energies. Virility does not mean simply the power of propagation, but connotes the whole part played by a man in his work within the community. As a result of this hypertrophy these authors claim to have produced an actual rejuvenation in man, and thus to have warded off for a time senility with its mental and corporeal manifestations. Further experiments and a longer period of observation are necessary before we can accept these results without reserve, but it must be owned that they are perfectly reasonable and follow, as a logical sequence, many years' observations and experiments in this field.

It would indeed be an advantage if we could postpone the slowly increasing incapacity which affects us all after a certain age has been passed. Pleasant as it would be to ourselves, it would be still more valuable to an old community such as ours, where the arrival of men in places of rule and responsibility coincides frequently with the epoch at which their powers are beginning to decline. The ideal condition would be one in which the senile changes affected all parts of the body simultaneously, so that the individual died apparently in the height of his powers. For it must not be thought that in any such way we could prolong life indefinitely. Pearl has pointed out that

if all the ordinary causes of premature death were eliminated, this would increase the average duration of life by not more than thirteen years. On the other hand, he shows that the children of long-lived parents have an expectation of life which is twenty years greater than that of the average individual.

It is evident, then, that if longevity is our goal it is not medical science we must look to but eugenics, and I doubt whether the question is one with which we are concerned. The sorrow of the world is not the eternal sleep that comes to every one at the end of his allotted span of years, when man rests from his labours. It is the pain, mental and physical, associated with sickness and disability, or the cutting off of a man by disease in the prime of life, when he should have had many years of work before him. To us falls the task of alleviating and preventing this sorrow. In our childhood most of us learnt that suffering and death came into the world through sin. Now, when as physicians we stand on the other side of good and evil, we know that the sin for which man is continuously paying the penalty is not necessarily failure to comply with some one or other of the rough tribal adjustments to the environment, which we call morality, but is always and in every case ignorance or disregard of the immutable working of the forces of Nature, which is being continually revealed to us by scientific investigation.

In spite of the marvellous increase in knowledge, to some aspects of which I have directed your attention, suffering is still widespread amongst us. Only by following out the injunction of our great predecessor —to search out and study the secrets of Nature by way of experiment—can we hope to attain to a comprehension of "the wisdom of the body and of the understanding of the heart," and thereby to the mastery of disease and pain which will enable us to relieve the burden of mankind.

The Equation of Van der Waals.[1]

By J. H. JEANS, Sec. R.S.

VAN DER WAALS' equation

$$\left(p+\frac{a}{v^2}\right)(v-b)=aT$$

expresses the result of supposing a molecule to be endowed with two distinct physical properties—finite size, giving rise to the term b, and cohesive force, giving rise to the term a/v^2. The physical meaning of the equation is best exhibited by drawing diagrams of isothermals of the familiar type. Representing different gases there will be different diagrams corresponding to different values of a and b. It is, however, readily shown that one diagram of this type can be made to represent all values of a and b, and so the isothermals of all gases, by suitable expansions and contractions of its horizontal and vertical scales. On removing the scale from any single diagram we have a universal diagram which represents the p, v, T relation for all gases, but without specifying the scale. The circumstance that such a diagram is possible is equivalent to the so-called "Law of Corresponding States"; this is now seen to be a mathematical consequence of Van der Waals having confined himself to a two-constant specification of molecular structure.

Thus the accuracy, or the reverse, of the law of corresponding states provides a test of the sufficiency of Van der Waals' two-constant specification of a molecule. In actual fact the law is not very closely obeyed; the deviations show distinct correlation with atomicity, and so suggest that the two-constant specification is not altogether adequate—a full treatment must take account of differences of atomicity (or physical shape) as well as of differences of size and cohesive power.

Van der Waals explained his cohesive power by the supposition that all matter possesses inherent powers of attraction for all other matter. Gravitational attraction is numerically far too small to come into the question at all, so that it is to the electrical structure of matter that we must look for the origin of this supposed universal attraction.

If molecules were electrically charged structures, similar molecules would repel one another; as they are electrically neutral, they will repel in some orientations and attract in others, but two molecules meeting at random are as likely to repel as to attract. It is only when the *duration* of molecular encounters is studied that we find an explanation of the preponderance of attraction over repulsion—attractive encounters draw the molecules farther and farther into each other's sphere of influence, and so last longer than repulsive encounters. Comparing the two types of encounters, the "birth rate" is the same for each, but the "expectation of life" is longer for attractive encounters, so that for the encounters in being at a specified instant, there is a preponderance of attractive encounters, and hence a resultant attractive force. This attractive force, however, originates far more in an abstruse theorem of statistical mechanics and far less in an inherent property of matter, than Van der Waals supposed.

If this interpretation is right, the cohesive forces must disappear at very high temperatures and must steadily increase with decreasing temperatures, so that a must be a function of the temperature and not, as Van der Waals supposed, a constant. In point of fact, all attempts to bring Van der Waals' equation into closer agreement with observation begin by making a a function of the temperature. Moreover, a is found to vanish at infinite temperatures in conformity with the suggested explanation.

The second constant b was supposed by Van der Waals to have its origin in the finite sizes of the molecules. If, for example, the hydrogen molecule is regarded as a sphere, its radius as calculated from the observed value of b is found to be $0{\cdot}64\times10^{-8}$ cm. The same radius can be calculated independently in other ways; the coefficients of viscosity, of conduction of heat and of self-diffusion all agree in yielding the value $0{\cdot}68\times10^{-8}$ cm. The average of these, $0{\cdot}66\times10^{-8}$ cm.,

[1] Synopsis of part of the Van der Waals Memorial Lecture delivered before the Chemical Society on November 8.

would give for the hydrogen *atom* a volume equal to that of a sphere of radius $0{\cdot}53 \times 10^{-8}$ cm. But the normal hydrogen atom, as is now known from the researches of Bohr, consists of two electric charges, describing a circular orbit, one about the other, of radius precisely equal to $0{\cdot}53 \times 10^{-8}$ cm. As regards collisions with other molecules, this invertebrate structure, consisting of two point-charges with no material connexion between them, appears to reserve for itself a three-dimensional spherical volume with as much precision as though it were a sphere of infinite hardness.

The explanation of this infinite hardness is to be found in the intangible fetters of the quantum dynamics. The nature of these fetters is not in the least understood, but it is believed that they are such that no force in creation can cause the electron of the hydrogen atom to describe a smaller orbit than the normal orbit of radius $0{\cdot}53 \times 10^{-8}$ cm. If it is further supposed that this orbit is free to assume all orientations in space we begin to understand why it is legitimate, for kinetic theory purposes, to treat the hydrogen atom as an infinitely hard sphere of radius $0{\cdot}53 \times 10^{-8}$ cm. The quantum theory brings us back, in a sense, to the infinitely hard spherical atoms of Lucretius, and the radius of these spherical atoms can now be calculated with precision from the quantum theory; their infinite hardness is beautifully exemplified in the experiments of Franck and Hertz.

It is thus seen that the a and b of Van der Waals admit of exact interpretation in terms of the physical conceptions of to-day. His b arises from what we may call the quantum forces—the perfectly unyielding restraints which bind the electrons of an atom down to definite orbits—while his a arises from the ordinary electric field of force. It is the b of Van der Waals which saves us from immediate annihilation, through positive and negative charges rushing together to their mutual destruction, just as it is his a which saves us from rapid disintegration.

The Nerves of Plants.[1]

By Prof. HENRY H. DIXON, F.R.S.

THE general similarity of the distribution of the fibro-vascular bundles in plants and that of the nerves in animals was early noticed. These structures in plants were in consequence often called nerves. However, anatomists and physiologists alike have long held the view that the likeness is merely superficial, and is not based on any real physiological or anatomical resemblance.

In plants—as in animals—the receptive and responsive regions are often quite distinct from one another, and may be widely separated. What becomes of the stimulus between the two, and how is it transmitted? Remarkable experiments during the last ten years have given the answers to these questions.

First may be summarised, in a few words, Ricca's work on the sensitive plant, Mimosa. The phenomena of transmission of stimuli in this plant are as striking as they are well known. The stimulus is propagated through its organs at velocities variously estimated at 10-20 mm. per sec. This speed is fast among plants, but very slow when compared with the velocity of transmission of stimuli along animal nerves.

Two views were suggested to account for this propagation. The first referred the passage of the stimuli to those excessively fine strands of protoplasm which, penetrating the walls of the living cells, place the protoplasts of adjacent cells in communication with one another. This view was a product of a period obsessed with the physiological importance of these then recently discovered protoplasmic fibrillæ, which, in all probability, have only a developmental significance. These fibrillæ composed of living matter were supposed to convey stimuli just as the living processes of the nerve cells do in the animal body.

This view was soon rendered untenable when it was shown that stimuli are effectively transmitted even after the protoplasm of the cells of the transmitting organs was killed by the application of heat.

To meet this new growth of knowledge Haberlandt developed his theory, that the stimuli are transmitted in Mimosa in the form of a pulse in the water filling certain elongated tubular cells situated in the bast of the bundles. At the best this was an unsatisfactory theory. For this method would require a much higher velocity of transmission than is observed, and it was wellnigh impossible to imagine how the turgor requisite to transmit this pulse could be maintained after the protoplasts of these tubes had been rendered permeable by heat.

In 1914 Ricca gave the *coup de grâce* to the pulse theory. He showed that the stimulus is transmitted through a strand of Mimosa wood from which all the bast, including the tubes of supposed transmitting function, had been removed for a considerable length. By a series of beautiful experiments Ricca showed that the wood, as Dutrochet long ago believed, transmits the stimulus, and that it does this even when all its living elements are eliminated. Further, he demonstrated that the mechanism of the transport is the transpiration current. This carries in its stream a substance, or hormone, originating from the receptive cells, to the cells of the reactive region and so evokes their response. Ricca's work also disposes of a more recent view that the stimulus is transmitted as an electrical disturbance in the bast.

Almost at the same time as Ricca was disposing of the older views regarding the transmission of stimuli in Mimosa, Boysen-Jensen was carrying out experiments on the phototropic reactions of seedlings, which were bound to have a profound effect on the received views regarding the propagation of stimuli.

When the tip of a grass-seedling is illuminated on one side a stimulus is transmitted from the receptive region downwards in the seedling and evokes a curvature in the shaded part. Boysen-Jensen found that this stimulus was transmitted downwards even when the protoplasmic continuity of the cells of the receptive apex with those of the responsive region was severed by complete section.

[1] Synopsis of a lecture delivered before the Royal Dublin Society on November 9.

Paàl repeated and confirmed Boysen-Jensen's results and added the important observation that the stimulus can pass a slice of pith 0·1 mm. thick impregnated with gelatin intercalated between the receptive and responsive regions. Similar work has been since carried out by Stark on thigmotropic and traumatotropic stimuli. This experimenter brought to light the fact that the receptive tip of one plant may be transferred to the base of another and after stimulation may determine curvature in the latter. Furthermore, the certainty of this response to thigmotropic stimuli depends, other things being equal, upon the phylogenetic affinity of the two parts. Recently Snow has shown that the gravitational stimulus is transmitted across protoplasmic discontinuities in the seedlings of *Vicia faba*.

From the foregoing it is quite evident that protoplasmic continuity is not requisite for the transmission of stimuli in the higher plants. The localisation of the positive and negative responses respectively to one side of the reacting region and the velocity of transmission will not allow us to assign the propagation to simple diffusion; but these characteristics point clearly to the transpiration-stream. It affords the localised delivery and the necessary velocity. Introduction of the requisite hormones may be effected through uninjured cells, or along moist wound surfaces. This consideration explains how it is that continuity between the vascular bundles of the receptive tip and those of the responsive base is not necessary to secure the reaction. Thus, there is great probability that in these plants, as in Mimosa, the transmission of stimuli is effected by the transport in the transpiration-stream of a substance derived from the receptive cells, and conveyed by this means in the wood of the vascular bundles to the responsive region. We may imagine that this substance is first liberated into the transpiration stream by changes in the permeability of the receptive cells, and response is evoked in the reactive cells by similar alterations in permeability.

Whatever the intimate mechanism of the system is, the subject of the transmission of stimuli through plant tissues offers a striking example of the swing of the pendulum of scientific opinion. The view based upon superficial resemblances, that the vascular bundles are the nerves of plants, was long abandoned, but now we see there is clear evidence that they actually transmit stimuli from the sensory to the motor regions, and so perform the function of nerves. The foregoing summary of recent work indicates how differently in detail this connexion is established in plants and animals.

Obituary.

MRS. HERTHA AYRTON.

APPEAL is made to me to give some account of Hertha Ayrton, the wife of my former colleague, who died last August.

"Is the study of heredity a science or a pure romance?" asks Mrs. Trevelyan, in her biography of her mother, Mrs. Humphry Ward. I would set the question in another form: Is *das ewig Weibliche* to be suppressed by science? Mrs. Ayrton was one of those who aspired to prove that woman can be as man as an original scientific inquirer. Did she succeed? If we are to frame a psychology of the scientific mind, regarding this as a species apart, we must carefully note and analyse the doings of such as she. I have but small qualification for the office, yet as she was my colleague's wife and we often met and were in fair sympathy, I was able to take notice of her idiosyncrasies and of the conditions under which she was placed.

Ayrton and I met originally in the autumn of 1879, when we were appointed the first two professors of the City and Guilds Institute and set the ball of technical education rolling in London; the ball rolled well and proved to be fissiparous but no one of the small band who gave it shape in the City and West End ever received the slightest recognition from the Guilds, their masters—and most of these have committed *hari-kari* as concerted workers in education. A strange world is ours and if we worked otherwise than for the sake of working, we should do little.

Ayrton had a peculiar experience: his then (first) wife—his cousin, Mathilda Chaplin—was a woman who had acquired merit in the cause of women's rights, as she was one of the three, I believe, over whom the fight first raged in Edinburgh whether women should be admitted to the study of medicine. When I met her, her health was more than failing. She was an ethereal being, a woman of infinite charm of manner but above the world—a mature Melisande; indeed, when I first heard Debussy's opera her memory was recalled to me by the peculiar rhythm and tone of its melody. Her daughter, Mrs. Zangwill, has inherited not a few of her mother's characteristics—especially her charm of voice. Her chief occupation was novel-reading, from penny-dreadfuls upwards, in which she ran a caucus race with our erratic friend, John Perry.

Ayrton married his second wife in 1885. If I were to compose an opera with my scientific friends as the characters, I should associate the Melisande theme with the first Mrs. Ayrton; I should not quite know where to place the second musically but it would be near to Brunhilde, as she had much of the vigour of Wotan's masterful daughter and, at least, aspired to be an active companion of scientific heroes—a race far above Wagner's dull and degenerate Teutonic gods, be it said.

Sarah Marks was the daughter of intelligent but poor Jewish parents in Portsmouth. She was a clever child and was early sent to a school in London kept by her paternal aunt, who became Mrs. Hartog; Mr. Hartog was a teacher of French in London. Mrs. Hartog was the mother of Numa Hartog, Philip Hartog and the professor of botany in Cork; also of two daughters, one very clever, a talented painter, who married Dr. Darmstadter of Paris; the other earned her living as a musician. Numa Hartog died early, after a most brilliant university career and seems to have been unusually clever. Mrs. Marks had four undistinguished children, besides Sarah; nothing is known of her parents. Mrs. Ayrton's ability, however,

would seem to have been derived from the mother's side.

At about the age of fifteen, Sarah Marks became acquainted with Madame Bodichon, a well-to-do lady, strong on the women's rights question, who sent her young friend to Girton College, Cambridge. Apparently, she then changed her name to Hertha. She took honours in mathematics. She is credited with the invention, during the period, of a sphygmograph and also of an instrument for rapidly dividing up a line into a number of equal parts. Through Madame Bodichon, she became acquainted with George Eliot and several other people of distinction. In 1884 she entered the Finsbury Technical College. I remember her coming. She not only came but was seen and soon conquered—Ayrton; and they married. As sole issue they had a daughter, who has her father's gift of tongue; she married a Christian, whilst his daughter by his first wife married a Jew. I often told him that he and his wife were an ill-assorted couple: being both enthusiastic and having cognate interests, they constantly worried each other about the work they were doing. He should have had a humdrum wife, "an active, useful sort of person," such as Lady Catherine recommended Mr. Collins to marry, who would have put him into carpet-slippers when he came home, fed him well and led him not to worry either himself or other people, especially other people; then he would have lived a longer and a happier life and done far more effective work, I believe.

Under her husband's inspiration, Mrs. Ayrton soon entered upon the study of the electric arc. Her work is recorded in the book on the subject which she published in 1902, in part a reprint of papers submitted to the Royal and other Societies. She was an indefatigable and skilful worker. Whatever the absolute value of her observations, her husband and his good friend Perry were the last not to make the most of her achievement, so probably the scientific halo with which they and others who fancied that women could be as men surrounded her was overpainted. Most of us thought, at the time, that they were ill advised in preferring her claim to the Royal Society; the nomination came to nothing on legal grounds. She was, however, elected into the Institution of Electrical Engineers and at her death was its only lady member. She also engaged in an inquiry into the formation of sand ripples and this led her, early in the War, when chlorine was first used as poison gas, to develop a fan-device for waving back the fumes. There is little doubt that she took too high a view of the practical value of the invention and was unwarrantably aggrieved at its rejection by the military authorities. She was awarded the Hughes Medal by the Royal Society in 1906.

Mrs. Ayrton was a very striking woman in appearance and of considerable personal charm, full of common sense; this kept her from being a militant suffragist, though she promoted the cause in every possible way. I never saw reason to believe that she was original in any special degree; indeed, I always thought that she was far more subject to her husband's lead than either he or she imagined. Probably she never had a thorough scientific equipment; though a capable worker, she was a complete specialist and had neither the extent nor depth of knowledge, the penetrative faculty, required to give her entire grasp of her subject. Ayrton himself, though a genius, was in no slight measure partial in his interests: by heredity literary and artistic, educated intensively in the classical school, a born actor and therefore a good lecturer and public speaker, impelled into science through contact with Sir William Thomson, he was a worker chiefly at its technical and commercial fringe rather than in its depths: so he was not a good judge of his wife's scientific ability. His partner Perry was the solid member of the firm. In fine, my conclusion is, that *das ewig Weibliche* was in no way overcome in Mrs. Ayrton: nor could we wish that a thing so infinitely precious should be: she was a good woman, despite of her being tinged with the scientific afflatus. HENRY E. ARMSTRONG.

DR. J. E. STEAD, F.R.S.

By the death of Dr. John Edward Stead, on October 31, at the age of seventy-two, Great Britain has lost one of its most famous metallurgists, a man who played a very honourable and a leading part in the development of scientific metallurgy, and is not unworthy to be ranked with the great names of John Percy, Lowthian Bell, and Roberts-Austen.

Dr. Stead was born in 1851 and was a younger brother of the late W. T. Stead. After the usual period spent at school, he was for a time an evening student at the Owens College, Manchester, in the early days at Quay Street. From there he passed to a steel works in the Middlesbrough district, where he served his apprenticeship on the practical side of iron and steel smelting, but he was only nineteen when he entered the laboratories of Pattinson, a consulting chemist and metallurgist in the district. Later the two men entered into partnership under the title of Pattinson and Stead, and he remained identified with the firm for the remainder of his life, a period of about fifty-two years in all. He became one of the best-known analysts in the north of England, and one can only conjecture how many large contracts were signed on the basis of Stead's analyses.

An incident related to the writer some twenty years ago by Dr. Stead will give some idea of how this man, with a very slight amount of what would be termed academic training, rose to a position of great power and trust, not merely in the Cleveland district where he lived, but also in the iron and steel industry of the whole country. He found on one occasion, in the early days of his association with Pattinson, that he had sent an incorrect analysis to one of the firm's clients. Without hesitation he wrote to explain that he had made a mistake and substituted the correct figures. The client in question was exceedingly angry, not because he had received an incorrect analysis, but because Stead had admitted that he had made a mistake. Apparently this is a serious matter where business is concerned. Stead retorted, "If I was unwilling to admit that I made mistakes, you would never know whether a result I sent you was correct or not." This was a new point of view, and the client was so much impressed by it, that he sent all his

analyses to Stead in the future, after having previously threatened to withdraw his custom.

It is not as an analyst, however, that Stead rose to fame. He was naturally of an inquiring mind, eager to discover truth in any form that he could, and in the course of forty-six years he published at least eighty papers before seventeen institutions, in which he covered a range of subjects in the metallurgy of iron and steel, such as few, if any other, men have attempted. If he could be said to have made one subject rather than another peculiarly his own, it was the influence of phosphorus on iron. This was perfectly natural, for the Cleveland ores are phosphoric, and phosphorus, at any rate in association with carbon, is the worst enemy of steel. It is not generally known that Stead played a very important part in the early days of the development of the Thomas-Gilchrist basic Bessemer process for the dephosphorisation of phosphoric iron ores, a process which enabled Germany to become the second largest producer of steel in the world, with all the consequences that have followed. One of the essential features of the process is the so-called "afterblow," when the blowing of air through the converter is continued after the complete removal of carbon. Stead was the first to advance the correct explanation of what takes place, namely, that phosphorus is removed during this period, but not until then, by iron oxide. Thomas and Gilchrist challenged this explanation and only accepted it in the following year when they obtained letters patent for the "afterblow."

Stead was one of the first men in Great Britain to realise the importance of Sorby's investigations, which led to the foundation of metallography as a science. With true vision he saw that here was a new experimental weapon for investigating the properties of all metals and alloys, and the majority of his investigations have lain in this field. Within the limits of this article it is impossible to give any adequate idea of their scope and variety, but this, at all events, may be said, that his contributions to our knowledge of the crystallisation phenomena observed in iron and steel, and the segregatory and migratory habits of solids in alloys, were such that he became one of the chief authorities in the world on these subjects. He made important contributions to the technique of microscopic metallography, and his method of heat-tinting specimens by oxidation became an accepted method for the micro-analysis of cast iron.

Living as he did to the age of seventy-two, it would have been very surprising if honours had not come to Stead. He became a member of council of the Iron and Steel Institute in 1895, a vice-president in 1910, and president in 1920. He received the Bessemer medal of the Institute in 1901. In 1910 he was president of Section B of the British Association at Sheffield. He also filled the office of president of the Cleveland Institution of Engineers. The majority of his papers were published before these two Institutions. He was given honorary doctorates of the Universities of Manchester, Leeds, and Sheffield, and he had been for twenty years a fellow of the Royal Society.

No man revealed himself more characteristically in his papers than Stead. He had a generous and ardent mind, and he pursued the search for truth with a single-mindedness which was an inspiration to all who knew him. The willingness to admit that he was wrong when he was wrong, which is not so common a virtue as it should be, and to which attention has already been directed, made him an ideal opponent in scientific controversy. Characteristically enough, he was particularly generous to young workers in the field of metallurgy, imbuing them with something of his knowledge and enthusiasm, and encouraging them by generous praise. The writer recalls several such occasions in his own experience. During the last eighteen months Stead had been forced to live in retirement and indeed had become a physical invalid, but his mind remained clear and active up to the time of his death. He leaves behind him the memory of a life splendidly lived, which those who were privileged to know him will always cherish.

H. C. H. CARPENTER.

M. Maurice Leblanc.

By the death of Maurice Leblanc on October 27, the world loses one of its greatest engineers. He had striking originality. In conjunction with M. Hutin, he invented the *amortisseur* or damping coil, which when applied to alternators enables them to run steadily in parallel. He also perfected the method of converting induction motors into generators by driving their rotors at speeds greater than synchronism by prime movers. He ran them in parallel, the frequency of the supply depending only on a small alternator in the supply circuit, the function of which he compared with that of a *chef d'orchestre*. In recent years he devised a remarkable system for high-speed electric traction. The energy is communicated to the moving train without rubbing contacts by means of magnetic induction. He proposed to utilise alternating currents having frequencies of 20,000, the current being carried over the track by a series of tubular condensers adjusted to resonance. The currents in the locomotive circuits are converted to low frequency by thermionic valves. They then operate induction motors as in ordinary traction systems.

In the very difficult years 1912–1914 Leblanc filled the post of president of the International Electrotechnical Commission with universal acceptance. His speech when resigning the office of president at the London meeting in 1919 was a powerful plea for nations and individuals to give up working exclusively for selfish ends. The lack of this in the past had led to the greatest catastrophe of all time. "From henceforth only productive work will be deemed honourable." He was elected an honorary member of the Institution of Electrical Engineers in 1915. His high ideals and singleness of purpose made friends for him in every country of the world. A. R.

We regret to announce the following deaths:

Mr. Thomas Pridgin Teale, F.R.S., the eminent surgeon and sanitarian, on November 13, aged ninety-two.

Dr. Boris Sidis, of the Sidis Psychotherapeutic Institute, Portsmouth, New Hampshire, known for his work on the psychology of suggestion and mental dissociation, on October 25, aged fifty-six.

Current Topics and Events.

THE Western Galleries of the Science Museum, South Kensington, which for nearly half a century have contained the valuable Science Collections of the Museum, were closed to the public on September 17. These galleries have now been vacated, and the constructional and other work (gun foundations, redecoration, etc.) considered by the Government to be necessary to make the galleries fit to house the collections and staff of the Imperial War Museum (created a few years ago, and now at the Crystal Palace) is already well in hand. The Science Collections have been transferred to three unfinished galleries in the eastern block of the new Science Museum building (see NATURE, June 30, p. 895), which were not vacated by the Post Office Savings Bank department until towards the end of September. The total floor-area available in these galleries is only about two-thirds that in the Western Galleries, which were already much overcrowded; but by using two of the new galleries as store-rooms, in which objects are packed very closely together, it has been possible to arrange objects in the third gallery under conditions which allowed this gallery to be open to the public from November 11. Here are shown groups of objects selected from the sections illustrating astronomy, surveying, meteorology, chemistry, optics, sound, and botany. The remaining objects in these sections, and all the objects in the sections illustrating mathematics, general physics, photography, kinematography, heat, geophysics, geology, geography, and oceanography—forming altogether about eighty per cent. of the Science Collections—are thus stored away, and cannot be placed on exhibition again until further space becomes available. The progress made during recent years with the fine new buildings of the National Science Museums of Germany and Austria, at Munich and Vienna respectively, affords a significant contrast to the above.

THE Council of the Trade Marks, Patents, and Designs Federation, Ltd., recently circulated a questionnaire in relation to trade marks, patents, and designs prepared by the International Chamber of Commerce to a number of societies interested in these matters. This questionnaire was drawn up with the object of ascertaining the directions in which modifications and amendments were desirable, from the British point of view, in the International Convention for the Protection of Industrial Property (Treaties Series, No. 8 (1913). Cmd. 6805. H.M.S.O. Price 6*d*. net.), signed at Washington on June 2, 1911 (State Papers, vol. 104, p. 116). A meeting of the representatives of some twenty of the societies consulted was held at Lever House, Blackfriars, on November 23. The questionnaire was discussed, and it was recommended, *inter alia*, that (1) a clause should be inserted in the Convention abolishing revocation of patent rights either for non-working or for abuse of monopoly, but permitting each country at its discretion to grant compulsory licences in such cases; (2) provision should be made for establishing in all Convention countries a uniform period of duration for patents, and renewal fees should be paid at agreed intervals of time and be based on a sliding scale system of progressively increasing payments; (3) there should be uniform provisions governing the use of an invention on vessels sailing under the flag of one of the States which has adhered to the Convention; (4) there should be provision for registration in a public register kept by the competent administration of each country of all assignments and licences affecting the legal proprietorship of patent rights; (5) steps should be taken to secure a greater degree of uniformity in the regulations at present in force in the various Convention countries with respect to the procedure to be followed on applications for the grant of letters patent. It was further agreed that it was neither desirable nor practicable to insist upon the institution in all Convention countries of a system of preliminary search of patent applications, but it was desirable that any party interested should have the right, prior to the grant of any patent, to institute opposition proceedings based on all prior publications or public users of the invention of which he has knowledge.

THE British Meteorological Office announces an important step towards supplying ships with information regarding the existing weather around the British coasts and forecasts for the seas adjacent to the British Isles. On January 1 a new series of broadcast wireless messages will be issued from the Air Ministry Station at 9 A.M. and 8 P.M. daily. Each message will contain the actual observations of wind, weather, pressure, barometric tendency, and visibility at ten stations on the British coasts taken only two hours before the broadcast issue. The messages will also give a general inference of weather conditions and forecasts for twelve hours for eleven sea districts; at the end a further outlook will be given when possible. The code and full particulars may be found in the Board of Trade notices to mariners for November or in the *Marine Observer*, a monthly magazine to be published by His Majesty's Stationery Office from the beginning of 1924.

IN an address delivered before the Scientific and Technical Circle of the Institute of Journalists on November 20, Sir Richard Gregory, the chairman, discussed the relation of science to progress. In his opening remarks he recalled that Ruskin in his "Crown of Wild Olive," George Gissing in his "Private Papers of Henry Ryecroft," and many other writers had associated science with agencies of death or denounced it as detrimental to social culture. This, however, is a narrow view, and it is futile to rail against the progress of science or attempt to prevent it. We are now on the threshold of developments by which forces may be unloosed and powers acquired far beyond those hitherto known to man. Science is no more responsible for the horrors of the War than for soul-destroying industrial conditions. Scientific discoveries may be used for the benefit of mankind or be applied to base uses. Thus

chlorine, the first poison-gas used in the War, had for more than a hundred years previously been used as a bleaching agent. Nitre, though a constituent of explosives, has been used in fertilisers with such success that the average yield of wheat per acre in England is now 30 bushels instead of 20 bushels as in the seventeenth century. The vast development in the production and export of cotton piece-goods is due to science and invention. China has vast stores of anthracite coal and other minerals, but because of the lack of scientific knowledge and ability to exploit these resources, most of the people of that country live in comparative poverty. It is impossible to foresee the applications of discoveries. Minerals which a few years ago were scientific curiosities, rare gases like neon, argon, and helium, have now uses unsuspected by the discoverers. It is our duty to see that the powers which science gives to the human race should be used for noble and spiritual purposes, so that they may be a blessing to mankind instead of a curse.

THE next Congress of the Royal Sanitary Institute will be held at Liverpool on July 14-19, 1924, by invitation of the Lord Mayor and City Council.

SIR ARTHUR KEITH will deliver the Thomas Vicary lecture of the Royal College of Surgeons of England in the theatre of the College in Lincoln's Inn Fields on Friday, December 7, at 5 o'clock. The subject of the lecture will be "The Life and Times of William Clift, First Conservator."

AT the November meeting of the Royal Statistical Society, the Frances Wood Memorial prize, value 30*l*., which is offered biennially for the best investigation of any problem dealing with the economic or social conditions of the wage-earning classes, was awarded to Miss E. J. M. Haynes, of Oxford, for an essay on human power in the English pottery industry.

THE Liverpool Psychological Society has been inaugurated under the presidency of Prof. Alexander Mair of the University of Liverpool, supported by Dr. Betts Taplin as vice-president and an influential committee. The Society intends to pursue the systematic investigation of the recent developments of the science. Further information can be obtained from the secretary of the Society, the University, Liverpool.

A JUNIOR assistant is required by the Royal Aircraft Establishment, South Farnborough, Hants, for aerodynamic research in wind tunnels. Candidates for the post must possess a good knowledge of physics and applied mathematics and an honours degree in natural science or engineering. Applications, marked Ref. A. 23, should be sent to the Superintendent of the Royal Aircraft Establishment.

APPLICATIONS are invited by the Queensland Government for the position of Director of the Laboratory of Microbiology and Pathology of the Department of Public Health, Brisbane. Candidates must hold a diploma in public health and have had recent special laboratory experience in microbiology. The Agent-General for Queensland, 409 Strand, W.C.2, will supply further information respecting the post. The latest date for the receipt of applications is December 17.

AN Inspector is required by the Ministry of Agriculture and Fisheries in connexion with agricultural and horticultural education and research. Candidates must have taken a University or Agricultural College course in science or agriculture and have had special training in the science and practice of poultry and small livestock keeping—including goats and rabbits. Forms of application, etc., may be had from the Secretary of the Ministry, 10 Whitehall Place, S.W.1. They must be returned by, at latest, December 8.

THE Committee of the Christie Hospital, Manchester, is offering a prize of 300*l*. for cancer research. The aim is to stimulate isolated work, particularly that already in progress, apart from the research schemes of cancer research institutions; for the Committee thinks that notable increase in the knowledge of cancer may come from an individual worker as well as from a team of men investigating the subject systematically. At the same time, the Committee intends to keep up its own research work at the University of Manchester. Since advances may be expected from sciences allied to medicine, the conditions attached to the prize are very wide. Candidates must be qualified in medicine, or in science cognate to medicine, and must produce evidence of original research on cancer done or projected. All documents must be submitted in English, but nationality is no condition of the award. Applications must reach the chairman of the Medical Board, Christie Hospital, Manchester, not later than December 31, 1924.

IN June the Canadian explorer, Dr. V. Stefansson, directed the attention of the Textile Department of the University of Leeds to the wool of the Ovibos (musk ox), which is capable of being bred in large numbers in the arctic zone of Canada and might be a considerable asset to the Dominion. The wool, of a natural brown colour, is hidden by an overgrowth of long hair, which is troublesome in manufacture. The first specimen woven in the Department was brought to the notice of the King at the time of the meeting of the Imperial Conference in October. Samples have been dyed successfully, and further experiments are in progress to eliminate the long hairs. The Clothworkers' Company of London, to whom the University is so greatly indebted in many ways, and particularly for the building, equipment, and endowment of the Textile Industries and Dyeing Departments, is showing a keen interest in these important experiments.

THE winter scientific reunion of the Natural History Museum Staff Association was held in the Board Room of the Museum on November 14, and attracted a large attendance of the staff and other workers in natural history. Many, varied, and interesting specimens were exhibited, among which may be mentioned: Fossil Arachnida from the Rhynie Chert, Old Red Sandstone, Aberdeenshire (the oldest recorded instance

of Arachnida); examples of sex dimorphism in cuttlefish; the second and third cervical vertebræ of a Sibbald's rorqual (revealing the exceptional size of the original whale); cast of the skull of *Baluchitherium Grangeri* from the Miocene, Central Mongolia; examples illustrating the germination of the coco-nut; selection of minerals collected by Mr. F. N. Ashcroft from Cavradi and Sedrun, Switzerland; example of a fish, *Gigantura chuni*, which had swallowed another, Chauliodus, double its length; a series of reproductions of remarkable photographs of African big game. The Cambridge and Paul Instrument Company demonstrated microtomes manufactured by that firm.

DR. S. JUDD LEWIS has been awarded the gold research medal of the Worshipful Company of Dyers, on the recommendation of the Society of Dyers and Colourists, for his work on the quantitative determination of the fluorescent power of various forms of cellulose and its derivatives, published in the Journal of the Society. It has been shown that the form and dimensions of the fluorescence curve, having as its co-ordinates the wave-length and fluorescent power per cent. relative to a standard paper, are related to the chemical constitution of the substance. The curves for pure cellulose, hydrocellulose, oxycellulose, cellulose acetate, etc., as well as those for various sugars, are all characteristic, with peculiarities in common for those substances of similar structure. The physical condition of the material has very little effect on the results. It is anticipated that this new method, which is conducted photographically, will prove useful in throwing light on the constitution of opaque solid substances in much the same way as absorption spectroscopy is applied to the investigation of transparent fluids.

MR. F. EDWARDS, 83 High Street, Marylebone, has just circulated Catalogue No. 452 of nearly 1400 books of voyages, travels, exploration, and sport. Among the works listed are the first edition of Hakluyt's "Navigations," etc., a complete set of the second series, to 1922, of the Hakluyt Society Publications, and a set of the Journal and Proceedings of the Royal Geographical Society to 1919. The same bookseller has also sent us a selected list of books, engravings, and maps relating to West Africa.

AMONG the new announcements of Messrs. Macmillan and Co., Ltd., to which attention has not hitherto been directed in NATURE, are the following: The Autobiography of Sir Archibald Geikie; "A Glimpse of the Natives of Central Australia," by Dr. G. Horne and G. Aiston, which will deal with the country, the habits, customs, and beliefs of the Wonkonguru and their neighbours (much of the information has been collected at first-hand from the natives); and the collected works on Economics of Prof. F. Y. Edgeworth, in 3 vols., with introductions to the various sections by the author.

Our Astronomical Column.

REINMUTH'S COMETARY OBJECT.—After considerable delay, owing to its faintness, a third photographic observation of this object was obtained by Graff and Baade at Bergedorf. Stracke has deduced the following elliptical elements:

T	1923, Nov. 28·92 G.M.T.
ω	182° 58′ 19″
Ω	229 17 10
i	16 18 4
e	0·4701
log q	0·1621
Period	4·537 years.

The Bergedorf plate showed no nebulosity, so the object may be a minor planet, of the type of Aethra. Its perihelion is well within the orbit of Mars. Its position at midnight on Dec. 3 is R.A. $1^h\ 47{\cdot}5^m$, N. Decl. 6° 27′; daily motion $+1{\cdot}55^m$, S. 18′.

THE TOTAL SOLAR ECLIPSE OF SEPTEMBER 10.—*Popular Astronomy* for October contains a photograph of the corona taken at Lompoc, California, by Mr. Worthington. The scale is too small to show much detail, but the outline conforms to the type of sunspot minimum.

The Sproul Observatory at Durengo, Mexico, the Steward Observatory expedition on the Gulf of California, and the Mexican and German expeditions at Yerbaniz, Berrendo, and Pasage (all in Mexico), all enjoyed good conditions and were able to carry out their programmes. Most of the other parties were partly or wholly clouded out.

Mr. Morgen Brooks ascended a mountain in Catalina Island and obtained some very interesting views of the passage of the shadow on the clouds. He makes the usual remark that light seemed to increase more rapidly than it diminished. This is probably subjective, one's eyes becoming more sensitive during the darkness. He saw no shadow-bands.

A REMARKABLE METEORIC PROCESSION.—A swarm of light meteors was seen on February 9, 1913, to pass over Canada, the United States, and the Atlantic, the length of the track being several thousands of miles. Prof. W. H. Pickering has made a study of their motion in *Popular Astronomy*, proving that their orbit before encountering the earth cannot have been of a cometary character, but must have been an ellipse not very different from the orbit of the earth itself, to permit the relative velocity to be so small. This would tend to support the view of the late Sir Robert Ball that the slow-moving fireballs were probably ejected from terrestrial volcanoes in the distant past. Their velocity on emerging from proximity to the earth would not be very different from the earth's velocity, and their subsequent orbits would be close to that of the earth.

Prof. Pickering notes that it is quite likely that (with the aid of the moon) some of these bodies may have been captured as satellites of the earth and revolve around it above the atmosphere. When they enter the latter they ultimately descend to the ground.

A PROJECTED FRENCH OBSERVATORY.—*La Nature* of November 3 states that M. Dina, an engineer, is endowing an important new observatory at Cruseilles in Haute-Savoie. He has recently discussed the plans with General Ferrié and MM. H. Deslandres and A. Danjon. It is expected that a large reflector will be included in the equipment, which will probably be devoted mainly to researches in astrophysics. Meteorology will also occupy an important place in the work of the observatory. It may be presumed that the quality of seeing has been already studied at the proposed site, as this is of such vital importance in the case of large aperture instruments.

Research Items.

RED DEER FROM THE HOLDERNESS PEAT.—Two discoveries of the remains of red deer in the peat of Holderness are recorded by Mr. T. Sheppard in the November issue of the *Naturalist*. The first was found in beds exposed on the shore near Skipsea, East Yorks. The entire skeleton with the exception of a few small bones was recovered and is now exhibited in the Municipal Museum at Hull. The antlers measure 2 ft. 3 in., and 2 ft. 2½ in., one having seven and the other six points. The second discovery was made in the peat on the shore at Withernsea at very low water during the spring tides. Consequently little time was available for excavation and only the antlers were secured. The right antler measured 33 in. in length and 9 in. in diameter at the skull. The left antler was unfortunately broken in the course of excavation and only a part recovered.

GEOGRAPHICAL WORK IN EGYPT.—The Ministry of Public Works, Egypt, publishes the report on the work of the Physical Department for the year ending March 31, 1923. In the Hydrological Service, rainfall observations were received from 281 stations in Egypt and surrounding lands, an increase of ten compared with the previous year. The Nile basin is fairly well supplied with stations except Abyssinia, where there are only six. River discharge measurements were taken on all the main branches of the Nile. A discharge station at Nimule, on the borders of the Sudan and Uganda, will give a measure of the amount of water available for storage in Lake Albert which is essential in any project for controlling the waters of that lake. Among numerous other researches it may be noted that experiments were made with hydrogen drift balloons carrying a magnesium flash mixture, in order to connect, by the help of a camera, the European and African triangulations by way of Crete. The Meteorological Service now receives observations from twenty-four stations in Egypt and twenty-nine in the Sudan. A station in the Sinai peninsula at Bir Abu Tif, founded two years ago by a commercial company, was closed.

FLORA OF THE TIBETAN MARSHES.—The ecologist will find an interesting description of a little-known region in Mr. F. Kingdon Ward's account of the flora of the Tibetan marshes in the Journal of the Royal Horticultural Society, volume 48, parts 2 and 3, issued September 1923. He describes the glaciated limestone plateau east of the Yangtze, a country of wide Alpine valleys and numerous small lakes with frequent lofty escarpments overlooking the rivers running from north to south. This country appears to be magnificently rich in herbaceous alpines, which are unaffected by the seasonal droughts occurring in their non-growing season, while these conditions prevent the vigorous development of woody plants. As opposed to the country to its west, it is a land of primulas rather than of rhododendrons. Mr. Ward's account of the vegetation is none the less interesting because it is written with a special reference to the plants which are of horticultural interest when transferred to the amateur's garden. Many students of rock gardens will be interested by his pertinent remarks, based upon the study of the rock flora in Nature, as to the places where certain plants should appear in the garden. Thus he suggests that plants with translucent flowers, such as a species of Onosma, are intended to grow on a level with the eye so that the light reaches the observer through the petals of the flower, while others, like some of the dwarf Campanulas, are intended to hang downwards from the crevices in the cliff.

LIGNITE IN NIGERIA.—The Bulletin of the Imperial Institute, volume 21, No. 2, 1923, contains an important article upon the lignite deposits of Nigeria, which are to be found on both banks of the Niger and seem likely to afford a practicable fuel of special value for boats navigating the Niger. The geological relations of the lignite deposits in the Southern Provinces of Nigeria are discussed and the distribution of the beds indicated so far as it is known. Analyses of the chemical composition of samples from various seams are presented and trials reported of the suitability of the lignite for manufacture into briquettes. A large scale trial of the Nigeria lignite was made by making up a considerable amount of the material into briquettes through the co-operation of a factory in Saxony; these bricks were then used in locomotives on the railways in both the northern and southern provinces of Nigeria with results that suggest that they will provide quite a satisfactory fuel. In view of the cost of imported coal in British West Africa the subject would seem to be of considerable economic importance.

NEW OLIGOCENE TOOTHED CETACEAN FROM SOUTH CAROLINA.—Mr. R. Kellogg figures and describes (Smithsonian Miscellaneous Collections, vol. lxxvi. No. 7) an apparently new toothed Cetacean from beds probably of Oligocene age in Berkeley County, South Carolina. The fossil consists of a skull 371 mm. (=14½ in.) in length. In some respects it resembles Agorophius and Archæodelphis, but is considered to represent a new genus and species and has been named *Xenorophus sloanii*.

ITALIAN EARTHQUAKES IN 1911.—For the first time since the War, the Central Office of Meteorology and Geodynamics at Rome has issued its "Notices of Earthquakes observed in Italy." The present volume of nearly 600 pages deals with the earthquakes of the year 1911 and forms an appendix to vol. xviii. (1914) of the Bollettino of the Italian Seismological Society. One advantage of late publication is that the results obtained at foreign observatories can be incorporated. The total number of earthquakes recorded in 1911 is about 800, of which one-fifth were of external origin. Of the latter, one in every three is described as a "distant earthquake," the position of its origin being apparently undetermined.

THE CHEIROPTERYGIUM IN AMPHIBIA.—Cope's genus Eryops, an early Labyrinthodont from the Permian of Texas and New Mexico, has been much discussed; but new light is now shed on it by a paper on its carpus, by W. K. Gregory, R. W. Miner, and G. K. Noble (Bull. Amer. Museum of Nat. Hist., vol. 48, p. 279, Oct. 17, 1923). The authors point to the primitive characters revealed by their research, and come to the far-reaching conclusion that, while all known fossil and existing amphibia have four digits in the manus, the most primitive forms had "a prepollex, five digits, and a postminimus" in the hand and similar features following a prehallux in the foot. The cheiropterygium was thus at least seven-rayed, with a tendency to reduction in the two marginal rays. It is pertinent to the recent discussion in NATURE as to the spelling of names derived from Greek that "cheiropterygium" in this paper is not only docked of its first "i," but, when broken at the end of a line, has the hyphen placed between the "p" and the "t."

CORAL-REEFS AND COASTAL PLATFORMS.—The papers on coral-reefs recently read by W. M. Davis before the National Academy of Sciences, Washington, D.C., and

referred to in NATURE (vol. 112, p. 460), have now been printed in the Proceedings of the Academy, vol. 9, pp. 292 and 296. The first deals with the marginal belts of coral seas, and it is pointed out that platforms of low-level abrasion are not known in association with the islands in the cooler zones of the Pacific region, while their depth below sea-level is not so uniform where they do occur as to satisfy Daly's theory of glacial control. If we accept glacial control, as Davis is quite willing to do, the evidence for subsidences of various degrees of magnitude, as put forward by Darwin, remains unimpaired. The second paper deals with the argument based on the uniformity of depth of the lagoons within adjacent atolls, and the author urges that level floors arise through infilling with detritus, which is spread out evenly by the wash of marine water.

PLANTS OF THE MIDDLE OLD RED SANDSTONE.—R. Kidston and W. H. Lang (Trans. R. Soc. Edin., vol. 53, pt. 2, p. 409, 1923) have investigated and completely described the remains of *Palæopitys Milleri* McNab, a plant originally found by Hugh Miller in beds containing *Coccosteus decipiens* near Cromarty. The authors confirm McNab's observation of bordered pits in the tracheides; but they are unable to decide, in the absence of any evidence as to the fructification, whether the genus should be referred to the gymnosperms or to the pteridophyta. In either case it is probably a distinctly archaic type. The same authors (*ibid.* p. 405) describe, and figure in a photographic plate, an extremely beautiful specimen of a plant with numerous stems spreading radially from a basal region. This was collected by G. Edward, and described by him in 1888. Edward placed it, with his other specimens from Scotland, in the Manchester Museum. Its locality is the Hill of Forss, Waas, Caithness, and it is of Middle Old Red Sandstone age. Sporangia set on short stalks occur; but G. Hickling, when on the staff of the University of Manchester, examined these for spores in vain. The authors now give a name to the plant, *Hicklingia Edwardi*, and seek its affinities in forms from the famous Rhynie cherts. It may be found, indeed, that Hicklingia extends our knowledge of the Rhyniaceæ.

DAILY AND SEASONAL VARIATIONS OF FOG.—The Meteorological Office of the Air Ministry has recently issued a Professional Note, vol. iii., No. 33, by Mr. F. Entwistle, on the above subject. Observations of fog from April 1920 to March 1922, a period of 2 years, were grouped for each month at Croydon, Lympne, Cranwell, and Dungeness for all hours of the day for which observations were made. A temporary increase in fog is shown in the early morning, a maximum being reached between one and two hours after sunrise. The summer maximum occurs about three hours earlier than the winter maximum. London smoke naturally somewhat affects the general visibility at Croydon, being influenced by the direction of the wind. Increase of fog in the early morning is said to be due probably to eddy motion mixing the layers of air near the surface. There is generally less fog during the afternoon, between midday and 6 P.M., than at any other time during daylight. For civil aviation it is considered desirable to arrange early morning services, before the maximum fog intensity is reached, while for ordinary services the middle of the day is the best time. In the winter season the larger proportion of slight fogs at Croydon are doubtless due to town influence. The thick fogs at Lympne are due chiefly to low cloud caused mainly by winds between south to south-west, so that the high ground of the North and South Downs is enveloped. The small amount of fog in winter at Dungeness seems to suggest that the best position for an aerodrome in winter is on the coast near sea level. In the summer months thick fog is frequent at Lympne and Dungeness; at Dungeness it is chiefly sea fog caused by the relatively warm air from off the land passing over the cooler sea.

FORMATION OF OZONE IN FLAMES.—Prof. Manchot, of Munich, communicated to the autumn congress of German Chemists at Jena a paper on the formation of ozone in flames. Parts of the flame which have a temperature of 750° C. only contain ozone, as can be proved by the silver reaction. The formation of ozone does not depend on the nature of the combustible gas, ozone being formed with hydrogen, carbon monoxide, methane, acetylene, cyanogen, etc. A flame of oxygen and hydrogen gas of 1300°-1900° C. contains about 0·1 per cent. of ozone, one of acetylene and oxygen of 2100° C. about 1 per cent. The latter blackens silver as if it were covered with soot. The thermal formation of ozone, and also the formation from hydrogen peroxide, are not possible, since ozone is also formed within a flame of perfectly dry carbon monoxide. It is probable that the ozone is formed by the action of electrons.

STANDARDISING PIEZO-ELECTRIC APPARATUS.—The extensive use of the piezo-electric properties of crystals in the measurement of transient pressures such as those due to an explosion makes it necessary to inquire into the validity of the method used to standardise the apparatus. It has generally been considered sufficient to apply a steady known pressure to the crystal and to note the effect. In a short paper in the November issue of the *Philosophical Magazine*, Dr. D. A. Keys, of the McGill University, Montreal, points out that as the standardisation experiment is an isothermal and the ordinary use an adiabatic one, there may be a difference in the piezo-electric constant of the crystal in the two cases. He examines this possibility in the case of tourmaline and comes to the conclusion that for that crystal the difference between the isothermal and adiabatic constants is only $\frac{1}{8}$ per cent.

CHANGES IN CRYSTALLINE STRUCTURE DUE TO TEMPERATURE.—Describing a simple arrangement for showing the alteration in the appearance, under the microscope, of a polished etched metal plate when heated, Herr H. Vogel, in the *Zeitschrift für Elektrochemie*, July 1, 1923, makes the following assumption as to the behaviour of the crystallites, of which the metal is built up. If two crystallites touch one another, the distance between the atoms in the boundary plane of one of them will, in general, be greater than in that of the other, and the forces holding the atoms in these respective planes will be different. When the metal is heated the first crystal will grow at the expense of the other, and as this takes place throughout the metal, the average size of the crystallites increases. It is possible for a crystallite to grow on one side and be consumed by another crystallite on another, so that the relation between the initial and the final structure may be complicated. The distance between atoms in the octohedron plane is greater than in the cube surfaces of the lattice, and it is still greater in the rhombic dodecahedron surfaces; thus when two crystals *A* and *C* touch with surfaces of the first and third kind, crystal *A* grows; while when *A* and *B* touch with surfaces of the first and second kind, crystal *B* grows and *A* is consumed.

CHEMICAL ANALYSIS BY X-RAYS.—In a paper read before the Deutschen Bunsen-Gesellschaft, Dr. D. Coster shows that the relations between the X-ray spectra of the different elements are so simple that, in

some respects, they are more useful for purposes of chemical analysis than ordinary luminous spectra (*Zeitschrift für Elektrochemie*, Aug. 1, 1923). An important advantage is the fact that the X-ray spectrum of an element is quite independent of the nature of the compound containing it which is examined. It is easy to detect the presence of an element when only 1 per cent. is present in a mixture of which not more than 1 mg. is available. Certain precautions are necessary in examining the X-ray spectra; although the number of lines for each element is comparatively limited, recent observations have shown the existence of a number of weaker lines; in addition to this, with the high voltages now generally used, not only the spectrum of the first order, but also those of higher orders appear. Slight impurities in the material of the anticathode, and in the substance under examination, also give their lines, so that there are often various possibilities to be considered before a given line can be explained. Not only the wave-length, but also the typical appearance of the suspected lines must be considered, as well as their relative intensity. By measuring photometrically the intensity of the spectral lines it is possible, in some cases, to obtain a quantitative estimate of the amount of an element present in a mixture. The method was used by Hevesy and the author in determining the amount of hafnium in zirconium minerals, and in investigating the chemical properties of the new element.

MAGNETIC RECORDS OF THE BRITISH ISLES.—The British Meteorological and Magnetic Year Book for 1920, published by the Meteorological Office, gives particulars of the diurnal variation of the principal meteorological elements at the Aberdeen, Eskdalemuir, Valencia, and Kew Observatories, with rainfall and sunshine data at Falmouth. The major portion of the volume, however, is devoted to terrestrial magnetism, especially at Eskdalemuir. Two pages are devoted to the diurnal variation of the potential gradient of atmospheric electricity. The results for Kew are based on 10 selected days a month free from negative potential. For Eskdalemuir there are two sets of data, the first derived like the Kew data from days free from negative potential, the second from days when negative potential occurred, although they were comparatively quiet. Taking the first class of days, the mean value of potential gradient at Eskdalemuir for summer (May to August) is practically identical with that at Kew. In the other seasons the Kew value is the greater, the excess being 9 per cent. for the equinoctial and 45 for the winter season. The difference is thus greatest in the months when fog—a recognised source of high potential—is most prevalent in the Thames valley. In addition to the regular tables of hourly values and diurnal inequalities of terrestrial magnetism, there is a discussion by Dr. Crichton Mitchell of different measures of daily magnetic activity at Eskdalemuir. All his criteria make 1920 a quieter year than 1919, and the same conclusion is drawn from the Kew data. There was, however, an exceptionally violent magnetic storm on March 22-23, 1920, during which the range of declination at Kew exceeded 2°. According to the table on p. 47, the fall of westerly declination from 1919 to 1920 was 9·9′ at Kew, 9·3′ at Valencia, and 9·0′ at Eskdalemuir. Inclination appeared to be practically stationary, while horizontal force showed a slight fall: 7γ at Eskdalemuir, 6γ at Kew, and 2γ at Valencia.

PHOTOGRAPHIC BLACKENING AND COLOURED LIGHT.—The second number (August) of the Bulletin of the Kiryu Technical College, Japan, consists of a lengthy and copiously illustrated paper by Tadaroku Ōtashiro on "The Relation between the Photographic Blackening and the Wave-length of Light." The author aims at expressing the blackening as a function of wave-length. For this purpose, different portions of a plate were exposed to different monochromatic lights of equal intensity, and in other cases the wave-length was kept constant and the intensity varied. Ordinary, orthochromatic, panchromatic, and ordinary plates "dyed" (bathed) with solutions of erythrosin, cyanin, and pinacyanol were employed. The author theoretically determines from the photo-electric viewpoint the actual relation between the blackening and the wave-length of the incident light, intensity being constant, and experimentally confirms it. "The general form of the function is quite independent of the kinds of plates, the strength of sensitising solutions, the time of bathing plates in a sensitising solution, the time of washing after bathing, the developers and the temperature during the time of development." The equation includes a "solarisation factor," and it is shown that there are "two maxima and one minimum effect of blackening on the continuous exposure to the most effective light . . . and the first maximum corresponds to the end of the period of over-exposure defined by Hurter and Driffield." He shows that there is a definite relation between the blackening and the strength of any dye solution. The author comes to other interesting conclusions, especially with regard to multiple exposures, and concludes "that the change when a plate has been acted on by white light should be essentially the same as that when the plate has been exposed to the most effective monochromatic rays of light."

ANALYSIS OF COAL.—The Fuel Research Board of the Department of Scientific and Industrial Research has issued through H.M. Stationery Office (1*s*. 6*d*. net), Pamphlet No. 2 on the "Physical and Chemical Survey of the National Coal Resources," consisting of an interim report on "Methods of Analysis of Coal." The Board has always had in view the physical and chemical survey of coal seams in the different mining areas—a task of great magnitude—and the policy pursued has been to encourage the formation of local committees of persons interested in the different coal fields to which the execution of the survey could be delegated. The results of such a survey would be greatly depreciated in value unless unity of analytical procedure were ensured, and accordingly the Board asked a committee on sampling and analysis of coal, presided over by Prof. T. Gray, to tabulate a scheme of coal analysis which could be uniformly adopted in the survey. This pamphlet records their efforts. The importance is even wider, for most commercial coal testing is confined to the proximate analysis—essentially empirical and demanding uniformity of practice if discrepant analyses and commercial friction are to be avoided. There is no doubt as to the value of the report in this direction. Although nothing of the kind has been done previously in Great Britain, the field has already been tilled by American fuel chemists—so well that in many cases the committee has been able to adopt their specification without serious modification. This applies particularly to the proximate analysis, and it is likely for that reason that many will find no difficulty in adopting the committee's recommendation. Several special and less common methods of coal assay and analysis are included which will add to the usefulness of the pamphlet. A statement of the permissible analytical error is sometimes given, and forms a welcome inclusion. In suggesting a form of report the committee employs a precision of stating results not quite consistent with its own tolerances. The important question of sampling is reserved to a second report.

School Geography.[1]

AMONG the valuable reports presented by committees of the British Association at the recent meeting at Liverpool was one on the teaching of geography. The committee included representatives of the two Sections of Geography and Educational Science, and was appointed to formulate suggestions for a syllabus for the teaching of geography both to matriculation standard and in advanced courses, to report upon the present position of the geographical training of teachers and to make recommendations thereon, and to report upon the practical working of Regulations issued by the Board of Education affecting the position of geography in training colleges and secondary schools.

That such a task was pressing, all who have the interests of secondary education at heart will readily admit, and it was well that such an independent body as a committee of the British Association should have undertaken it, for the report shows that the matter demanded urgent consideration and considered judgment. The committee consulted with heads of schools, teachers of geography, examination boards, and universities, and the report is full of suggestions expressed with marked clarity and cogency.

There can be no doubt that a reconstruction of the method and content of geography teaching along the lines of this report is a matter of urgency. The world of to-day is fundamentally different from the world of twenty years ago—or indeed of ten years ago. Life is much more complicated: not only is man more dependent for his social well-being on the activities of a vastly wider world, but his immediate social environment is a complex that requires for its comprehension a degree of reasoning power and scientific knowledge that the school curriculum of a few decades back failed to give. The study of classical literature may give one a deep insight into the life and thought of intellectual giants of the past, but the most pressing need of modern education is a curriculum that will bring before the pupil vividly, and in logical order, the controlling factors that are shaping and giving colour to the social world in which he has to live, and enable him to understand his environment, adjust himself to it, and adjust it to himself. "Geography as ordinarily understood," says the Report, "deals with the world of to-day: it occupies a special position in the study of human conditions at present obtaining in the various parts of the earth and the tendency of the changes taking place therein." Geography, therefore, must take a prominent position in any modern scheme of humane studies. Huxley spoke and wrote strenuously for a curriculum more fitted to help a citizen through the increasingly complicated life that he had to lead (it was the age of scientific discoveries), and his arguments hold with increased force to-day.

One charge that has been laid at the door of modern education is that the teaching of science, history, etc., is formal rather than human, that the courses maintain steady paths parallel to each other without converging at any point. What is wanted is a "core" subject which draws on the others for its facts, co-ordinates them, and thus, by correlation, gives each a fuller and richer meaning. This report shows how geography can be made to function as this core subject. Mackinder and Herbertson at Oxford, Lyde and Chisholm in London, demonstrated this new conception of geography twenty years ago, and the rapid strides made in recent years in the methods of geography teaching in secondary schools are due to the efforts of the young teachers whom they primarily inspired.

At the present time geography takes a place in the school curriculum on a level with history, and below that of classics, French, mathematics, and science. That more sympathy with the subject is not forthcoming is due, first, to the lack of trained geography teachers, whose enthusiasm and knowledge would compel greater recognition, and, secondly, to the fact that the inspectors of the Board of Education, being mainly interested in other subjects, have hitherto attached small importance to it.

For the lack of trained geography teachers one has to blame the Board of Education and the universities jointly. If the former had recognised the importance of the subject earlier and pressed for skilled geography teachers, it is reasonable to assume that the Universities would have established honours schools in geography, as they did, in like circumstances, in science and history; conversely, if the universities had taken the lead, the Board of Education would have been forced to give greater recognition to the subject, just as it has recently been induced to institute a geography group in advanced courses for secondary schools, through pressure from the council of the British Association.

That the geography group will justify its inclusion in the advanced course there can be no doubt, and when one considers the comparative merits of other subjects as a training for life and citizenship one wonders why its inclusion has been so long delayed. At the moment, however, the total lack of geographical scholarships at the universities is a factor that will operate very strongly against a pupil's choice of geography in the advanced course. A boy destined for a professional career to whom the other subject groups are perhaps more useful as a preliminary training for his university course, will naturally make his selection from them, the quantity of scholarships being a strong determining factor. The British Association might usefully direct its attention to this aspect of the problem.

On the other hand, the geography group presents attractions that should more than counterbalance this drawback. To begin with, parents whose boys are destined for city careers—clerical, secretarial, or commercial—have hitherto failed to see, and very naturally, how a two-years post-matriculation course in one of the existing subject-groups can help their sons in a degree at all commensurate with the expenditure of time and money involved. Added to that, many firms prefer to engage youths at the earlier age, and parents with sons of eighteen years have a difficulty in placing them. There is, however, a growing demand for young men who can produce evidence of specialised training for business life—a training, by the way, which so far only private institutions have endeavoured to provide, albeit fairly adequately and remuneratively. In the syllabuses for these examinations—Institute of Secretaries, etc.—geography occupies an important position, and it is also an important subject-group in the course for the B.Com. and B.Sc. (Econ.) degrees which represent the hall-mark, as it were, of vocational training for business life. For these examinations, the geography group is clearly the most useful, and cannot fail to prove attractive.

On turning to the Report itself one has to admit that

[1] Geography Teaching. Report of Committee (Prof. T. P. Nunn, Chairman; Mr. W. H. Barker, Secretary; Prof. H. J. Fleure, Mr. C. J. R. Howarth, Sir H. J. Mackinder, Prof. J. L. Myres, and Prof. J. F. Unstead, from Section E; Mr. G. H. J. Adlam, Mr. D. Berridge, Mr. C. E. Browne, Sir Richard Gregory, Mr. E. Sharwood Smith, Mr. E. R. Thomas, and Miss P. Wright, from Section L) (British Association, Burlington House, London, W.1.) Price 1s.; 10s. per doz.; 4l. per 100.

any attempt to summarise it must meet with failure: every aspect of the subject is dealt with in all its bearings, and there is scarcely a redundant word. The chapter on the aim and function of geography is particularly illuminating. Stress is laid on the fact that school geography must be the geography of geographers: not the mere learning of geographical data and results, but a training in the geographer's characteristic methods and principles of interpretation, and an assimilation of his characteristic point of view. This, we consider, is a most important statement, and postulates a trained geographer for the success of any geographical scheme.

Proceeding, the Report deals with the stages of school life, and outlines the principles which should guide in the formation of a syllabus of geographical instruction in secondary schools: a detailed syllabus for each year is appended. Stress is laid on the necessity of proceeding psychologically with young children and of adopting a logical order only as riper years are gradually reached. An outline scheme for each stage, including the advanced course, is given, and apart from its merits as a scheme it possesses special value for the teacher because the underlying aim of each step is made abundantly clear. Great importance is attached throughout to the value of direct observational work and to the construction and interpretation of maps and charts. "One important value of geography in education is the opportunity it gives to express thought in diagram and sketch no less than in words." This sentence should be constantly in the mind of every geography teacher. A highly controversial dictum is that formal lessons in physical geography should not precede the advanced course: incidental teaching of most subjects is apt to be disjointed and incoherent, and the experience of many examiners at matriculation proves that geography is no exception to the rule.

The suggestions for a scheme of study in the advanced courses are excellent. Emphasis is laid on the economic conditions of the modern world, and it is suggested that a small area be selected for comprehensive analysis and synthesis. Correlation of the subsidiary subjects is of course taken for granted.

The chapter on the relation of geography to science and history cannot fail to impress upon the most uninformed reader what a tremendous range of knowledge, not only of topographical facts, but of such allied subjects as physics, geology, botany, biology, history, and economics, is demanded of the geography teacher called upon to carry out such a modern geography course. It is pointed out that it is not his duty to teach these subjects; nevertheless, to correlate them he must know them. The Report proceeds to summarise the facilities offered at the universities for the training of geography teachers. Practically all the universities have established honours schools of geography—mostly in the Faculty of Arts—and there is general agreement that the subject of study should include geology, history, and political economy at least to intermediate standard. The number of trained geographers leaving the universities is steadily increasing, and "the result," to quote the Report, "undoubtedly will be not only a more thorough and scientific study of the subject, but a general increase of accurate knowledge of the Empire and the rest of the world, which will affect the every-day life of the community through its economic and political relationships with other countries."

J. MARTIN.

Transport and its Indebtedness to Science.

IN the Engineering Section of the British Association at Liverpool, one whole morning was devoted to the subject of transport, the other sessions being occupied by papers—many of great interest—on very diverse branches of engineering. The president of the Section, Sir Henry Fowler, was chief mechanical engineer of the Midland Railway, and he took as the subject of his address "Transport and its Indebtedness to Science." extracts from which were published in NATURE of September 29, p. 474. He was followed by Mr. A. E. Berriman, the chief engineer of the Daimler Co.; Col. O'Brien, the electrical engineer of the L.M.S. Railway; Major-General Sir Sefton Brancker, of the Air Force; and Mr. A. T. Wall, of Messrs. Wall, Maas and Co., naval architects, of Liverpool.

Each speaker dealt with the branch of the subject with which he was specially identified. As the president pointed out, there is probably no city in the world more dependent on transport than Liverpool, and no city which has done such pioneer service in its development. Whether one considers canals, steam railways, electric railways, or motor traffic, one finds that Liverpool was in the forefront of development, and it was a happy thought of the president, a non-academic engineer, engaged in practice, to take as his thesis that progress in all means of transport has been based upon scientific investigation, to predict that this will be even more marked in the future, to insist on the interdependence of science and engineering, and the necessity for the terms scientific and practical being synonymous. In concluding his address Sir Henry said that "one would like to feel that the meetings of the British Association were more generally used as the occasion on which the scientist and the engineer would meet in larger numbers."

Mr. Berriman gave a very valuable review of the position of road transport. He was somewhat scathing in his criticism of the railway companies' lack of faith in the railway principle, as shown by their proposal to operate their own road vehicles for through traffic. He maintained that, since the tractive effort on rails is only 5 lb. per ton against 60 lb. per ton on average roads, it is technically a sheer waste of energy to transport by road between distant points that are rail-connected. Mr. Berriman also dealt with the question of traffic regulation, and maintained that the warning signs on roads have been put up on a wrong principle and are consequently largely disregarded; in his view, every crossing should have a primary and a secondary stream of traffic, the former having priority and not being expected to slow down; drivers on the secondary roads would be warned to go dead slow on approaching a crossing.

Col. O'Brien's paper, as was to be expected, dealt largely with the question of electrification, which is really an economic one; there are no engineering difficulties. "A very slight lowering of rates of interest and in the price of the material required for such electrification is likely to produce a very considerable development in future." "There is no doubt that the electrification of any main line containing gradients of 1 in 300 or greater and averaging over 2 trains per hour in either direction would at least involve no loss of any kind to the company, while the indirect advantage to both the railway company and the electrical industry of the country would be very large."

Sir Sefton Brancker's breezy optimism with regard to aerial transport caused some amusement. He was fortunate in delivering his paper before the news came

through of the London-Manchester air-mail disaster, which occurred on the same day, more especially as he emphasised the safety, comfort, and exhilaration of flying. Under present conditions, he stated, the cost per passenger-mile could not be reduced below 8½ pence, whilst the highest fare obtainable was 6 pence per mile, leaving 2½ pence to be covered by subsidy. Freight costs per ton-mile he placed at 3*s*. 6*d*. to 5*s*. The only difficulty in the way of development, beyond the economic one, is the difficulty and danger of flying under conditions of poor visibility. The economic range for airships is more than 1000 miles, whilst that of aeroplanes is rarely more than 300 miles, hence the two are complementary and should develop together.

In dealing with sea transport, Mr. Wall emphasised the need for scientific research, especially in metallurgy, but he stated that a very hopeful sign for future progress is to be found in the increasing number of scientific experiments on a large scale carried out by shipbuilders and engineers and sometimes by shipowners. "Experience may, and often does, precede the scientific treatment, but progress is much more rapid when science is used to guide experience."

The Future of the Imperial Institute.

A WHITE Paper (Cmd. 1997), issued on November 22, contains the report of the Committee appointed by the Secretary of State for the Colonies to inquire into the affairs of the Imperial Institute, consequent upon financial difficulties, and also the resolutions passed by the Imperial Economic Conference on considering that report. An article commenting upon the recently published report on the work of the Institute appeared in NATURE of November 10, p. 677.

The Committee considers that the collection and dissemination of information in regard to raw materials is the most important work carried out by the Imperial Institute at the present time. It recommends that the Imperial Institute should continue to function at South Kensington as a clearing-house of intelligence and information, equipped with laboratories for the preliminary analysis and investigation of raw materials, and maintaining sample rooms illustrative of Empire raw materials. The collections in the Public Exhibition Galleries, although recognised as possessing educational value, are not regarded as essential to the future work of the Institute, and it is recommended that the collections be discontinued, though the Committee is by no means unanimous on this point, as is shown by a note appended to the report. It is proposed, however, that a representative selection of Empire products should be made for the purpose of a travelling exhibition of an educational character, and that the organisation of travelling exhibitions of the staple products of the Colonies and Protectorates in appropriate trade centres should be considered.

The Committee proposes reforms in the management of the Institute, suggesting that it should be made responsible to the Department of Overseas Trade. After the completion of these reforms, the Committee recommends the amalgamation of the Imperial Mineral Resources Bureau and the Imperial Institute. The annual expenditure of the reformed Institute (including the Imperial Mineral Resources Bureau) is estimated at about 40,000*l*., to be provided on a contributory basis. Failing the provision of this sum, which is regarded as a condition precedent to the Committee's recommendations, an alternative scheme is proposed to retain the essential functions of the present Institute, *i.e.* of an intelligence and information bureau.

The Committee expresses appreciation of the valuable services rendered by the Director, Prof. W. R. Dunstan, F.R.S., to the Institute and to the Empire during the long period of his connexion with the Institute, and pays a tribute to the work of the technical staff. Prof. Dunstan was appointed Director in 1903, when he had already been for eight years concerned with the work of the Institute.

The report was submitted by H.M. Government to the Imperial Economic Conference, with the proposal that the main scheme of the Committee should be adopted and the necessary funds guaranteed for a term of years. On the recommendation of a Committee appointed by the Conference, under the chairmanship of Lord Salisbury, the main scheme was adopted, subject to certain modifications not affecting the principles involved.

In the *Times* of November 23 it was announced that, in view of the changes in the constitution of the Imperial Institute which have been decided upon, Prof. W. R. Dunstan will resign the directorship of the Institute next month.

University and Educational Intelligence.

BIRMINGHAM.—Mr. Henry Barber, of Culham Court, Henley-on-Thames, who was formerly a solicitor in Birmingham, has given 20,000*l*. for the endowment of a chair of law in the University.

Mr. H. P. Dean has been appointed assistant lecturer in mechanical engineering, and Mr. M. C. Johnson demonstrator in physics.

It is hoped that Prof. F. C. Lea, who has recently resigned the chair of civil engineering on being appointed head of the Engineering Department of the University of Sheffield, will continue to discharge the duties attaching to the chair for the rest of the current session.

CAMBRIDGE.—The degree of Master of Arts, *honoris causa*, is to be conferred upon Mr. J. B. Buxton, professor of animal pathology.

Prof. T. B. Wood has been reappointed by the University as a Member of the Council of the National Institute of Agricultural Botany.

The Frazer lecture is to be delivered by the Rev. John Roscoe on "Immigrants and their Influence in the Lake Region of Central Africa."

A syndicate has been appointed to obtain plans and estimates for extending the School of Agriculture and constructing a building for the Animal Diseases Institute.

GLASGOW.—Prof. W. J. Goudie, James Watt professor of the theory and practice of heat engines, has given 500*l*. to found an "Agnes Rhind" bursary in memory of his mother, for a third-year student of mechanical engineering who has the best class-record in his subject.

Mr. A. Henderson Bishop and his son have offered to the University, for the new Zoological Museum, the great collection of Coleoptera and Lepidoptera made by his late father, Thomas G. Bishop, of Dalmore, Helensburgh. The collection is contained in 18 cabinets enclosing 700 separate boxes, and numbers some thirty or forty thousand specimens. All are beautifully mounted, labelled, systematically arranged, and in perfect condition. The University has had no difficulty in accepting the splendid gift, with the condition that it shall be accessible for consultation by qualified entomologists, whether they belong to the University or not.

The University Court has submitted for the approval of His Majesty in Council an ordinance establishing the new honours degree of B.Sc. in architecture. The course will extend over four years, and the necessary instruction will be furnished partly within the University, and partly in the School of Architecture, conducted under the joint direction of the Royal Technical College and the Glasgow School of Art.

The Court has also, under powers given by a recent Act of Parliament, approved an ordinance for the superannuation and pensioning, under the Federated System for Universities, of principals and professors hereafter appointed. Principals will retire at seventy and professors at sixty-five. Under the System, years of service as assistant or lecturer, in this or other Universities, may be counted as pensionable service by a professor.

LEEDS.—The Hull Education Committee has decided to make a grant of 800*l.* to the University for the financial year 1924–25.

The title of emeritus professor has been conferred upon Dr. Arthur Smithells, who recently retired from the chair of chemistry, on the grounds of intellectual distinction and of long and meritorious service to the University.

LONDON.—Mr. W. E. Le Gros Clark has been appointed as from Jan. 1, 1924, to the newly instituted readership in anatomy tenable at St. Bartholomew's Hospital Medical College. During 1919–20, Mr. Le Gros Clark was demonstrator in anatomy at St. Thomas's Hospital, and since 1920 has been Principal Medical Officer at Sarawak, Borneo. He has published papers entitled "Series of Ancient Eskimo Skulls," and "On the Pacchionian Bodies."

The following doctorates have been conferred: *D.Sc. in Embryology*, Miss Margaret Tribe, an internal student (University and King's Colleges) for a thesis entitled "The Development of the Hepatic Venous System and the Postcaval Vein in the Marsupialia"; *D.Sc.* (*Economics*), Mr. B. R. Ambedkar, an internal student (London School of Economics), for a thesis entitled "The Problem of the Rupee."

It was resolved that the Physiological Laboratory Library should be kept together as part of the University Library, and be developed in connexion therewith as a memorial to the late Prof. A. D. Waller.

Three free public lectures on "Some Chapters in the Recent Development of the Theory of Electrolytic Dissociation" will be given by Prof. J. N. Brönsted, of the University of Copenhagen, at University College, on December 10, 12, and 14, at 5.30 o'clock.

A course of five free public lectures on "The Influence of Environment on the Life of Bacteria" will be given by Mr. F. W. Twort, at the Royal College of Surgeons of England on December 11 13, 17, 18, and 19, at 4 o'clock.

THE use of mental alertness tests for prospective university and college students is strongly advocated by President W. D. Scott, of North-western University. All institutions of higher education should, he considers, have a "personal director" to perform "an educational function similar to that of the diagnostician in medicine. The giving of mental alertness tests will be as much a matter of the routine with such a director as is the use of the clinical thermometer by the diagnostician in medicine."

THE University College of South Wales and Monmouthshire, Cardiff, issued an appeal in December 1921 for the sum of 250,000*l.* for purposes exclusive of those connected with the development of the Medical School, and particularly with the view of the erection, equipment, and maintenance of laboratories for the Departments of Physics and Chemistry. For these purposes 50,000*l.* had been subscribed by Lord Glanely, and 10,574*l.* by other subscribers, making a total, with accrued interest (12,000*l.*), of 72,574*l.*, part of this sum having been received before the appeal in December 1921 was issued. At a luncheon given by Lord Plymouth on November 20, further gifts amounting to 56,700*l.* were announced, thus bringing the total sum realised by the appeal up to 129,274*l.* It is of interest to note that the foundations of the buildings are just being completed at a cost of approximately 15,000*l.*, and that the cost of the superstructure to accommodate these two departments, based on a recent estimate, is 144,000*l.*; this figure is, of course, exclusive of the cost of equipment and maintenance.

THE second annual report of the Education Statistics branch of the Dominion Bureau of Statistics of Canada gives the total number of university students in 1921–22, excluding preparatory, summer, and other short courses and correspondence courses, as 23,800. Included among these are: undergraduates in arts and pure science, 6859 men and 3872 women; graduates, 712 and 300; medical, 3134 and 154; engineering and applied science, 2513 and 3; music, 278 and 717; theology, 854 and 11. The teaching staffs numbered 3137, including 307 women. The total assets of the universities amounted to 67 million dollars, including endowments, 26 million, land and buildings, 27, and scientific equipment, 5 million. Incomes amounted to 9½ million, and were derived from: investments, 1½ million; government and municipal grants, 4½ million; fees, 2 million; and other sources, 1½ million.

EDUCATIONAL development and scientific research are not figuring largely in the election pledges of the several political parties and the speeches of their leaders, except those of the Labour party, and this party's promises are subject to considerable discount in view of the disproportion between the stupendous cost of carrying out its programme, including "the abolition of the slums," etc., and the resources that would be at the disposal of a Labour party government. This disproportion would necessitate the scrapping of a large part of the programme. The Liberal party manifesto contains on the subject of education only platitudes, but Mr. Asquith promised the Women's National Liberal Federation "smaller classes, provision of free places in secondary schools, State scholarships for universities, more adequate training for teachers," and "the encouragement and fuller development of adult education," while Lord Grey, when speaking on adult education on November 23, is reported to have said, "What was wanted was not State control but State assistance. For the small sum of 500,000*l.* they would get a better return than in any other way." It is part of the Conservative election policy to concentrate attention on the main issues of unemployment and protection, and the party leaders are accordingly saying little about education. Mr. Baldwin's speech of November 19 showed that he is alive to the supreme importance of the evils of juvenile unemployment, but does not suggest that he believes in retention in school as an appropriate remedy at the present time. In his speech at Reading on November 21 he referred to the importance of agricultural research and education as a permanent part of the life of the country, and remarked that the Government, recognising this, has given 1,000,000*l.* for promoting them.

Societies and Academies.

LONDON.

Royal Society, November 22.—F. **Simeon**: The carbon arc spectrum in the extreme ultra-violet—II. The spectrum of the carbon arc in vacuum extends as far in the extreme ultra-violet as that of the spark, with the exception of a very faint line at 360·5 Å, and about 25 lines have been added to the arc spectrum as already recorded. The L series of carbon can be excited by a potential of between 30 and 40 volts. A number of lines in the carbon spectrum are probably true "arc" lines. Providing the grating will give radiation in the short-wave region, the same technique suffices to photograph the spectrum from 1850 Å to 370 Å.—H. J. **Gough** and D. **Hanson**: The behaviour of metals subjected to repeated stresses. The effect of static and alternating stresses on the microstructure of metals was examined, the main object of the research being to determine whether the crystalline structure of a metal can be affected when subjected to ranges of stress *less* than the limiting range of stress (fatigue range). With "Armco" iron, mild steel, and copper, crystalline "slip" occurs at ranges of stress considerably less than the fatigue range. It is suggested that metals can be "strain-hardened" under the action of alternating stresses, as well as under static stresses; fracture occurs, in a metal subjected to alternating stresses, when a certain limiting strain for the material is exceeded.—W. **Sucksmith** and L. F. **Bates**: On a null method of measuring the gyro-magnetic ratio. A new method is described of determining the gyro-magnetic ratio; as in the ordinary resonance method, the specimen, suspended vertically by a fine wire along the axis of a helix, is magnetised by an alternating current of the same frequency as the natural frequency of the system; but the resulting resonance amplitude is reduced to zero by a series of impulses timed to oppose those due to gyro-magnetic effect. As no measurement of magnetic moment, frequency, or damping is involved, a considerable gain in precision is obtained. The method is independent of time-lag in magnetisation, and so can be applied to Heusler alloys. The following mean values of the ratio obtained for iron, nickel and Heusler alloys were obtained: Iron 0·503; nickel 0·501; Heusler alloys 0·501.—J. H. **Shaxby**: Studies in Brownian movement.—II. The determination of Avogadro's number from observations on bacteria (cocci). A determination of Avogadro's number by measuring the displacements, due to their Brownian movements, of small spheres suspended in water was carried out with cocci. Their surfaces may be supposed to be "wetted" so that there is no slip between the water immediately adjacent and the spheres themselves, and the resistance which might arise from electrical sources depending on slip is avoided. The value of N thus found, from the large number of observations made on *Staphylococcus albus*, is $6{\cdot}08 \times 10^{23}$.—H. **Hartridge** and F. J. W. **Roughton**: The kinetics of Hæmoglobin.—II.—A. F. A. **Young**: The thermionic and photo-electric properties of the electro-positive metals.—O. F. T. **Roberts**: The theoretical scattering of smoke in a turbulent atmosphere.

Zoological Society, November 6.—Sir S. F. Harmer, vice-president, in the chair.—A. **Loveridge**: (1) East African birds (chiefly nesting-habits and endo-parasites), collected 1920–1923. (2) East African snakes, collected 1918–1923. (3) East African tortoises, collected 1921–1923, with description of a new species of soft land-tortoise. (4) East African lizards, collected 1920–1923, with descriptions of two new races of *Agama lionotus* Blgr. (5) East African insects, collected 1915–1922.—I. G. S. **Montagu**: On some mammals from Jugo-Slavia.—I. G. S. **Montagu** and Miss Grace **Pickford**: The Guernsey Crocidura.—G. H. **Goldfinch**: Notes on the African crested rat (*Lophiomys imhausi*).—H. G. **Jackson**: A revision of the isopod genus Ligidium Brandt (Crustacea).—S. S. **Flower**: On additions to the snake fauna of Egypt.—S. **Hirst**: On some new or little-known species of Acari.—C. F. **Sonntag**: On the pelvic muscles and generative organs of the male chimpanzee.

Geological Society, November 7.—Prof. A. C. Seward, president, in the chair.—R. W. **Hooley**: On the skeleton of *Iguanodon atherfieldensis* sp. nov., from the Wealden shales of Atherfield (Isle of Wight). The nearly complete specimen was obtained in 1914. There is an essential similarity as regards the relationship of the bones of the skull to the American predentate dinosaurs. Grooves on the premaxillæ prove that the tip of the snout was sheathed in horn. The quadrate bone articulated freely with the squamosal, and there was a fore-and-aft action of the mandible. The tongue must have been extremely narrow, with a broad tip, and prehensile. The neck was habitually flexed, the point of greatest arching being at the ninth cervical. All the pre-sacral vertebræ carry ribs. The sacrum comprises six fused vertebræ. The ossified elements of the left carpus were preserved. The integument was very thin and covered with small tubercles, interspersed with groups of large polygonal plates, as in Trachodon. The estimated length of the skeleton is 6·3 m. (about 21·6 feet). *I. atherfieldensis* is distinct from any known species, and the skull and bones are intermediate in form between that of *I. mantelli* and *I. bernissartensis*.—S. H. **Reynolds**: The igneous rocks of the Tortworth inlier. The igneous rocks occur in two bands, the upper of which is associated with calcareous tuffs containing Silurian fossils and is doubtless lava. The lower band appears to be intrusive. The rocks of the two bands have several features in common. The rocks of the lower band are characterised by the presence of pseudomorphs after olivine, and may be grouped as olivine-enstatite-basalts. Those of the upper band are devoid of olivine, and consist of pyroxene-andesite. They are characterised by the presence of highly corroded xenocrysts of quartz and felspar, and by the occurrence of variolitic and glassy patches in the ground-mass.

Linnean Society, November 15.—Dr. A. B. Rendle, president, in the chair.—E. J. **Salisbury**: The relation of earthworms to soil reaction. Natural undisturbed soils usually show a definite gradient with respect to organic material and acidity, both of which tend to attain a maximum at the surface. Analyses of worm casts show that these have a high organic content indicating their origin from the superficial and most acid layers. Comparison of the hydrogen ion concentration of worm casts and surface soil shows that acid soils tend to be rendered much less acid by passage through the worm. Markedly alkaline soils may similarly be rendered less alkaline. The former action may be attributed to the calciferous glands. The greatest frequency of worms is met with in soils with approximately neutral reaction.—Miss E. M. **Blackwell**: The flora of Solomon's Pools. Solomon's Pools lie about six miles south of Jerusalem, 2616 feet above sea level, in a valley, Wâdy Artâs, which runs east and west between low hills of red-brown ferruginous earth through which limestone bosses project. The pools, three in number, are obviously artificial. The middle and lowest pools have been

cleaned and partly repaired, and pumping plants erected. In July 1923 the uppermost pool had already dried up. The clear water of the pools supported a luxuriant growth of *Chara connivens* in the lowest and *C. contraria* and *C. fragilis* in the middle pool, forming almost a pure society. In the middle pool there was in addition an aquatic grass and a new filamentous algæ, desmids and diatoms. In the lowest, *Potamogeton flabellatus* var. *scoparius* was flowering and fruiting, almost rivalling the Chara for dominance. At the deeper end of the lower pool were tufts of *Riella helicophylla*, their spirally coiled thalli floating out into the water in loose rosettes at a considerable depth. Where the floor of the west side of the lowest pool was exposed on account of the slope, the drying mud was covered with bleached plants of Chara, and growing up through it *Typha latifolia*, *Scirpus maritimus*, *Heleocharis palustris*, and *Euphorbia aleppica*. The flora is similar to that of the "slacks" in the Lancashire sand-dunes. The waters in both cases have a high percentage of dissolved solids, especially chlorides and carbonates.—R. E. **Chapman**: The carbohydrate enzymes of certain Monocotyledons. The material used was the green foliage leaves of the snowdrop, the onion, and the leek, with a starch-forming plant, a common dock, for purposes of comparison. The leaves were air-dried, powdered, and added to dilute solutions of starch, dextrine, maltose, cane sugar, and amygdalin, using qualitative tests and changes in the rotation of polarised light for the detection of hydrolysis. Toluol was used as antiseptic and the solutions incubated at 39° C. The results indicated that of the five carbohydrate enzymes—amylase, dextrinase, maltase, invertase, and emulsin—maltase and emulsin were absent from the snowdrop, dextrinase from the onion, amylase from the leek, but all five were present in the dock. The formation of starch in the parenchyma cells of the three Monocotyledons is thus prevented, because the necessary set of enzymes is incomplete. In certain cases (*e.g.* Galanthus and Narcissus) starch is always present in the guard cells, and prolonged starvation in darkness does not cause the disappearance of this starch. In the snowdrop the adult leaf has starch in the guard cells together probably with diastase but not maltase, so that hydrolysis can proceed only to maltose, and the system, starch $\rightleftarrows$ maltose catalysed by diastase, may be part of the mechanism controlling the opening or closing of the stomata.

Royal Meteorological Society, November 21.—Dr. C. Chree, president, in the chair.—L. F. **Richardson**: Attempts to measure air temperature by shooting spheres upward. Whilst making observations of the upper wind by shooting polished steel spheres upwards in a direction slightly inclined from the vertical so that the wind caused the returning sphere to fall quite close to the gun, the time of absence of the sphere can afford a measure of a mean temperature of the air through which it has passed. The upper air temperature was measured from the mean of six shots with a standard error of 1° C. at sunrise in calms or light winds. On such occasions, there is often a layer of cold stagnant air near the ground, so that the temperature in the Stevenson screen is a poor guide to the temperature at 70 metres. Here the projectile may be useful.—S. N. **Sen**: On the distribution of air density over the globe. Thirteen charts of "isopycnics" or lines of equal air density are drawn depicting the density distribution at the various levels. The air density at the 8 km. level all over the globe is illustrated by the chart for that level. The air density is controlled by temperature up to a height of about 8 km. and by pressure above that level. The name "thermosphere" is proposed to denote the atmospheric shell in which temperature is the controlling factor, and "barosphere" that in which pressure is the controlling factor. On the average, when the temperature is rising in one hemisphere there is a diminution of air density in the thermosphere and an increase in the barosphere, and the effect of diminishing temperature in the other hemisphere is the reverse. These opposite thermometric tendencies create a mechanism for the automatic breaking down of the stratification of the free atmosphere. This mechanism, or the "convective cycle" which is postulated to be established between the North and South poles, also affords a means for the interchange of air between the two hemispheres.

PARIS.

Academy of Sciences, November 5.—M. Albin Haller in the chair.—The president announced the death of M. Arnaud de Gramont, member of the section of free Academicians.—G. **Ferrie**, R. **Jouaust**, and R. **Mesny**: The amplification of the current from photo-electric cells and its applications. The currents produced by photo-electric cells are very small, of the order of 10^{-10} amperes. These can be magnified by the use of a three-electrode lamp as a relay without inertia. A magnification of 1000 has been obtained with a lamp of the dimensions of an ordinary receiving lamp; with an emission lamp of 50 watts working under 1000 volts, an amplification of 10,000 was obtained. A more complicated method, based on the conversion of the photo-electric current into an alternating current and transforming up, is described: this permits of amplifications up to the order of 10^6.—J. **Costantin**: The Pleurotus of the blue thistle of the Vanoise.—L. **Maquenne**: The theory of chlorophyll synthesis. A discussion of the Boussingault-Bæyer theory of chlorophyll synthesis of the carbohydrates. An alternative hypothesis is put forward in which quadrivalent magnesium is assumed. Carbonic acid is assumed to be taken up by direct addition to the :N–Mg–N: groups; the assumption of the intermediate formation of formaldehyde is unnecessary.—Andre **Bloch**: Paratactic congruences and Dupin's cyclid.—M. **Angelesco**: The generating functions of Hermite polynomials.—Emile **Borel**: Remarks on the preceding communication.—J. **Wolff**: Non-measurable ensembles.—N. **Gunther**: A problem of hydrodynamics.—A. **Foch**: The dynamicable similitude of an aspiration tube and its model. A discussion of the application of aspiration tubes to turbines, with especial consideration to the formulæ governing the relations between models and the full-size turbine.—Louis **Breguet**: The calculation of the weight of combustible consumed by an aeroplane during ascent. The formulæ for the effective range of an aeroplane have been worked out on the assumption of horizontal flight. Modifications are introduced into the Rateau equation showing the variations in petrol consumption during ascent and descent.—C. **Chéneveau** and J. **Callame**: A micropalmer. A description, with diagram, of an instrument designed for measuring the thickness of thin sheets or plates of rubber or other plastic material, with an accuracy of 0·001 mm.—E. **Brylinski**. Michelson's experiment.—Mlle. Berthe **Perrette**: An arrangement of the electric arc in a vacuum allowing the spectra of metals to be obtained with very small quantities of material. The cathode is formed of tungsten (or tungsten-thorium) wire, and the anode of a tungsten plate in which a small cavity is drilled to hold the material. The cathode is raised to a high temperature by a current of 4 to 5 amperes from accumulators.

The voltage between anode and cathode is 110 volts, the whole working in a vacuum of about 0·002 mm. of mercury. The lines of the spectrum given by this apparatus are very fine and give high orders of interference, and less than 0·05 gm. of material can be taken.—N. **Perrokis**: Study on the stability, in the presence of water, of a certain number of binary mixtures. Two groups of pairs of miscible liquids were studied: ethyl alcohol with phenyl ether, benzene, *o*-cresol, phenol; benzene, with various alcohols. The figure determined was the quantity of water necessary to produce two layers when added to 100 gm. of the binary mixture. Some results are given in a diagram.—N. D. **Zelinsky**: The polymerisation of acetylene by contact.—B. Darder **Pericás**: The tectonic of the neighbourhood of Sineu and of Ping de Sant Onafre (Island of Majorca).—Jules **Wolff**: The conditions favourable or prejudicial to the germination of the seeds of orchids and to the development of the seedlings. The seeds of the orchid can be germinated aseptically in a rich medium, and in the absence of fungi. The seedling can then be planted out on mycelium, and symbiosis is established normally. The presence of the fungus at the commencement of the germination is not only unnecessary, but may prove injurious to the seedlings.—J. **Dauvergne** and Mlle. **Weil**: The culture of plants in a sterile liquid medium. A development of Mazé method, the seeds being supported on perforated aluminium plates.—C. **Fromageot**: Assimilation in the green cells and the structure of the protoplasm.—Lucien **Daniel** and Jean **Ripert**: Researches on the variations of chemical action in grafted plants.—A. **Maige**: The metabolism of the sugars in the cell and amylogenesis. It results from the experiments described that even in cells where amylogenesis requires only a very low concentration in sugar, the essential phenomena of cellular metabolism which assure the continuity of life and growth of the living material may be effected at still lower concentrations.—**Chavastelon** and J. **Luquet**: Contribution to the study of the edaphic conditions of the pastoral associations in the massif of Mont-Dore.—Emile F. **Terroine**, R. **Bonnet**, and P. H. **Joëssel**: The composition of seeds and yield of energy in germination.—Mme. L. **Randoin** and H. **Simonnet**: The influence of the nature and quantity of the glucides present in a ration deprived of factor B on the precocity of appearance of the accidents of polyneuritis in birds. In constructing an artificial diet for experiments on diet deficiency, it is very important to take into account the digestive utilisation of each of the food materials composing the diet. The experiments give some support to the idea that the magnitude of the factor B requirement is not absolute but is relative and in direct relation with the degree of utilisation of one or several elements of a ration, and, in particular, with the quantity of sugars assimilated.—Paul **Voukassovitch**: The biology of two parasitic Hymenoptera of Pyralis of the vine.—Marc **Bridel** and Jean **Charpentier**: The biochemical characterisation of galactose in a mixture containing galactose and arabinose. Galactose can be detected in the presence of arabinose, by the action of emulsin in 70 per cent. alcoholic solution. The β-ethylgalactoside can be obtained in the crystalline state, suitable for identification.—André **Lwoff**: A new free ciliated Infusorian, *Stephanopogon Mesnili*. Its taxonomic importance.—Mlle. M. **Gauthier**: The development of the egg and embryo of Cyathocephalus, a parasite of the trout.—Henri **Stassano**: The double rôle of the heating plates in apparatus for the sterilisation of liquids in continuous circulation.

WASHINGTON, D.C.

National Academy of Sciences (Proc., Vol. 9, No. 10, October).—L. B. **Loeb**: The mobilities of electrons in air. The mobilities of electrons in air at pressures of 41, 51·5, 60, 66·5, and 92 mm. of mercury were measured in an ion chamber. A constant field superposed on the actuating alternating field was used to neutralise the field produced by the accumulation of ions. Plotting mobility constant (mobility reduced to atmospheric pressure) against critical voltage (static voltmeter) minus retarding potential, curves are obtained showing breaks probably due to attachment of electrons to molecules. Expressions are given for the mobility constants for the distance separating the plates in the ion chamber (1·955 cm.).—P. W. **Bridgman**: The thermal conductivity of liquids. A radial flow apparatus with the liquid between two concentric metal cylinders was used. The inner cylinder was the source of heat, and conductivities were measured at 30° C. and 75° C., and at atmospheric pressure, 6000 kg./cm.^{2} and 12,000 kg./cm.^{2} pressures. Water and fourteen organic liquids were used. Conductivity decreases with rise of temperature, at atmospheric pressure, except for water. At constant temperature, it rises with increasing pressure; at 12,000 kg./cm.^{2}, the increase is from 1·5 to 2·7 fold, the more compressible liquids showing the greater increase. The absolute conductivities at 30° C. range from 0·000505 (methyl alcohol) to 0·000265 (ethyl iodide); for water the value given is 0·00144. A formula connecting the conductivity, gas constant, velocity of sound in the liquid, and the mean distance of separation of the centres of the molecules of the liquid, is derived. The high value for water is referred to its low compressibility and the closeness of the centres of its molecules.—E. S. **King**: (1) Photovisual magnitudes of one hundred bright stars. The Draper 8-inch refractor was used and Cramer Isochromatic Instantaneous plates with a yellow filter. All the plates were taken 1·25 cm. or more outside the focus. Results for Ao stars agree with the photometric magnitudes. In general, the photovisual colour index is greater than the visual or photometric index. (2) Revised magnitudes and colour indices of the planets (*v.* NATURE, November 24, p. 769).—R. H. **Bowen**: The origin of secretory granules. Nassonov, working on Salamander glands, showed that early secretory granules are associated with the Golgi apparatus of cells and afterwards have caps or girdles of Golgi material. These results are confirmed. It is suggested that the acrosome of the animal sperm, which arises as a vesicle in close connexion with the Golgi apparatus, and from which the Golgi apparatus is finally separated, is a secretory granule applied to the head of the mature sperm, whence its substance may be released at fertilisation. Referred to other gland cells, the hypothesis suggests that there is direct relation between the Golgi cells and chemical synthesis, and in particular enzyme formation.—R. R. **Huestis**: The heredity of microscopic hair characters in Peromyscus. Two geographic races (coast- and desert-race) of two species of deer-mouse were used. Each coast-race differed from the corresponding desert-race in much the same way. It is concluded that the differences observed between contrasted races have been evolved in the wild state, and some at least are the effect of environment. The results indicate Mendelian inheritance of multiple factors.—C. G. **Abbot**: Preliminary note on the variation of the sun's visible features associated with variations of solar radiation (*v.* NATURE, November 17, p. 738).

Official Publications Received.

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards, No. 475: Visibility of Radiant Energy. By K. S. Gibson and E. P. T. Tyndall. Pp. 131-191. 15 cents. Technologic Papers of the Bureau of Standards, No. 242: Detector for Water Vapor in Closed Pipes. By E. R. Weaver and P. G. Ledig. Pp. 637-644. 5 cents. (Washington: Government Printing Office.)

Department of the Interior: Bureau of Education. Bulletin, 1923, No. 45: Work of the Bureau of Education for the Natives of Alaska. By William Hamilton. Pp. 4. (Washington: Government Printing Office.) 5 cents.

U.S. Department of Agriculture. Farmers' Bulletin No. 1354: The Yellow-Fever Mosquito. By L. O. Howard. Pp. 14. (Washington: Government Printing Office.) 5 cents.

Department of the Interior: United States Geological Survey. Mineral Resources of the United States in 1922 (Preliminary Summary). Introduction by G. F. Laughlin; Statistics assembled by Martha B. Clark. Pp. iv+124a. (Washington: Government Printing Office.)

Department of the Interior: United States Geological Survey. Bulletin 689: Boundaries, Areas, Geographic Centers and Altitudes of the United States and the Several States; with a Brief Record of Important Changes in their Territory. By Edward M. Douglas. Pp. vi+234+7 plates. 60 cents. Bulletin 709: Triangulation and Primary Traverse, 1916-1918. Pp. vi+914+2 plates. 75 cents. Bulletin 739: Mineral Resources of Alaska: Report on Progress of Investigations in 1921. By A. H. Brooks and others. Pp. vi+169+xiv+3 plates. Professional Paper 132-A: Rock Formations in the Colorado Plateau of South-eastern Utah and Northern Arizona. By C. R. Longwell, H. D. Miser, R. C. Moore, Kirk Bryan, and Sidney Paige. Pp. 23+10 plates. (Washington: Government Printing Office.)

Dove Marine Laboratory, Cullercoats, Northumberland. Report for the Year ending June 30th, 1923. Edited by Prof. Alexander Meek. Pp. 151+21 plates. (Cullercoats.) 5s.

The Royal Technical College, Glasgow. Annual Report on the One Hundred and Twenty-seventh Session, adopted at the Annual Meeting of Governors held on the 16th October 1923. Pp. 70. (Glasgow.)

Annalen van de Sterrewacht te Leiden. Deel 13, Stuk 3: Positions of 84 Stars near the North Pole determined with the Meridian Circle of the Observatory in the Years 1877-1885, under the Directorate of Prof. Dr. H. G. van de Sande Bakhuyzen. Pp. 63. Deel 14, Stuk 2: Dessins de la voie lactée faites à Athènes par J. Fr. Julius Schmidt dans les années 1864-1876. Pp. 8+4 plates. (Haarlem: Joh. Enschede en Zonen.)

Marconi's Wireless Telegraph Company, Ltd. Report of the Directors and Statement of Accounts for the Year ended 31st December, 1922, to be presented at the Annual General Meeting of the Company, to be held at the Connaught Rooms, Great Queen Street, Kingsway, London, W.C.2, on Monday, the 3rd December, 1923, at 12 o'clock noon. Pp. 12. (London: Marconi House, Strand.)

Diary of Societies.

SATURDAY, DECEMBER 1.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—F. R. S. Balfour: Trees and Flowers of the North-West Pacific Coast.

MONDAY, DECEMBER 3.

ROYAL INSTITUTION, at 5.—General Meeting.

SOCIETY OF ENGINEERS, INC. (at Geological Society), at 5.30.—J. W. Gordon: Railway Surveying by Photography.

ROYAL SOCIETY OF MEDICINE, at 5.30.—Dr. Strandberg: Treatment of Tuberculosis of the Nose and Throat by Finsen Light Baths: Results.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—C. M. R. Balbi and others: Discussion on Electrical Apparatus for the Deaf.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—Dr. Dorothy Wrinch-Nicholson: Some Aspects of Scientific Method.

ROYAL SOCIETY OF ARTS, at 8.—Prof. A. F. Barker: Recent Progress in the Wool Industries (Cantor Lecture) (1).

INSTITUTION OF THE RUBBER INDUSTRY (London Section) (at Engineers' Club, Coventry Street), at 8.—Major V. Lefebure: Accelerators.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—J. Allen Howe: The Use and Preservation of Building Stone.—J. J. Fox and T. W. Harrison: The Chemical Aspects of Building-Stone Decay.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Sir Charles Bell: A Year in Lhasa.

ROYAL SOCIETY OF MEDICINE (Tropical Diseases and Parasitology Section), at 8.30.—Sir Leonard Rogers and others: Discussion on Sprue and Cœliac Disease.

TUESDAY, DECEMBER 4.

INSTITUTION OF CIVIL ENGINEERS, at 6.

INSTITUTE OF MARINE ENGINEERS, INC., at 6.30.—J. H. Anderson: Spontaneous Ignition of Coal.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—H. Dennis Taylor: The Future of the Cinema; and Photography as an Extension of Vision. (Annual Traill-Taylor Memorial Lecture.)

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—H. Balfour: Observations on the Technology of the Nagas of Eastern Assam.

RÖNTGEN SOCIETY (at British Institute of Radiology, 32 Welbeck Street), at 8.15.—Dr. L. G. Heilbron: Modern Radiographical Technique.

WEDNESDAY, DECEMBER 5.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—D. J. Farquharson: The Geology of Southern Guernsey.—C. W. Osman: The Geology of the Northern Border of Dartmoor, between Whiddon Down and Butterdon Down.

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 5.30.—Pathological and Clinical Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—L. B. Turner: The Relation between Damping and Speed in Wireless Reception.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS, INC. (at Engineers' Club), at 7.—A. J. Assheton: Vacuum Steam Heating.

ROYAL MICROSCOPICAL SOCIETY (Biological Section), at 7.30.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—H. Toms: Crystalline Bromides of Linseed Oil.—M. S. Salamon: The Plea for Standardisation.—H. T. S. Britton: Note on the Estimation of Chromium.—R. L. Andrew: The Colorimetric Estimation of Lead in Cream of Tartar.

ROYAL SOCIETY OF ARTS, at 8.—Dr. A. W. Hill: The Work of the Royal Botanic Gardens, Kew.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

THURSDAY, DECEMBER 6.

ROYAL SOCIETY, at 4.30.—E. G. T. Liddell and Sir Charles Sherrington: Recruitment Type of Reflexes.—G. S. Carter: The Structure and Movements of the Latero-Frontal Cilia of the Gills of Mytilus.—*To be read in title only*:—V. B. Wigglesworth and C. E. Woodrow: The Relation between the Phosphate in Blood and Urine.—J. B. S. Haldane, V. B. Wigglesworth, and C. E. Woodrow: (*a*) The Effect of Reaction Changes on Human Inorganic Metabolism; (*b*) The Effect of Reaction Changes on Human Carbohydrate and Oxygen Metabolism.—J. A. Campbell: Concerning the Influence of Atmospheric Conditions upon the Pulse Rate and "Oxygen-Debt" after Running.—J. Gray: The Mechanism of Ciliary Movement. IV. The Relation of Ciliary Activity to Oxygen Consumption.

ROYAL SOCIETY OF MEDICINE, at 5.30.—Sir Jagadis C. Bose: Assimilation and Circulation in Plants.

NEWCOMEN SOCIETY (Annual General Meeting) (in Room 13, Caxton Hall), at 5.30.—I. B. Hart: The Dynamics of Leonardo da Vinci.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—L. Brooks: The Beginnings of Geographical Teaching.

CHEMICAL SOCIETY, at 8.—C. K. Ingold: The Additive Formation of Four-membered rings. Part III. A System of Nomenclature for Heterocyclic Four-membered Rings and the Formation and Properties of some Derivatives of β-Methylenedi-Imineoxide.—H. J. S. Sand and E. J. Weeks: The Dependence of Polarisation-Overvoltage on Hydroxyl and Hydrogen Ion Concentration. Part I. Polarisation-Overvoltage of an Antimony Cathode in Aqueous Alkaline Solution.—H. King: Stereoisomerism and Local Anæsthetic Action in the β-Eucaine Group. Resolution of β- and Iso-β-Eucaine.—A. Green: β-Alizarin. An Isomeric Form of Alizarin.—O. L. Brady and F. P. Dunn: The Isomerism of the Oximes. Part XV. The Supposed Fourth Benzildioxime.—W. E. Garner and F. C. Randall: The Alternation in the Heats of Crystallisation of the Normal Monobasic Fatty Acids.

FRIDAY, DECEMBER 7.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—W. Foster: The Archives of the Honourable East India Company (Sir George Birdwood Memorial Lecture).

ROYAL ASTRONOMICAL SOCIETY, at 5.—Geophysical Discussion: Gravity Deflections in Great Britain and the Geoid. Chairman, Col. E. M. Jack. Opener, Sir C. F. Close. Other speakers, H. L. P. Jolly, A. R. Hinks, Col. H. L. Crosthwait, Dr. J. W. Evans, and Capt. G. T. McCaw.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: The Life and Times of William Clift, First Conservator (Thomas Vicary Lecture).

PHILOLOGICAL SOCIETY (at University College), at 8.—C. R. Enock: Euphratean Origin of Man, Language, and Place-Names.

ROYAL SOCIETY OF MEDICINE (Surgery, Ophthalmology, Otology, Laryngology, Odontology, and Anæsthetics Sections), at 8.30.—Dr. P. Watson-Williams and others: Discussion on The Comparative Value of Cocaine Substitutes.

PUBLIC LECTURES.

SATURDAY, DECEMBER 1.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N. Milligan: The Natural History of Dragons.

BIRKBECK COLLEGE, at 6.—Dr. F. H. Hayward: Celebration of The Geologist.

MONDAY, DECEMBER 3.

LONDON HOSPITAL MEDICAL COLLEGE, at 4.15.—Dr. Gordon Holmes: Some Symptoms of Cerebral Irritation (Schorstein Memorial Lecture).

TUESDAY, DECEMBER 4.

KING'S COLLEGE, at 5.30.—Miss Hilda D. Oakeley: The Roots of Early Greek Philosophy: (2) Scientific.

WEDNESDAY, DECEMBER 5.

UNIVERSITY COLLEGE, at 5.30.—W. C. B. Sayers: Library Classification in Modern Life.

THURSDAY, DECEMBER 6.

KING'S COLLEGE, at 5.30.—Dr. A. R. Pastor: Spain and Europe (League of Nations Union Lecture).

FRIDAY, DECEMBER 7.

UNIVERSITY COLLEGE, at 5.15.—Prof. Karl Pearson: Eugenics.

SATURDAY, DECEMBER 8.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. E. M. Delf: Sunlight and Life.