NATURE

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Smallpox and Vaccination.

THE present limited outbreak of smallpox in London gives point to the leaflet on smallpox and vaccination issued by the Research Defence Society. The widespread distribution of this circular would help in dissipating much misapprehension on the subject. Those requiring a more detailed exposition will find it in a recent report of nineteen pages issued by the Ministry of Health at the price of 3*d*.

The leaflet of the Research Defence Society points out that some fifteen million persons in England and Wales at the present time are unprotected against smallpox by vaccination. Figures are quoted illustrating the well-known facts that smallpox attacks chiefly the unvaccinated, that the fatality among unvaccinated is much higher than among vaccinated patients, and that practically no vaccinated child under ten years old suffers from the disease.

The supply of glycerinated calf lymph renders it impossible for either tuberculosis or syphilis to be conveyed by vaccination. This danger was always remote. It is now extinguished. The occurrence of complications after vaccination is avoidable if proper care and cleanliness are maintained. Yet a large proportion of the total population are unprotected by vaccination, and are dependent for their freedom from smallpox, on the prompt recognition and notification of every case of smallpox, on the intelligence and completeness of the work of the medical officer of health, and on the satisfactory working of every part of the machinery of sanitary administration which, almost times without number, has restrained outbreaks of smallpox within a small circle. This machinery comprises hospital isolation of patients, disinfection, a complete list and daily surveillance of contacts with the patient, and the surrounding of the patient with a complete ring of persons protected by vaccination, including sanitary inspectors, disinfectors, ambulance drivers, doctors, nurses, wardsmaids, and so on.

It is this ring of protected persons and the prompt vaccination or revaccination of all who have been exposed to infection which enables us to point to a record of smallpox prevention of which the country can be proud—a record in remarkable contrast to the national record as regards whooping-cough and measles. Every person vaccinated and revaccinated diminishes the strain on public health administration ; and if this means of protection were to be systematically and universally adopted, smallpox hospitals would on longer be required.

Religio Chirurgi.

WE have received an address to theological students by that famous and well-beloved old surgeon, Dr. W. W. Keen of Philadelphia, the master and the representative of American surgery, whose work has long been honoured over here. He gives to his address the title "Science and the Scriptures"; but, of course, he is concerned with that hardship of thought which all of us confess. In America, he says, there is a mischievous "recrudescence of the warfare over Evolution": and he sets himself, by sixty-two years' study and teaching of anatomy and surgery, to confute such people as look for their science to the Book of Genesis, and say that man was "a separate direct creation." He finds it easy enough to establish a more reasonable view, and we over here can only wonder that it should now be necessary to do so. The distinctive mark of this address is, however, Dr. Keen's determined will to be as strong in the Christian faith as in his reasons touching evolution.

"I believe that man, himself, will only attain his final development in the future life beyond the grave. In that wondrous life I believe as fully as I do in my own present existence. . . . Bodywise, man is an animal, but, thanks be to God, his destiny is not the same as that of the beasts that perish. To develop great men, such as Shakespeare, Milton, Washington, Lincoln, and then by death to quench them in utter oblivion would be unworthy of Omnipotence. To my mind it is simply an impossible conclusion. Man's soul must be immortal."

Therefore, Dr. Keen invents a phrase that the moral and spiritual life of man has been "engrafted upon" his natural life. The phrase is, however, unsatisfying. Man's likeness bodywise to animals is acknowledged, but Dr. Keen evades the animal's likeness conductwise to man. What is the use of Shakespeare and Milton to us who do not admit any great difference or gap between animals at their highest and man at his lowest?

Doubtless, in this quandary, it may advantage us to remember that no science has anything to say about personality. There is a lot of slipshod talk about organisms; but not a word about the animal itself, the inscrutable person which is the cat or the dog, the very self which is "engrafted upon" the animal organism. Until we understand—which possibly we never shall—the mystery and secret of the creation of animals, we shall remain in a quandary that is too deep for scientific analysis. The only way of escape seems to be that which Dr. Keen has taken. It reconciles no difficulties. It holds things apart, not brings them together. Still, he is not the only man, full of age and experience, who has taken this way; and we may get, from his outspoken declaration of faith, a touch of that delight which Socrates always found in talking to old men.

Chemical Technology.

(1) *The General Principles of Chemical Engineering Design.* By Hugh Griffiths. (Chemical Engineering Library.) Pp. 63. (London: Benn Brothers, Ltd., 1922.) 3*s.* net.

(2) *Materials of Chemical Plant Construction—Non-Metals.* By Hugh Griffiths. (Chemical Engineering Library.) Pp. 64. (London: Benn Brothers, Ltd., 1922.) 3*s.* net.

(3) *The Weighing and Measuring of Chemical Substances.* By H. L. Malan and A. I. Robinson. (Chemical Engineering Library.) Pp. 63. (London: Benn Brothers, Ltd., 1922.) 3*s.* net.

(4) *The Flow of Liquids in Pipes.* By Norman Swindin. (Chemical Engineering Library.) Pp. 64. (London: Benn Brothers, Ltd., 1922.) 3*s.* net.

(5) *Pumping in the Chemical Works.* By Norman Swindin. (Chemical Engineering Library.) Pp. 80. (London: Benn Brothers, Ltd., 1922.) 3*s.* net.

(6) *Recent Progress in Rubber Chemistry and Technology.* By Dr. P. Schidrowitz. Pp. 64. (London: Benn Brothers, Ltd., 1922.) 3*s.* net.

IT was, we believe, Pascal who observed that knowledge tends to concentrate itself in little books. The half-dozen monographs, published by Messrs. Benn Brothers, of which the titles are given above, are at least an exemplification of the truth of this aphorism. They form members of a series intended primarily for the use of the chemical engineer. The information they afford is given in what may be called "tabloid" form. They are small octavo booklets of some sixty or seventy pages, and are suitably illustrated. The actual amount of letterpress is, therefore, very small. Still, small as they are, they are packed with useful data, and as they are compiled by authorities and are brought up-to-date, they will no doubt be found useful by the class of technologists for whom they are more particularly designed.

(1) "The General Principles of Chemical Engineering Design," by Mr. Hugh Griffiths, treats of the essentials of a successful chemical plant: its physical, chemical, and mechanical factors; its practical and economic factors; and the settlement of the final design in the light of experience of the working of these factors—a matter frequently of no small difficulty in view of the complexity of the problem. The book may be regarded as introductory to the series. It deals simply with first principles and generalities, illustrated here and there by facts based upon practical experience. It is well written and suggestive, but contains little but what a chemical manufacturer is already well aware of, from, it may be, a more or less painful experience. The little book would serve admirably as the intro-

ductory discourse to a course of instruction on the technique of chemical manufacture.

(2) In his little work on materials of construction Mr. Griffiths deals with facts rather than with principles. In his introduction he speaks somewhat contemptuously of the designing engineer who has but little knowledge of chemistry, and of the research chemist who is ignorant of even the most elementary principles of mechanics, both of whom know little or nothing of the behaviour of materials of construction towards the action of chemical substances under the special conditions of the manufacture, but who are yet called upon, one to design and the other to work the plant.

There is no doubt that in too many cases the strictures are well merited. So long as chemical manufacture is confined, as in the case of so-called "heavy chemicals," to comparatively few substances and those of a restricted class, the disastrous results, material and financial, of such ignorance are not likely to be very serious. But as the range of his work extends, the chemist is called upon to face an increasing complexity of conditions in manufacture, and he cannot be too well informed concerning the application of constructional materials to chemical plant: he must know, not only the usual influences of atmospheric action, weathering, rusting, etc., but also the effects of physical conditions and the specific action of substances in varying circumstances of temperature, pressure, catalytic influences, etc.

In the space of some six or eight short chapters the author deals with the properties of bricks and tiles, refractories; stone, natural and artificial; ceramic materials and glass; rubber, ebonite, leather etc., wood; and a variety of non-metallic materials, such as mortar, cement, lutes and jointings, paints and enamels. In the very limited space allowed to the author, the treatment is necessarily highly condensed, but it gives the essential facts accurately and in sufficient detail.

(3) The little book on "The Weighing and Measuring of Chemical Substances," by Messrs. Malan and Robinson, is concerned solely with these operations as they may, or should be, carried out in chemical works. It deals with the general mechanical principles and theoretical considerations applicable to the various types of instruments employed. These, of course, differ according to the physical nature of the substance to be weighed or measured, *i.e.* whether solid, liquid, or gaseous. All the commoner forms of apparatus are referred to, as well as those of modern type, some of which are of rather elaborate construction and need intelligent use. The booklet may be commended as a useful account of methods to be employed in checking the various stages of the production of a manufactured article with the view of economy and the prevention of waste.

(4, 5) The two books by Mr. Norman Swindin on the flow of liquid chemicals in pipes and chemical works pumping are concerned with associated subjects of great importance to the chemical engineer. In the first-named the general principles involved in the consideration of viscous flow—kinematic and absolute viscosity, the relation between mean velocity and velocity at axis of pipes, the practical application of the kinematic viscosity equation, the flow of liquids in channels, and pipe-line losses—are set out in such detail as the very limited space at the author's disposal permits.

Justice is done to the classical work of Osborne Reynolds and to the more recent investigations at the National Physical Laboratory by Dr. Stanton, and of Mr. E. Parry of the English Electric Company. In the discussion of the various formulæ for expressing the relation between viscosity and temperature, Rodger, the collaborator of Thorpe in their investigation of the connexion between viscosity and chemical constitution, is inadvertently spelt Rogers. The book concludes with a number of useful tables showing the viscosities at different temperatures and the densities of various liquids of importance in the chemical arts.

The booklet on pumping contains a description of the construction and mode of working of pumps employed in connexion with corrosive liquids—a problem of a very different order of difficulty compared with that with which the hydraulic engineer has usually to contend. The various types of pumps applicable to the conditions in chemical works are succinctly described with the aid of suitable figures and diagrams. Both books are useful compilations, and will be of service to the works manager and chemical engineer.

(6) Dr. Schidrowitz's little book on "Recent Progress in Rubber Chemistry and Technology" is a work of a very different order, and is in no wise connected with the Chemical Engineering Library. It deals more particularly with the extraordinary development of our knowledge concerning the nature of rubber, especially of plantation rubber, the conditions of its economical production, the mechanics of vulcanisation, the properties of vulcanised rubber, and the technique of rubber manufacturing processes—a development largely due to the creation of the tyre industry. Dr. Schidrowitz is an acknowledged authority on the subject of his book, and it is certain, therefore, to command the attention of all who are interested in rubber, whether as producers or as manufacturers. It is significant how little is heard to-day of synthetic

rubber; as a possible competitor of the natural variety its future appears hopeless. More plantation rubber is being produced than the world at present requires, or is likely to require for some time to come. At the same time, the investigations which have led to the synthesis of rubber, or of rubber-like substances, have great theoretical value, and have shed much light on the true nature and chemical constitution of this most remarkable substance.

Forward Progression.

Gaseous Exchange and Physiological Requirements for Level and Grade Walking. By Henry Monmouth Smith. (Publication No. 309.) Pp. viii + 310. (Washington: Carnegie Institution, 1922.) 6 dollars.

FORWARD progression, perhaps the form of muscular activity most commonly engaged in by the average human being, is, both in its anatomical and physiological aspects, one of extraordinary complexity. The work of Marey, Carlet, Braune and Fischer has thrown much light on the actual movement of the body and legs during the forward movement, and the researches of Zuntz and Schumburg, Durig, Douglas, Benedict and Murschhauser, and others have helped towards the elucidation of the metabolism and energy expenditure of the movement. A number of problems which have emerged from the previous investigations still remain unsolved; some of these questions are discussed, and in part elucidated, in this new volume from the Carnegie Institution's Nutrition Laboratory at Boston.

This book forms the natural sequel to the work of Benedict and Murschhauser. These workers dealt with the changes in the metabolism, the cost and the efficiency of the human body during horizontal walking. Monmouth Smith's work, although ostensibly it is meant to deal principally with "grade" walking, contains much new data on horizontal walking, more especially as regards the influence of the movement and change of position on the blood pressure, pulse and temperature. The effect of horizontal walking on the blood pressure is not great; as regards the pulse rate, one of the most striking features is the great variation found in the same subject under apparently identical conditions. In connexion with the rectal temperature several interesting facts emerge: (*a*) there is a definite lag in the rise of temperature which occurs in changing from standing to walking; (*b*) except at the higher rates the effect of the rate of walking is small; and (*c*) the maximum increase at any speed less than 100 metres per minute does not exceed 0·5° C. (without taking into consideration the duration of the exercise). Many new observations have also been made on the "step-lift." A slightly lower value for the cost of this operation than that of previous workers was found. A slightly lower value than that commonly accepted was also found for the energy cost per horizontal kilogrammetre.

In the grade-walking experiments a preliminary series of experiments were made on the influence of the mouthpiece on the breathing of the subject. These tests are of considerable technical interest. The general result is that unless the preliminary period of breathing with the mouthpiece in position be of sufficient duration, the accuracy of the determination of the respiratory quotient is endangered.

A large number of observations were also made on the influence of grade walking, in addition to the determination of the energy cost, on the blood pressure, pulse, pulmonary ventilation, and temperature. Those on the temperature are particularly interesting. It was found, for example, that the temperature increase was not always the same for the same amount of work, although, as might be expected, a higher temperature and a greater increase over normal were usually observed when the work and the metabolism were greatest. The maximum total increase, when the work done was heavy, was between 1·5° C. and 2° C. A number of very interesting experiments on the rate of the fall of the rectal temperature after the cessation of work are recorded. In one experiment at least it was very rapid, 1·14° C. in twelve minutes, or 0·09° C. per minute. On the other hand, if observations were continued, the rectal temperature was found to approximate normal pre-work temperature only about two hours after the cessation of work.

The Nature of Science.

What is Science? By Dr. Norman Campbell. Pp. ix+186. (London: Methuen and Co., Ltd., 1921.) 5*s*. net.

"WHAT is Science?" is a question that may be answered in as many ways as "What is Truth?", and much depends on the questioner. In this case the original questioner was apparently an audience drawn from the Workers' Educational Association. Fifty or more years ago the worker was all agog for science; now, it appears, he either shoulders it aside as too academic for practical use, or rejects it as the "stone" of vocational education proffered instead of the "bread" of culture. The worker, in this limited sense, is not alone in misapprehending what is meant by "science," for the public at large, as recent years have given abundant proof, often blames it for sins

of both commission and omission, due really to human nature. It is well then that we should be provided in this handy form with a clearly-written and common-sense account of what scientific men mean by "science."

So much for the form of the answer. As for its content, Dr. Campbell will find one or other of his statements disagreed with by each philosopher in turn. But he refrains, wisely, from straying far along the perilous paths of metaphysics, and, while expressing his own opinion, admits frankly that there are others. If the question is to be answered by way of definition, Dr. Campbell's may be accepted as giving at any rate one point of view: "Science is the study of those judgments concerning which universal agreement can be obtained." In rebutting the objection that there cannot be universal agreement, Dr. Campbell selects as the most perfect example the order in which events occur. But have not some of the relativists suggested that agreement on this may not necessarily be universal?

Probably a definition is not the best way of answering the question. Dr. Campbell's definition may be true, but it does not cover the whole ground. It has one advantage, in that it omits reference to "the external world of nature," and that advantage is not merely metaphysical but practical, since without further discussion it permits one to include the study of the human mind and its products. It has been the attempt to define science by reference to its subject matter that has led to much of the misunderstanding. Science is, it seems to us, rather a way of looking at things or a method of study, and if it excludes any subject it is only because the method proves inapplicable. Undoubtedly a necessary condition is agreement upon the judgments. Take literature for example. Purely æsthetic criticism will never give that "Quod semper, quod ubique, quod ab omnibus" which science demands; and science therefore must decline to appraise the poetic merits of "Lear," "Hamlet," and "Macbeth." But the number of lines with weak endings in those plays can be ascertained definitely, and can therefore be subjected to scientific inquiry.

How science works is the subject of three chapters, which consider the nature, the discovery, and the explanation of the laws of science. We used to be taught that "a Natural Law is a regular sequence of Cause and Effect." Dr. Campbell discards the causal relation and replaces it by "invariable association." It is this invariability that lies at the base of the definition of science recently given by the Master of Balliol: "a body of generalisations from facts which enables us to predict fresh facts." But further inquiry shows that the associations, in their original sense, are not invariable. Exceptions arise and have to be met by new laws, either of the same kind or of a new type. The discovery of a new type of law is the privilege of genius. So far one may go with Dr. Campbell, but when he implies that the genius imposes the law in accordance with his "intellectual desires" and that "the universe obeys the dictates of [his] mind," it is not so easy to follow him. Does he mean that all our systems are purely subjective? To some extent the answer to this question is given in the section headed "Are theories real?" The reality of a theory depends on its power of predicting true laws, and thus it gains universal acceptance. "A molecule is as real, and real in the same way, as the gases the laws of which it explains. It is an idea essential to the intelligibility of the world not to one mind, but to all; it is an idea which nature as well as mankind accepts. That, I maintain, is the test and the very meaning of reality."

The position is intelligible, but our difficulties recur when we come to the interesting remarks on symbols and the æsthetic sense of the mathematician—"one more illustration of the power of pure thought, aiming only at the satisfaction of intellectual desires, to control the external world." Would it not be truer to say that the external world, by countless direct and indirect means, acting since life began, has so influenced the unconscious as well as the conscious perceptions of man, that the mind necessarily regards as harmonious those relations which conform to the seen or unseen reality of the universe? The scientific genius is he who has a deeper intuition of that harmony than his fellows, or, perhaps more accurately, he who can the most easily raise to the plane of consciousness the subconscious promptings of external nature.

Aspects of Military Medicine.

History of the Great War, based on Official Documents. Medical Services: Diseases of the War. Vol. 1. Edited by Major-General Sir W. G. MacPherson, Major-General Sir W. P. Herringham, Col. T. R. Elliott, and Lt.-Col. A. Balfour. Pp. viii+550. (London: H.M.S.O., 1922.) 21s. net.

UP to the beginning of the nineteenth century the medical history of wars was very incomplete, and is to be found in memoirs or commentaries written by individual military surgeons. To this category belong the works of Percy, M'Grigor, and particularly Baron Larrey, the great military surgeon of the Napoleonic period. A great change, however, took place with the publication by the Americans of the splendid and exhaustive "Medical and Surgical History of the War of Rebellion (1861–1865)," which has remained a model for all later works on military medicine. After the greatest of all wars it was to be

expected that the medical histories which were bound to make their appearance would be voluminous and detailed, and that this country would not be behind others in this respect. The volume before us does not lead one to anticipate a standard work of permanent value in medical literature. From the brief preface, occupying a page and a half, it is not clear what the object of the work is. It is stated that the contributors had at their disposal the material contained in official documents, while later on it is said that "there has been little opportunity for further analysis and study of accumulated records of medical cases," and an apology is made that the contributors have been handicapped by the fact that papers published during the war were comparatively few. To any one conversant with the volume of medical literature which poured out in every country, this must seem an extraordinary statement. The "Index Medicus War Supplement," dealing with 1914–17, occupies alone 260 pages of titles, which at a conservative estimate represents at least 10,000 papers which were published on some aspect of military medicine during these three years.

Whatever was the intention of the editors, the book before us consists, in fact, of a series of short essays dealing with general statements rather than with actual data acquired during the war with respect to the several diseases of which they treat. Thus typhus fever and cholera are disposed of in sixteen and thirteen pages respectively, while the article on "General Aspects of Disease during the War" occupies less than ten complete pages. The other articles deal with such conditions as the enteric group of fevers, dysentery, cerebro-spinal meningitis, malaria, trench fever, jaundice, scurvy, beri-beri, pellagra, nephritis, and cardio-vascular diseases.

There are twenty-one contributors, and of these but four were regular officers in the army. It cannot serve a useful purpose to make an analysis of each of the individual articles. Many are sketchy, some are trivial, but those of Dr. Wenyon on malaria, of Sir W. Willcox on scurvy and beri-beri, of Sir J. Rose Bradford on nephritis, of Dr. Hume on cardio-vascular diseases, and of Col. Lelean on pellagra, are worthy of study. We are informed in the article on cholera that "all recent evidence shows that the cause of cholera is infection with the cholera bacillus." The word "recent" must here be taken as implying a period of nearly forty years.

The bibliographies in general are short, and some bear the impress of the professional copyist from the "Index Medicus" rather than represent the works consulted by the authors. In some cases the references given are to abstracts and epitomes and not to the original works, although the latter were easily accessible. References such as "Nicolot, Bour, Monier-Vinard and Buguet, Le Paludisine," without date or *locus* of publication, are not helpful to the reader. The coloured illustrations, six in number, are successful, but the index bears evidence of having been compiled by some one unfamiliar with this class of work. In future volumes it is to be hoped that some of the defects of this one will be rectified. Compared with the greatness of the subject, the appearance of the volume is not attractive. W. B.

Our Bookshelf.

Engineering Inspection. By Prof. E. A. Allcut and C. J. King. Pp. xv+187. (London: G. Routledge and Sons, Ltd., 1922.) 15*s*. net.

THE authors of the work under notice commence with a summary of the objects of inspection, and follow this by descriptions of inspection methods ranging from the inspection of raw materials to the carrying out of running tests on the manufactured product. These descriptions should make the book valuable to inspection staffs, who will find therein much of the information required in ordinary inspection work. In many cases references are given to original papers dealing with special methods of inspection, while the general information given in the text is amplified by a collection of useful tables in the appendix. In some respects the last chapter is the most important in the book, since it deals with the kind of temperament, as well as the qualifications, required in inspectors and viewers. Throughout the book the authors emphasise the point that the aim of an inspector should be to "scrap" as little work as possible, to detect faults in materials and workmanship at the earliest possible stage of manufacture, and to pass all sound work with the minimum delay. The type of organisation sketched out will be of interest to all engineers, and may indicate lines on which existing inspection systems can be improved; the general tone of the book should serve to remove much of the distrust with which inspection is still viewed by many. The authors are to be complimented on having presented so comprehensive a survey of an important subject in such a readable and well-balanced form.

The Emotions. By Carl G. Lange and William James. (Psychology Classics, vol. 1.) Pp. 135. (Baltimore, Md.: Williams and Wilkins Co., 1922.) 4 dollars.

WILLIAM JAMES and Carl Lange, investigating the problem of the emotions, independently and within a year, arrived at a very similar point of view with regard to the relation between the emotion as experienced by the subject and its bodily expression. The theory, generally known as the James-Lange theory, inverts the usual common-sense sequence which would say that we cry because we are sorry, and asserts that, on the contrary, we are sorry because we cry. Practically every student of psychology since the publication of the original articles has had to consider this conten-

tion; it is fairly easy to criticise, extremely easy to ridicule, and yet still remains provocative.

Very much more knowledge of the physiological processes concerned in emotion is available now, and although few thinkers could be found to accept the theory in its more extreme form, nevertheless it still has vitality.

The whimsical humour characteristic of James's writing arrested most readers' attention, and there seems little doubt that, although it in its turn had been stimulated by the work of Darwin, the publication of this theory gave considerable impetus to the study of the emotions and their relation to organic processes.

The present book, a reprint of James's and Lange's work, will be a valuable addition to the psychologist's library, presenting as it does, in convenient form, papers hitherto not easily obtainable.

A Manual of Clinical Laboratory Methods. By Prof. Clyde L. Cummer. Pp. 484. (London: H. Kimpton, 1922.) 28*s.* net.

DR. CUMMER has produced this manual for students and practitioners with the object of presenting clinical laboratory methods in concise and accessible form. The book is divided into seven chapters dealing with different materials—the examination of blood, of urine, of gastric contents, etc. In each, the methods of carrying out an investigation are first described, and the significance of the findings is then discussed.

The subject-matter of each section is well arranged, and there are numerous excellent engravings and plates; but there is much detail which could with advantage have been omitted. The method of using the inaccurate Tallquist hæmoglobinometer does not merit description in a text-book which aims at being concise; nearly half the book is devoted to the examination of the blood, and the chapter on urine is comparatively brief; the estimation of basal metabolism is not mentioned at all. The best section is that on cerebrospinal fluid, which contains good descriptions of modern investigations, including the Lange colloidal gold reaction.

The Teaching of General Science. By Prof. W. L. Eikenberry. (University of Chicago Nature-Study Series.) Pp. xiii+169. (Chicago, Ill.: University of Chicago Press, 1922.) 2 dollars.

THE rapid spread of the teaching of general science follows on the recognition of the educative value of the subject. Much of this is lost, so far as children are concerned, if the content is restricted to what may be useful for some of them in future training as specialists. "The preparatory values are incidental. The adjustment between general science and special science must be made by the latter building upon what foundation the former lays, rather than by any attempt to prescribe that certain materials shall be used for preparatory reasons." This is the main idea underlying Prof. Eikenberry's book, in which he describes the history and practice of the teaching in America. He has gone to the root of the matter, dealing fully with the principles on which practice should rest; and the result is a book which no one who has the interests of science teaching at heart can afford to ignore.

The Elements of Astronomy. By Prof. D. N. Mallik. Pp. viii+233. (Cambridge: At the University Press, 1921.) 14*s.* net.

THE problems of the diurnal rotation, meridian observations, the motion of the moon and planets, precession, nutation, refraction, etc., are dealt with in quite an elementary manner in the work under notice. The chief new feature is an interesting account of ancient Indian astronomy. The book is, unfortunately, greatly in need of revision, misprints, misspellings, and other errata being numerous. Some of them are likely to cause serious misconceptions; thus, the moon's distance is given as 23,800 miles, both on pp. 102 and 117. On p. 146 the distance of Europa from Jupiter is given as 9400 miles; on p. 138 the periodic time of a planet is stated to vary as r^3. It is difficult to suppose that the proofs were read with any care. A. C. D. C.

The Iron and Steel Institute. Carnegie Scholarship Memoirs. Vol. 11: *The Corrosion of Iron.* By Dr. J. Newton Friend. Edited by George C. Lloyd. Pp. vi+161. (London: The Institute; E. and F. N. Spon, Ltd.; New York: Spon and Chamberlain, 1922.) 16*s.* net.

DR. FRIEND'S collection of reports, dealing with various aspects of corrosion, does not represent a complete treatise on the subject. Many important researches and theories are not to be found in it, but the sections of the subject dealt with (including much of Dr. Friend's own work) are treated fairly fully. The subject of the corrosion of iron is one which has occupied man for some thousands of years, and a collected account of further progress will, therefore, be useful. Each investigator has usually emphasised one aspect of the process more than others, and in a "colloidal" theory of corrosion we recognise Dr. Friend's contribution.

Construction des réseaux d'énergie. Par M. Daval. (Bibliothèque Professionnelle.) Pp. 275. (Paris: J. B. Baillière et Fils, 1922.) 8 francs net.

M. DAVAL'S work is written for those who have to design or superintend the working of electric power networks. It is written from a severely practical point of view, and assumes only the slightest mathematical knowledge on the part of the reader. The author lays particular stress on those practical points about which the academically trained engineer is often ignorant. The book is clearly written, and will be helpful to the junior staff engaged in the distribution of electric power.

Les Encres, les cirages, les colles et leur préparation. Par Maurice de Keghel. (Bibliothèque Professionnelle.) Pp. 384. (Paris: J. B. Baillière et Fils, 1922.) 10 francs.

REFERENCE has already been made in NATURE to an earlier volume of this encyclopedia. The subjects are treated from the technical point of view, *i.e.* recipes are largely given. Many of these would seem likely to be useful in the laboratory as well as in the workshop, and the book should fulfil the purpose for which it is intended.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Isotopes of Antimony.

OWING to the kindness of Prof. G. T. Morgan, who prepared a specimen of pure antimony trimethyl for this purpose, I have now been able to obtain the mass-spectrum of antimony. The element is characterised by two lines of nearly equal strength at 121, 123. The first is the more intense by perhaps 10 to 20 per cent. If sufficient exposure is given two faint companions are visible at 122, 124, but the general evidence suggests that these are due to hydrogen addition products. The isotopic nature of the lines 121, 123 is amply confirmed by the appearance of similar pairs 15 and 30 units higher, due to molecules of their monomethides and dimethides. The most trustworthy measurements show that the masses of the isotopes of antimony are most probably less than whole numbers by one to two parts in a thousand.

These results show that the chemical atomic weight 120·2 at present accepted is certainly too low. They are, however, in excellent agreement with the value 121·77 recently obtained in America by Willard and M'Alpine. F. W. ASTON.

Cavendish Laboratory,
Cambridge, November 16.

Experiments on the Theory of Soil-acidity.

IN a recent paper "On the Adsorption of Ions" (*Phil. Mag.* (VI.) 44, 321) the origin of soil-acidity has been discussed (pp. 338-45, especially pp. 343-45). In the following a short account is given of some experiments carried out with Mr. Kamalacharan Bhattacharya and Mr. Bankim Chandra Roy.

It was suggested that the acidity is due to the adsorption by the gels (of silicic acid, aluminium oxide, and ferric oxide) of the anions of acids. The adsorption is so strong that the adsorbed substance cannot be washed out by water, and the aqueous extract is neutral. The anions are adsorbed on the surface by "chemical forces" whereas an equivalent number of cations forms the mobile second sheet of the double layer. If the cations consist in part of $H^{\cdot}$ ions, in treating with excess of a neutral salt (KCl) solution there is a displacement of the cations of the second layer by the cations of the neutral salt, as the latter is present in relatively enormous concentration, and as the forces acting on the cations of the mobile second sheet of the double layer are mainly electrical in nature.

Experiments have been carried out with powdered precipitates of silica, ferric oxide, and alumina. Of these, silica has been found to adsorb appreciable quantities of acids, *e.g.* acetic, citric, hydrochloric, and nitric. The adsorption is so strong that on repeated washing the adsorbed substance cannot be removed so that the aqueous extract soon becomes perfectly neutral. On now shaking the precipitate with KCl—which is tested with indicators to be perfectly neutral—the aqueous extract (free from particles of the precipitate) is found to be distinctly acid. The amount of the acid depends on the amount of the precipitate. In the extract with the neutral salt solution, acetates or citrates could not be detected.

The formation of insoluble salts of alkali metals or replacement of hydrogen ions by metallic ions in complex silicic acids is evidently out of the question. It is unanimously agreed that silica is an acid, and the probability of forming definite complex acids with acetic acid is very remote.

It might be argued that the acids are adsorbed as such, that is, the entire molecule is adsorbed. This point has been settled by simultaneous experiments on electro-osmosis. The apparatus used was a modification of that used by Briggs (*Journ. Phys. Chem.* 22, 1918, 256), which the writer found was employed by Dr. Ishikawa in the Physical Chemistry Laboratory of Prof. F. G. Donnan, University College, London. The sample of pure precipitated silica (British Drug Stores, Ltd.) we are using shows a marked negative charge in pure water. On treating with acetate the charge increases as shown by the rate of motion.

The results are accurate within about 10 per cent.

	Velocity in cm. per min.
Pure water	2 cm. ; 2·05 cm.
N/1000 sodium acetate . .	3·9 cm.
N/2000 acetic acid . . .	2·7 cm. ; 2·7 cm.
N/1000 sodium hydroxide .	3·4 cm. ; 3·2 cm.
N/100 acetic acid . . .	1·7 cm.
N/1000 hydrochloric acid .	2·3 cm.
N/1000 potassium chloride .	3·1 cm.

It will be seen that in the presence of sodium acetate and potassium chloride the negative charges increase 100 and 50 per cent. respectively. The experiments have been carried out under identical conditions. In the case of sodium acetate the presence of hydroxyl ions have to be taken into account. It will be seen, however, that acetanions are adsorbed to a greater extent than hydroxidions, and it is well known that the more strongly adsorbed substance largely displaces the other which is not so strongly adsorbed. In the case of potassium chloride the question of hydrolysis does not arise.

As is to be expected from the greater mobility of the hydrogen ions and the views of the writer (Far. Soc. Disc., Oct. 1921, *Phil. Mag.* (VI.) 44, 330-37), the acids of the same concentrations show a smaller charge than their salts. The charge is, however, undoubtedly greater than that with pure water, so that there is unmistakable evidence of the adsorption of anions, but owing to the effect of hydrogen ions the charge indicates a smaller adsorption than is really the fact.

We are at present engaged in working with the gels (which are likely to have greater specific surface) and with chemically pure silica or silicic acid gel. It appears that the electro-osmotic apparatus is also capable of further improvements.

These experiments clearly show that we are really dealing with the kinetic exchange of ions (hydrogen or $Al^{\cdot\cdot\cdot}$ in the case of soil acidity) in the second sheet of the double layer or present as electrically adsorbed, as suggested by the writer. It is not necessary to assume the hydrolysis of potassium chloride into alkali and acid in water, or the displacement of hydrochloric acid from alkali chlorides by humus acid, or the formation of insoluble salts of alkali metals, as has been done in the past.

There is other corroborative evidence in support of this point of view. J. N. MUKHERJEE.

Physical Chemistry Department,
University College of Science, Calcutta,
September 20.

New Spectra of Water Vapour, Air, and Hydrogen in the extreme Ultra-violet.

AFTER reading of the excellent work of Prof. Wood on the extension of the Balmer series of hydrogen, I decided to investigate the Lyman series of hydrogen

in a similar manner. In the process of this investigation, some results were found which I now describe.

Water vapour in contact with films renders them insensitive to the extreme ultra-violet, and on the other hand, new films may be made sensitive for immediate use if they are thoroughly dried.

Water vapour gives a spectrum in the ultra-violet extending to about λ900. It consists of oxygen lines, hydrogen series lines, the secondary spectrum of hydrogen, and some bands probably not due to hydrogen. The A.C. or D.C. current used was found to dissociate water into its elements almost completely. A condensed discharge, however, formed compounds in the receiver of the vacuum grating spectrograph which fogged the films in the path of the light. It is, therefore, not surprising that a spectrum of water vapour should be found in this region of short wave-lengths, for hydrogen is known to be transparent here, and the author has shown (*Physical Review*, in press) that oxygen likewise is remarkably transparent in a portion of this region.

With condensed discharge and low pressure in receiver and discharge tube, a spectrum was obtained for air to λ350. In this experiment no attempt was made to eliminate mercury vapour. Many of the lines in the neighbourhood of λ600, recently found by Lyman to constitute a helium series, were also found on these films.

Ordinary commercial films were found sensitive at λ1215·7, so that a very clear line was produced on the film after only five minutes' exposure, with hydrogen at a pressure of 0·3 mm.

Using wet hydrogen and a long discharge tube three new members of the Lyman series of hydrogen were found. Thus there are now six lines of that series known. Appearing on the same spectrogram with these was a line λ243·2±0·2. This was observed on many films, and on some of them it occurred in the first, second, and third orders. Its wave-length agrees within limits of experimental error with the equivalent wave-length (λ248) for the L critical potential of oxygen, observed by Kurth, using photo-electric methods. The observation of this line in hydrogen at a pressure of 0·3 mm., after the light had traversed a distance of one metre, shows the transparency of hydrogen in this region. This fact may be useful to those working in soft X-rays or in the region of these short ultra-violet radiations. Furthermore, the presence of this line indicates that the great absorption band of hydrogen which begins at about λ850 terminates on the long wave-length side of λ243.

J. J. HOPFIELD.
Department of Physics, University of California,
Berkeley, October 30.

Molecular Viscosity.

THE following remarks are offered rather in the nature of a foreword, suggesting a particular line of research, than as an article of belief. Although the conclusions arrived at are purely theoretical, and have at present no experimental confirmation, the practical test outlined at the end of the paper should supply a definite answer as to whether there is any foundation for the theory advanced.

Our conception of the physical forces which are called into play when a liquid is caused to flow with linear or stream-line motion is gradually undergoing a change. The old definition of viscosity as internal friction needs revising. Already Dunstan and Thole (Journ. Inst. Petr. Tech., vol. iv. p. 197) have come to regard viscosity in the nature of a dual phenomenon, which they attribute partly to internal friction and partly to deformation of molecular grouping (although these may conceivably be one and the same thing). There is one aspect of the subject which does not seem to have received its fair share of notice. Allusion is made to the gyroscopic resistance offered by any orbits, the motion of which has components at right angles to the line of flow.

When a vapour condenses into a liquid, the molecules still retain the major portion of their high velocity; and since it is only their mutual attraction that prevents them from escaping again into space, it follows that their paths must be very curved, and that in all probability there will be at any instant of time a certain number of them revolving round one another in orbits, after the fashion of the twin stars. These systems would doubtless have only a short life, being destroyed by collision with neighbouring molecules, but for the instant of time during which conditions were favourable similar orbits would be formed to take their place.

For want of a better name this particular form of viscous resistance will be referred to as gyro-viscosity. We may then consider the property, common to all liquids, of resistance to flow as made up of at least two parts, namely:

(*a*) gyro-viscosity.
(*b*) molecular friction or deformation.

Whereas (*a*) lends itself readily to mathematical treatment, (*b*) is still so largely a matter of conjecture, that while our ideas are in their present state of flux, we cannot be sufficiently definite about anything in this connexion to attempt any sort of analysis. We can, however, be moderately confident that in some degree (*a*) must obtain, and it is hoped to show a means whereby it may be measured. When a liquid is subjected to a shearing stress, in other words when flow starts, there will be at once the gyroscopic resistance of those components of the orbits at right angles to the line of flow; and when these have been turned through a right angle and flow continues there will remain the constant resistance of those orbits which are produced during flow. Viewed in this way the initial momentary resistance should be greater than the subsequent constant resistance; and since the former is independent of the rate at which the orbits are being formed, it would afford a means of estimating the relative molecular gyro-viscosity, if only it could be measured with sufficient accuracy. A method of doing this which suggests itself is based upon the correct resolution of the forces which go to produce the so-called Couette correction for flow through capillary tubes.

Couette found that when the length l of the tube was doubled the corresponding time t was not quite doubled, and that in order to satisfy his equation it was necessary to replace l by $l+kd$, where d is the diameter of the capillary and k a constant having an approximate value of 0·25. Since this correction is, in a sense, a measure of the total work W_o done *outside* the tube, it must contain also the preliminary work W_m required to turn all the orbits in existence at any instant of time in the whole volume run. The difference $W_o - W_m$ represents the work done *outside* the tube in overcoming viscous resistance of the liquid *already in motion* (the kinetic energy correction was, of course, allowed for, and therefore does not enter into these quantities).

The Couette value affords a direct means of determining W_o but the calculation of $W_o - W_m$ presents considerable difficulties. We are faced with the problem of finding (1) an expression for the distribution of the velocities in the trumpet-shaped lines of flow of the liquid before it enters the tube; (2) the *varying* acceleration of any one of these lines before it attains its final constant velocity on entering the

tube; (3) the influence of the head of liquid on the curvature of these lines. As all of these admit of exact mathematical treatment, it should be possible, by running a gram-molecule of the liquid, to calculate W_m. This would be entirely independent of the velocity of flow and would represent the relative molecular gyro-viscosity. Whereas the ordinary figures for absolute viscosity appear to bear no general relationship to the other physical constants of the liquid, it is possible that these values might be more productive of results. A thorough investigation of these lines of flow is therefore the first necessary step towards the solution of this most interesting problem.

FRANK M. LIDSTONE.

37 Powell St., Derby,
November 1.

New Weights and Measures for India.

I HAVE read with interest the article in NATURE of September 2, p. 325, on the weights and measures of India by Mr. Silberrad, president Indian Weights and Measures Committee. Mr. Silberrad reports conditions much the same as I found them in India in 1910. One of the pleasures in reading NATURE is that the desirability of producing commodities and methods of service is taken for granted. Now in attacking this problem it is assumed that a simple, useful system of weights and measures is desired for India. While in India I was asked to rewrite the article on weights and measures for the "Times Year-book," and in looking up data in this connexion, I came across the permissive Metric Act of 1871. This Act represents one of the attempts of the leaders of India to secure the advantages of the general use of the metric system. By it the Viceroy of India is empowered to make what preliminary arrangements might be necessary, and proclaim the date after which metric weights and measures shall come into general use.

Let us consider the various necessary units of measurement in their logical order.

1. Mr. Silberrad rightly mentions "the Peshawari yard of 38 in. to $38\frac{3}{4}$ in.," and also the yard of approximately 40 inches. Also the Ilahi gaz, which is frequently in the neighbourhood of, if not exactly, 39·37 inches or one metre. These are only a few examples of units of length in a country of approximate lengths that could be best standardised on the international metre.

2. Practically the same thing is true of measures of area. Nearly all of the British engineers that I have met have favoured the metric system, and few have any desire to continue the use of such a difficult unit as the acre. The square metre and the hectare of 10,000 square metres are good and sufficient, and will, we believe, be used eventually in all civilised countries. Several of the Indian units fortunately approximate to the hectare.

3. The suggestion that "the standardisation of suitable measures of capacity at the nearest suitable multiple of the bulk of $1\frac{1}{4}$ seers of water, this being approximately equivalent to the bulk of a seer of wheat," is not so unfortunate as it may seem. This probably will soon become the litre.

4. My findings also correspond with those of Mr. Silberrad in reference to the tola of 180 grains, about 12 grams. This brings the seer to approximately 1 kilogram. When it is understood that the seer has been adopted for practically all railroad transactions in India by the British Government, one realises that India is using the metric system in what amounts to 60 per cent. of all accurate transactions according to weight.

It was my pleasure to spend part of the past summer in England, and confer in regard to the metric campaign with members of the Decimal Association and others who are actively interested in the metric movement. I found a general desire to secure the advantages of decimal currency and metric weights and measures. It was forcibly brought home to me that the chief men of England who have the vision of service and big foreign trade will not only encourage the Colonies to make progress in the metric movement, but will also see to it that the British Government leads the way in this much-needed reform. Readers of NATURE will be interested to see the following statement by Prof. J. C. McLennan of Toronto University: "In the early part of 1906, at the request of the Hon. L. P. Brodeur, Minister of Inland Revenue of the Dominion Government of Canada, I agreed to deliver a number of lectures on the use of metric weights and measures.

"Through the co-operation of the Department mentioned, a schedule of the lectures was arranged, and it was made known in various centres throughout Canada that my services in connexion with the metric campaign would be available on certain dates for the various local societies interested in this subject.

"In carrying out this rather strenuous schedule, lectures were given in Montreal, Ottawa, Toronto, Winnipeg, Regina, Vancouver, and in over 30 other Canadian cities. In some places the idea of the simple metric system corresponding to decimal currency was then new to many people. Our meetings were well attended, in some cases as many as 600 people being present. At the close of each address, all present were invited to take part in the discussion of the subject. The pros and cons were propounded with the utmost frankness, and in some cases with considerable vigour. Never during this lecture tour or at any other time have I heard, in so far as I can judge, a really valid argument against the general use of metric weights and measures. On the other hand, the many valid reasons for their use increase as time passes.

"It is highly desirable that this preliminary educational work, conducted entirely at the expense of our Government, should be effectively followed up. It is chiefly for the purpose of encouraging others to do their part in securing for Canada the advantages of the use of the metric system that on April 28, 1922, I accepted the Chairmanship of the Toronto Section of the American Metric Association. At that time Mr. W. P. Dobson of the Hydro-Electric Power Commission was elected Secretary, and Mr. L. Burpee, of the Canadian General Electric Company, Ltd., was elected Treasurer. Our Section is composed of volunteer workers, who desire to see the metric campaign progress as it should. We believe that everybody can do something to help. We hope that a great many people will let Mr. Dobson know that they will help the metric movement in their own industry or line of work."

It may seem a far cry from Canada to India, but there is a direct connexion when one realises that the various peoples of the world can understand and serve each other best when they use the same convenient weights and measures. The members of the American Association are determined to secure these advantages in the United States and Canada, and we ask for the hearty co-operation of all progressive men and women throughout the world.

HOWARD RICHARDS
(Secretary).

American Metric Association,
156 Fifth Avenue, New York.

By the courtesy of the Editor I have read Mr. Richards's letter, and think that he and I disagree solely by reason of the difference in our Indian experiences. If it were a case of starting with a clean sheet there would be no greater difficulty in adopting the metric system than in adopting any other; but this is not the case. The British yard *has become* very widely known, whereas the metre is quite unknown. The Peshawari yard and the Ilahi gaz, themselves variable units, are used only to a comparatively small extent, while the most widely known unit of length, the hath or cubit, is very near to half the British yard, and as a matter of practical fact this measure is regarded as representing it exactly.

Similarly, the acre *has now become* very widely recognised and used as a unit of area, while the hectare has scarcely even been heard of.

It is true that the 80-tola seer (of 14,400 grains) is near the kilogram, but it is not exactly equal thereto, and to change it would, as a matter of practical fact, involve altering the weight of the rupee, as that coin is universally recognised as representing in weight 1 tola. This question of changing the weight of the rupee so as to give a seer of exactly two pounds, or else of 1 kilo, was one that the Weights and Measures Committee considered very carefully and on which it recorded much evidence, and (the majority of the members) reluctantly came to the conclusion that any alteration —whether in weight or value—of that coin would give rise to so much suspicion as to make it more than doubtful whether such a change would be worth while.

It has taken fifty years to spread the knowledge of the 80-tola seer to the extent now achieved; to introduce a new unit would mean starting all over again, and the same remark applies to any change in the units of length or area.

I have no doubt that engineers would prefer the metric system—so would I, personally. But the people of India are not engineers. Ninety per cent. of them live in villages or small towns of less than 5000 inhabitants, and are only interested in weights and measures being true and uniform within the limited range of their journeyings. For one transaction in which it would be an advantage to use a world-wide system, there must be at least 10,000 in which it would be of not the slightest advantage.

Mr. Richards refers to Canada. I imagine that it would be difficult to find two peoples more absolutely different than those of Canada and of India; the Canadian is well educated and progressive, the Indian, as a rule, very poorly educated, and intensely conservative. It would be difficult to conceive of widespread lecturing on weights and measures in India; audiences might perhaps be secured in half a dozen of the largest towns, but nowhere else, and the population of India is more than thirty times that of Canada. (I do not wish to imply that Mr. Richards thinks lecturing advisable, but merely to emphasise the difference between the two countries.)

My own experience of India at the time of the Weights and Measures Committee was twenty years in the Civil Service, all on the executive side, in the course of which I usually spent four to six months every year on tour among the villages and small towns of my district; that of my Indian colleague on the Committee (who shared my views, with very insignificant exceptions) was very similar. With this experience we disagreed from our other member, and held that there were not sufficient advantages attached to the metric or other non-Indian system to justify us in making a recommendation which, if accepted, would affect the method of carrying out an enormous number of petty transactions, and could be given practical effect only by a large amount of interference. Now interference of such a kind as would be required to enforce the use of a new system of weights and measures means interference by a large and therefore necessarily low-paid staff, and what that means any one with Indian executive experience knows, for though the head of the Indian Government colossus *may* be golden, its feet *are* very certainly still decidedly argillaceous!

In brief, we found a very general desire for a uniform system of weights and measures, but for one based on a unit that was known, and hence we recommended that system which could be adopted with very much less difficulty than any other.

C. A. SILBERRAD,
President Indian Weights and Measures Committee, 1913–14.

Harpoons under Peat in Holderness, Yorks.

On page 481 of NATURE for October 7, Mr. O. G. S. Crawford states that he believes one of the alleged harpoons said to have been found under the peat in Holderness to be genuine. At the Hull Meeting of the British Association he thought that both were genuine. After the spade-work to which he refers, I feel satisfied that he will consider both of them are modern. I am also glad to learn that he now regards the evidence supplied by the flint axe to be of no value, whereas formerly he considered that it helped to prove the great age of the harpoons.

As one who knows Holderness fairly well, I should like to ask what evidence there is for the statement that "There can be little doubt that in Holderness exist remains of the early neolithic age, remains which are older than the Long Barrows"? At Hull we were promised that a committee should be formed to inquire into the question of the harpoons. I have heard nothing further about it, but trust such a committee may be called together.

If I have cast doubts upon the authenticity of implements which have been accepted as genuine by quite a number of authorities, and my doubts prove to be unfounded, I deserve censure. If, however, the statement I made proves to be correct, the facts should be published, in the interests of truth.

Reasons for my belief are given in a communication which I sent to the Editor of *Man* a little while ago, as Mr. Armstrong's illustrated description of the harpoons first appeared in that journal. I do not remember having made the statement in public that the harpoons had been "*made* by the supposed finder." I did say they were not as old as Mr. Armstrong.

T. SHEPPARD.
The Museum, Hull.

The Relationship between the common Hermit-crab (*Eupagurus bernhardus*) and the Anemone (*Sagartia parasitica*).

THE relationship between the common hermit-crab (*Eupagurus bernhardus*) and its messmate anemone *Calliactis* (*Sagartia*) *parasitica* has long been a subject of much conjecture, owing largely, the present writer thinks, to the unnatural figures of these animals in all the text-books and most popular books—derived probably from old and abnormal aquarium specimens. In most figures purporting to show the relationship of these animals, the anemone is shown with its tentacles beautifully expanded and the mouth region facing *upwards* away from the ground, and generally

also one anemone as the central figure sitting on the top of the shell—containing the hermit-crab—with its column extending high above the shell and crab.

When these hermit-crabs with their associated anemones are caught fresh in the trawl it may be observed that although the anemones come up closed in no case are they sitting on the shell as is shown in the well-known figures; on the contrary, whether there is only one or as many as three anemones on a shell they are all found to be either hanging from the shell with the disc region towards the ground or are straining their bodies to reach their discs over the side of the shell towards the ground (see Fig. 1). In order to obtain more information, a collection of fresh hermit-crabs and anemones was obtained by trawling in September 1920 and a few experiments made in a tank. The hermit-crabs and anemones were isolated and kept without food for a few days, in the course of which most of the anemones closed. At 11.30 A.M., September 22, the crabs, carrying altogether 18 anemones, were fed with cockles and queens. At 12.5 P.M. all anemones were open with their discs and tentacles spread flat out on the bottom of the tank (as is shown in Fig. 1) and being trailed about in this position by the crabs. At 10 A.M., before the feeding, two anemones were closed, three already had their discs on the ground, and thirteen were held horizontally from the apical region of the shell-house of the crab, and at 1 P.M., after feeding, many were again closed or with their bodies held horizontally. On September 29 the experiment was repeated, but this time fresh dredgings only were thrown into the tank. All the anemones soon put their discs flat on the ground, and those which were sitting horizontally bobbed their discs down on the ground within a few minutes, almost as though the order "heads down" had been given and obeyed. It was not possible to see whether the unusual movements of the crabs on the addition of food, or the smell of the added food, caused the anemones to react as they did.

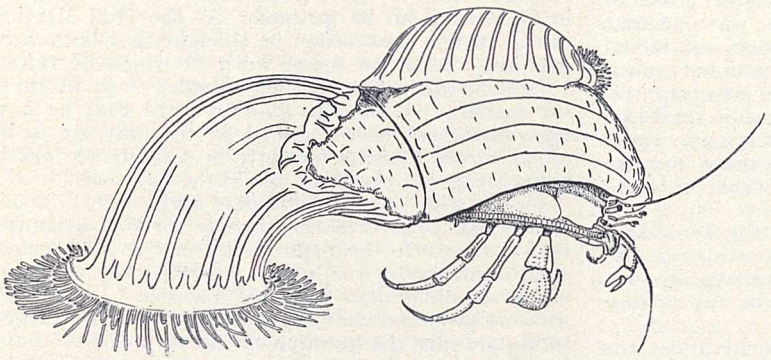

FIG. 1.—Drawing from life of the Hermit-crab (*Eupagurus bernhardus*) in a shell of the common whelk with two anemones (*Calliactis parasitica*) shown in the natural feeding position, and with the commensal worm (*Nereis fucata*) in the act of taking food out of the jaws of the hermit-crab. (About half the natural size.)

On adding the food to the tank it was also observed that the worms (*Nereis fucata*) living in the shells inhabited by the hermit-crabs also came out to feed. The hungry worms came out cautiously some time after the hermit-crabs had begun to feed, and in one case a worm was observed to crawl alongside the body of the crab (see Fig. 1), over the active mouth appendages, and literally to take with impunity a piece of food from between the jaws of the crab and bolt it. There seems to be little doubt that this action of the worm is consciously tolerated by the hermit-crab, as it was observed that the crab can apparently control the exit of the worm from the shell. It was found, however, that strange worms taken from other hermit-crab shells are not regarded in a kindly manner by either the anemone or the crab: worms fed to anemones are eaten, and worms straying in the neighbourhood of hermit-crabs were mercilessly torn up and tasted but rejected as food. The spectacle of a hermit-crab cleaning itself after feeding is a revelation of the value of spines and hairs and of the meticulous cleanliness of these animals, and cannot fail to impress the observer with the pleasure—and even mild intoxication—experienced by the hermit-crab from the feed.

It is clear that the anemone derives advantage from the hermit-crab by getting dragged about with its tentacles on the ground and being given opportunities for picking up pieces of food left or lost by the hermit-crab and for capturing other animals as food. The hermit-crabs were not seen to pass on pieces of food definitely to the anemones, but there would always be a good chance of an anemone getting some food from the table of the hermit-crab, owing to the habit of the latter of tearing the food apart.

The crab itself probably derives some measure of protection from attacks from fishes owing to the unpleasantness of its associated anemones as food, but it is well known in this laboratory that the common ballan wrasse (*Labrus bergylta* (*maculatus*)) will watch its opportunity to seize a large claw of a hermit-crab and shake it—like a dog worrying a rat—with the common result of extracting the whole hermit-crab out of the shell-house without touching the anemone.

The function of the worm in the shell can scarcely be guessed at, but the curious and constant wave-like motion of the whole body of the worm—which can be seen by making a window in the shell—will certainly keep up a strong current of water around parts of the body of the hermit-crab, and may assist the hermit-crab in this way in the aeration of its body or in the removal of effete products. The advantage to the worm of obtaining shelter and of partaking of the hermit-crab's food is obvious.

J. H. ORTON.
Marine Biological Laboratory, Plymouth,
November 9.

First Lessons in Practical Biology.

AFTER being encouraged by favourable criticism, both from the Press and from private individuals (not in all cases personal friends), I was somewhat surprised at the acerbity of the attack, published in NATURE, November 4, upon my unpretentious book "First Lessons in Practical Biology." Helpful criticism is welcome to an author, and the correction of errors can be the making of a second edition of a text-book; but adverse criticism in which personal bias of opinion is allowed to outweigh generally accepted beliefs can have little value either for the author or for the reading public.

If "the telson is *not* a segment" I am consoled by the thought that two such standard works as "Practical Zoology" (Marshall and Hurst) and "Biology" (Parker) contain the same heresy. If "the biramous appendage is *not* the primitive form of crustacean appendage" I have still to read a more convincing argument than that given in the "Cambridge Natural History (Crustacea)."

I conclude that the critic was so pained by my restricted use of the term "embryo" (as applied to plants) that he failed to read to the end of the chapter; otherwise he would not have stated that "experiments on plant physiology are not reached until chapters 16 and 17." I agree that it is desirable to introduce plant physiology at an earlier stage in the course; but, with the exception of *germination* (which is introduced in the Easter Term), the experiments seldom yield good results in the winter months. The school year begins towards the end of September, and the arrangement of the chapters (as stated in the preface) was based upon this assumption.

E. W. SHANN.

Oundle School, November 10.

I REGRET that Mr. Shann regards my review of his book as an "attack," and yet more that it calls from him the word "acerbity." The need for brevity compelled, perhaps, a certain bluntness; and I beg him to accept my assurance that it was solely to my regard for space in your columns that any such bluntness was due. It was from like considerations that I was obliged to refrain from indicating the authority for and adducing evidence in support of some of my criticisms.

With regard to the telson and biramous appendage I adhere to my statement. If Mr. Shann will refer to p. 144, § 2 *c* of Marshall and Hurst (9th edition, 1920), he will see that the telson is spoken of as a "region" of which a "segment" is a part. On referring to the passage in my copy of the "Cambridge Natural History" I find that when I first (presumably in 1909) read its discussion of the relative claims of the biramous and foliaceous limb to be regarded as "primitive," I wrote in the margin "All the facts here stated, if taken in the reverse order, support the opposite theory." This is equally true to-day. If Mr. Shann will read H. M. Bernard's "The Apodidæ" (Macmillan, 1892) I shall be astonished if he does not abandon the biramous as the "primitive" form of crustacean limb.

I duly noted that the course was arranged with the view of beginning in the Michaelmas Term; but as the very next sentence in the preface suggests modification of the order "at the discretion of the teacher," I felt justified in directing attention to the tardy appearance of plant physiology. The fact that some physiological experiments occur as early as chapter 14 does not seriously affect my criticism.

THE REVIEWER.

The Mechanism of the Cochlea.

IF I understand Dr. Perrett's letter in NATURE of November 11, p. 633, his objection to Yoshii's experiments (which would apply equally to those of Wittmaack and Siebenmann) is based on the assumption that the intensity of the stimulation of every part of the cochlea must be proportional to the amplitude of the vibration set up in that part. I think this assumption is unwarranted, as the intensity of the sensory impression may vary also with the rapidity and the rate of change of direction of the movement imparted to the cilia of the hair-cells; *i.e.* as the total energy of the stimulus, not its amplitude only. Even supposing Dr. Perrett's assumption were correct, still Yoshii's deductions are not invalidated. Take the case in which he found that after prolonged subjection to high-pitched noise the basal portion of the cochlea showed degeneration. He deduces the logical conclusion that a high-pitched note stimulates the basal portion of the cochlea. It does not matter whether the stimulus thus applied were small as compared with that produced in the apical region by a prolonged low note or not. The apical region remained unaffected because it was not stimulated at all.

I cannot say that my model shows the shifting of the responses according to the intensity of the stimulus that Dr. Perrett says it should do, and possibly my knowledge of physics is insufficient to enable me to appreciate the reasons which lead him to look for this result. Personally, I have very little faith in the "crucial test" method of solving the problem of sound perception. The question has already been so long and so keenly debated, and so many "crucial tests" have been applied on both sides of the argument, that one almost begins to doubt the possibility of tone perception at all.

I have read Sir William Bayliss' letter (p. 632) with great interest. Naturally, it is very gratifying to me to find that my view of the mechanism of the cochlea has the support of so distinguished a physiologist. I am not very sanguine that my model will throw much light on the more refined details which he gives of the working of the cochlea. What the model actually shows is a definite, though not always well-defined, series of responses at different points along the "basilar membrane" for vibrations varying in frequency from about 100 to about 1000 D.V. per sec., the higher notes being at the proximal and the lower at the distal end of the scale. More than this I cannot claim for it. The mechanical difficulty of setting up a series of short threads, evenly spaced, evenly graduated in tension, and maintaining their spacing and tension unaltered during and after the processes of fixation, embedding and immersion in fluid, is so great that I have not succeeded so far in attaining anything approaching accuracy.

One need scarcely say that so imperfect an apparatus cannot, in its present state, throw much light on the more recondite points. If on the other hand we concentrate our attention on the more obvious, and more fundamental factors, I think the model does give some help. We recognise in the basilar membrane of the cochlea a threefold differentiation of its fibres, for length, tension and mass, and this differentiation is progressive, and in the same sense for each factor. We can embody those mechanical factors crudely in the form of a working model, and we get some sort of remote and inaccurate representation of what happens in the cochlea. The effects observed are undoubtedly resonance effects. It follows that the same resonance effects must take place in the cochlea. One cannot understand how Nature could evolve so elaborate a mechanism of resonance as we find in the cochlea, except by means of, and for the purpose of, increasingly accurate analysis of sound.

G. WILKINSON.

387 Glossop Road, Sheffield, Nov. 15.

An Offer of *Nature* Volumes.

THE writer has been entrusted with the disposal of thirty-three volumes of NATURE (unbound, as issued) which their owner wishes to present to some library in the war-devastated area. These consist of vols. 50 to 56, 74 to 92, 97 and 98, and 103 to 107. A few parts are missing. Should any reader of NATURE know of some one who may be communicated with for this purpose, the information would be gratefully received.

M. GHEURY DE BRAY.

40 Westmount Road, Eltham, S.E.9,
November 13.

Human Blood Relationships.

THE idea that a loss of blood by hæmorrhage or the possession of blood of a poor and deteriorated quality might best be rectified by the introduction into the body of blood from a healthy person is of respectable antiquity. It is small wonder that the ancients attributed to so splendid and conspicuous a tissue an importance rather beyond its due. About the time of the fire of London Pepys attended experiments in which the blood of one dog was passed into another and found to be sufficient for its needs, and on another occasion at which a man was hired for a sovereign to have some sheep's blood let into his body. For even at this time it was realised that some sorts of blood were more suitable for transfusion into man than others. Little boys might be bled to death in the fifteenth century to provide stimulating potions for aged Popes, but human blood seems scarcely to have been available in Lower's time, and the choice generally fell on the sheep, partly because of its gentle and amiable disposition and partly "quia Christus est agnus Dei," as Coga said, an indigent bachelor of divinity who subjected himself to the experiment in 1667. But transfusion of blood never became an important or popular therapeutic procedure on these terms; large quantities of foreign blood were found to cause serious and even fatal ill-effects and small amounts did no good. With the discovery of the last thirty years that the tissues of any one species of animal are foreign and more or less poisonous to the economy of any other species came the recognition that transfusion in man could be done only with human blood, and in recent years the value of the procedure has been fully established, large quantities being transfused from a healthy to a sick person without untoward effect.

In this revival of human transfusion it was, however, soon found that the capacity of the body to identify any blood as foreign to and incompatible with its organisation was based on finer distinctions than zoological species. If from a dozen people a few cubic centimetres of blood are withdrawn, and in each case preparations made of the serum and of the red corpuscles washed free from serum, and if a sample of each lot of corpuscles is then mixed with a little of each serum in a series of test-tubes, it will be found that the results are not all the same. In some the corpuscles behave as if they were suspended in physiological salt solution—remain dispersed from one another and intact; in other cases they run together into larger or smaller clumps and masses and often disintegrate. It is obvious that the occurrence of this agglutination in the circulating blood is very undesirable, as the masses of corpuscles are liable to block important blood-vessels, and there is plenty of experience to show that serious trouble may be caused in this way. It is therefore not every human blood that is suitable for transfusion into a given person.

By sorting over a large number of people by this test it has been found that they may be classified into four groups by the satisfactory hypothesis of von Dungern and Hirschfeld. On this view there are two agglutinating factors in human blood serum (*a* and *b*) and two agglutinable factors (A and B) in human blood corpuscles: A corpuscles will react only with *a* serum, *b* serum only with B corpuscles. A is never found in the same person as *a*, nor B with *b*; either combination would be incompatible with life. The blood characteristics of the four groups are:

	Serum.	Corpuscles.
Group I. . .	neither	A and B
Group II. . .	*b*	A
Group III. . .	*a*	B
Group IV. . .	*a* and *b*	neither

It follows that the serum of Group I. will not agglutinate anybody's corpuscles, while the corpuscles of Group I. are agglutinated by all other sera except their own. Group IV. is the reverse of this, while the serum of Group II. agglutinates the corpuscles of Groups I. and III., and the serum of Group III. the corpuscles of Groups I. and II. The corpuscles of Group I. can safely be put only into recipients belonging to the same group, those of Group II. only into Groups I. and II., those of Group III. only into Groups I. and III., those of Group IV. into anybody. It is a curious fact that in actual practice it is only the qualities of the donor's corpuscles and the recipient's serum which need be considered. When, for example, Group IV. blood is transfused, the plasma of it should agglutinate the corpuscles of the recipient if the reaction took place as it does outside the body. This does not appear to happen, or if it does it produces no obvious ill-effects—which is fortunate, as otherwise safe transfusion would be impossible except between members of the same group. Why this should be so is at present doubtful. It is most probably due to the quantity of transfused plasma being insufficient, when diluted with the recipient's blood, to cause a significant agglutination of the recipient's corpuscles. The fact that it is plasma which is injected and not serum may also have some influence, though the recipient's plasma has the same effect as his serum, at any rate qualitatively.

While it is convenient to recognise four varieties of individuals, it will be seen that there are only two factors concerned. A is characteristic of Group II., and B of Group III.; A+B are present in Group I., and both are absent in Group IV. A corpuscles are necessarily associated with not-*a* serum, and B corpuscles with not-*b* serum. In inheritance these qualities have been shown to be transmitted as straightforward Mendelian factors. It follows that the blood of parents and children are by no means necessarily compatible: though parents both of Group IV. can produce children only of the same group, two Group I. parents may have offspring belonging to any group, according to the particular composition of their hybridity. The possibility of using these blood reactions to investigate cases of disputed parentage has been carefully worked out by Ottenberg, who shows that the method can have but a limited application, though the answers are conclusive if they can be obtained at all. Of much interest also is the observation that the proportion of the population falling into Groups II. and III. varies a good deal in different races. In England about 40 per cent. are Group II., about 15 per cent. Group III., Groups I. and IV. giving about 2

and 43 per cent. respectively. Several workers, and especially the Hirschfelds, have shown that as one travels from west to east the prevalence of Group II. (A) decreases and that of Group III. (B) progressively rises. In Western Europe, A is found in about 45 per cent., in Russians and Arabs in 37 per cent., in negroes and Indians in 27 per cent. B, on the other hand, increases from about 15 per cent. in France, through the Balkans (20 per cent.), Malagasies (28 per cent.), negroes (34 per cent.) to Indians with 49 per cent. We have here an obvious suggestion of two original races of mankind, which have mingled in various degrees: it is possible that in some remote place a pure A or B variety still exists.

At present there is no evidence that these blood characteristics are associated with any other qualities, and it seems likely, like some other Mendelian characters, that they are negligible in the problems of selection and survival. It would, too, be an error of the ancients to suppose that the qualities of the blood dominated personality and conferred a general characteristic on the individual. There is much evidence of the essential similarity of parents and offspring. The greater success of grafting tissues from one animal to another if they are of the same family is a germane example. In blood tests brothers and sisters by no means always agree so far as the agglutination of their corpuscles is concerned: in other respects their bloods are probably more similar than those of more remote relations.

The History of the Photographic Lens.

DR. REGINALD S. CLAY performed a needed and useful service when he selected for the subject of the twenty-fifth annual Traill-Taylor Memorial Lecture, which he delivered at the meeting of the Royal Photographic Society on October 10 last, "The Photographic Lens from the Historical Point of View." It was a needed service, because a historical review of the origin and development of the photographic lens is necessary for a just estimate and balanced perspective of the many and diverse scientific factors that have to be taken into account in the production of modern photographic lenses. It was a useful service, because the fascinating and, at times, almost dramatic story that Dr. Clay had to tell brings out clearly the paramount importance of the pioneer work done in this field by British firms and scientific workers, and it must act as a useful corrective to the tendency, sometimes manifested in unexpected quarters, to underrate the value of British work in the optical field.

After touching lightly on the early history, Dr. Clay comes to "one of the great landmarks in the history of optics—the invention of the achromatic lens." John Dolland, after numerous experiments, exhibited to the Royal Society an achromatic prism in 1758 of crown and flint glass, and explained its construction. Of the authors who contributed, in this period, before the invention of photography, to the theoretical treatment of the lens, Dr. Clay instances, after Kepler, the following:

> Huygens, who, besides expounding the wave theory of light and the explanation of double refraction, also dealt with the spherical aberration of lenses, and showed how it varied with their aperture and focal length; Newton, who investigated the dispersion of light; Joseph Harris, who discussed the cardinal points, optical centre, oblique pencils, curvature of field, etc., in his "Treatise of Optics"; Herschel, who obtained valuable equations for the calculation of objectives free from chromatic and spherical aberration; George Biddell Airy, who investigated the conditions for eliminating astigmatism and distortion; William Hamilton, who evolved powerful mathematical methods which even yet have not been fully utilised; and, last but not least, Henry Coddington, who worked out the methods which, I believe, still form one of the most useful bases for attacking new problems in lens construction.

The next milestone marks the almost simultaneous announcements of the inventions of photography by Daguerre in 1838 and Fox Talbot on January 30, 1839, and we reach "the epoch from which we may date the great evolution of the photographic lens." After referring to the photographic lenses of Charles L. Chevalier, Dr. Clay comes to the work of Josef Max Petzval (1807–1891), who computed a new and most successful lens, corrected for spherical aberration over a small angular field, which was made by Frederick Voigtländer in 1840.

We may pass over much interesting record and come to a new chapter, opened in 1866 with the aplanatic lenses of Steinheil and Dallmeyer. Steinheil, "beginning to recognise the value of symmetry in reducing astigmatism and distortion," concluded that the astigmatism would be less if the refractive indices of the glass were more nearly equal; he therefore used two flints instead of flint and crown, putting the higher refractive glass outside. Dallmeyer also used two flints, and called his first lens a "wide-angle rectilinear lens," 1866. It worked at f/15, and he followed it by his symmetrical at f/7 and f/8. In 1874 Steinheil made a portrait lens of two cemented lenses working at f/3·5, and in the same year Ross brought out their portable and rapid symmetrical, calculated by F. H. Wenham. "This is of interest," says Dr. Clay, "as Ross and Co. (as the firm then was) was thus the first firm to employ a scientific man as calculator. Wenham was with them from 1870 till 1888."

The next step, which Dr. Clay describes as "the greatest step in the development of the photographic lens," was made possible by the new glasses—the barium crowns of the Schott glass factory at Jena. The problem and its solution is thus expressed:

> An achromatic lens of ordinary crown and flint, which we may call an "old achromat," could be corrected spherically, but not made anastigmatic. An achromatic lens made of the new barium crown and a flint could be corrected for astigmatism, but not spherically. To correct both, all three glasses must be used—old crown, flint, new barium crown. To take full advantage of this principle, it is obvious that each component can be made of all three glasses. It can then be achromatic, anastigmatic, and aplanatic. By combining two such components into a symmetrical lens, it can also be made orthoscopic, and can easily be given a flat field. This is the principle underlying the well-known Goerz lenses. Another way to achieve the result is to use two unlike combinations, one of which is made responsible for

correcting the spherical aberration and the other for correcting the astigmatism. This is usually the method adopted by Rudolph in the earlier of the Zeiss lenses and several of the recent lenses by other makers.

Hugo Schroeder and Stuart, of Ross and Co., were the first to take advantage of the new Jena glasses, and in 1888 they patented the "concentric" lens, composed of a flint and a barium crown. It was corrected for astigmatism, but had a lot of spherical aberration. Dr. Clay reviews briefly the series of Zeiss lenses—Planar, Protar, Unar, and Tessar—made by Ross under license, and in this connexion tells the following significant story:

In 1911, when Zeiss had finished their factory at Mill Hill, they gave Ross notice to terminate the license, and themselves made the Tessar—the only one of which the patent was still running. This is rather an illuminating fact. It must be remembered that in 1892, when Ross started making the Zeiss lenses, Ross had a great name as makers of photographic lenses, while Zeiss's were practically unknown in that connexion, and undoubtedly Ross's reputation helped to make the new lenses known; yet no sooner are Zeiss ready to make their lenses over here than they terminate the contract! No further comment is necessary.

An interesting summary follows, which we have not space to notice in detail, of a brilliant series of lenses produced by Ross from 1892 to the present day. Dr. Clay says: "One other achievement of this firm I must refer to. When the Air Force began to take aerial photos in the war they found the Ross-Zeiss Tessar, of 8½-in. focus, suitable, but soon wanted great numbers, and also asked for a longer focal length lens with perfect definition over a small angular field, *e.g.* a 20-in. lens to be used with a 5 by 4-in. plate. This was wanted urgently, and in a single fortnight the lens was recalculated, and the 'Airo-Xpres' lens evolved in November 1918, working at f/5·6. Messrs. Taylor, Taylor and Hobson also made a variety of the Cooke lens, the 'Aviar,' for the same purpose."

We have not space to deal more than hurriedly with the fascinating record that Dr. Clay gives of the other work done in Britain in the development of the photographic lens to its present stage of wonderful achievement. An interesting account is given of the lenses introduced by the firm of Dallmeyer, and special attention is directed to the striking advance represented by their telephoto lenses. The original patent for the telephoto was taken out in 1891. Another English firm, R. and J. Beck, Limited, it is interesting to note, were the first to apply the iris diaphragm to photographic lenses, as early as 1882. In 1906 Beck introduced their "Isostigmar Universal," and in the following year their Isostigmar portrait lens. "These lenses do not obey the Petzval condition—that the sum of the power of the lenses, divided by their refraction index, should be zero—and were constructed by omitting this from consideration, as they believed it was not essential for a flat anastigmatic field"—a view afterwards confirmed by the investigations of W. Elder. The Isostigmar is of interest, as it covers a field of 85 to 90 degrees at f/16, the first wide angle with such an aperture. Beck also introduced another simple idea—the use of magnifiers in front of a lens—made for their Frena camera in 1894.

We have left till the last not the least of the British achievements in the development of the photographic lens—the Cooke lens invented by W. H. Dennis Taylor and made and put on the market by Taylor, Taylor and Hobson, Limited. Dr. Clay says: "I do not think the great step which the Cooke lens marks is as well appreciated here as on the Continent. The introduction of this lens has formed the starting-point for a new method of lens construction which has had, and will continue to have, many fruitful applications." The germ of the invention is thus expressed by Dennis Taylor:

It . . . occurred to the author that since the normal curvatures of images due to any lens, whether simple or compound, are fixed by its refractive indices and power alone, and are independent of the state of rays entering the lens, whether convergent, divergent, or parallel, then it should follow that the normal curvature errors of an achromatic and aberration-free collective lens should be neutralised by the normal curvature errors of an achromatic and aberration-free dispersive lens of the same power (and made of the same glasses), placed at a considerable distance behind the collective lens; while the combination would, *as a result of the separation* . . . yield a positive focus. . . .

The patents for the Cooke lens were taken out in 1893, 1895, and 1898. During the war the special Aviar lens, referred to above, was evolved, designed by Arthur Warmisham of Taylor, Taylor and Hobson. It is a split-divergent lens, which was a conception of the inventor of the Cooke lens, but the exploitation of the idea was left to Warmisham, who was able, by making a special study of coma, to improve upon the large aperture Cooke lenses, and secure a flat field of larger area than had hitherto been found possible.

In a brief review of Dr. Clay's lecture we have had perforce to omit much of important interest, but we may conclude by re-echoing the words of the author: "In this story I think we in Britain may claim that we have borne our share, in spite of all the praise that has been lavished on the Germans."

Obituary.

Prof. Heinrich Rubens.

HEINRICH RUBENS was born at Wiesbaden on March 31, 1865, and received his early training at the *Realgymnasium* at Frankfurt on the Main, where he gained the School Leaving Certificate, equivalent to Matriculation, in March 1884. In the summer term of that year he proceeded to the Technical High School at Darmstadt to take up the study of electro-technics. During the following winter term and the summer term of 1885 he continued his studies at the Technical High School at Charlottenburg, but soon recognised that his ability and interest lay in the domain of pure science, and for this reason he began the study of physics. After spending the winter term (1885–86) at the University of Berlin, Rubens passed on to Strass-

bourg at Easter of the latter year to work under August Kundt. He followed Kundt to Berlin in May 1888, and obtained his Ph.D. there the year following. His early post-graduate career was spent as *Assistent* under Kundt at the Physical Institute of the University of Berlin, where he remained until 1896, when he was invited to the Charlottenburg Technical High School, and in 1900 he was officially elected professor at that institution. In the autumn of 1906 he was elected to a full chair of experimental physics at the University of Berlin, and to the directorship of the Physical Institute, which posts he filled during the remainder of his life. He died of leuchæmia on July 17 last.

Rubens was a member of the Berlin Academy of Science, and of many other similar bodies in his own country and abroad, including the Royal Institution, of which he was an honorary member. He held doctor's degrees (*honoris causa*) of the Universities of Leeds and Cambridge, and was a recipient of the Rumford Medal of the Royal Society.

Most of Rubens' scientific investigations were concerned with the infra-red region of the spectrum, and the logical connexion of his numerous researches is a noteworthy feature of his scientific activity. Many of the instruments used in the prosecution of his work were of his own construction, including the Rubens thermopile, and the Rubens-Du Bois spherical sheath galvanometer. He was led to the discovery of residual rays as a result of his work and measurements on the optical properties of various substances with regard to heat rays. He succeeded in reducing the previously unexplored region of about twelve octaves (from $\lambda = 0{\cdot}005$ to 50 mm.) between the infra-red region of the spectrum and electrical waves, by his discovery of about seven of the missing octaves.

After his observation that a number of minerals strongly reflect infra-red waves of certain definite wave-lengths, and transmit the rest of the rays, Rubens was able to isolate rays up to a wave-length of about 0·01 mm. Repeated reflection of the radiation from such surfaces results in a residual radiation which contains certain definite wave-lengths only; *e.g.* from fluorspar (0·022 and 0·033 mm.), rock salt (0·052 mm.), sylvine (0·063 mm.), potassium bromide (0·083 mm.), potassium iodide (0·094 mm.). In part collaboration with Wood, Rubens isolated still greater wave-lengths by the quartz-lens method, in which, by virtue of the higher refractive index of quartz for these long waves than for the shorter infra-red and visible rays, and by the use of suitable diaphragms, he succeeded in obtaining rays with a wave-length of about 0·110 mm. from an incandescent mantle. Using a quartz mercury lamp he extended this limit to beyond 0·3 mm. In continuation of his earlier measurements on wave-lengths in the near infra-red, Rubens and his co-workers examined the dispersion and absorption of the whole range of the infra-red in numerous substances. By making use of the refractive indices of numerous substances found for these long wave-lengths, or the values extrapolated for infinite wave-length, he tested the validity of Maxwell's law ($n^2 = k$) between the refractive index for these waves, and the corresponding dielectric constant of the substance in question. Several series of measurements on the absorption of infra-red waves in water vapour supplied him with the material requisite for the comparison of Bjerrum's theory of rotation spectra with experiment, and for calculating the main moment of inertia of the water vapour molecule.

In addition to his fundamental work on residual rays, Rubens accomplished much in other branches of radiation. He carried out measurements in collaboration with Hagen at the *Physikalisch-Technische Reichsanstalt* on the reflecting power (R) of metals, which led to the empirical result that for metals the coefficient of penetration ($P = 1 - R$) for very long waves can be represented by the relation $P = 0{\cdot}365\sqrt{\sigma/\lambda}$, where σ is the specific resistance of the metal, and λ the wave-length of the rays in terms of the unit 0·001 mm. This result is in agreement with deductions from the electromagnetic theory of light. His investigations on the validity of the law of radiation are of primary importance. Conjointly with Kurlbaum he carried out measurements on black body radiation of long wave-length, and this work was largely responsible for a revision of Planck's first radiation formula, and thus supplied one of the experimental bases of the quantum theory. Only last year, Rubens again applied his great experimental ability in an endeavour to test Planck's law of radiation in its final form. The results of this work led to the complete confirmation of the theory. They were communicated to a Congress of Physicists at Jena in the autumn of 1921, and Rubens was acclaimed by the congress in a manner seldom met with in scientific life.

Rubens, whose wife survives him, was in failing health for some years prior to his death. To those who knew him well, it seemed that the privations attendant upon war-time conditions were in a large measure responsible for hastening the end. In addition to his great powers and achievements, his active nature and kindly disposition bound him closely to his colleagues, who realise that in Rubens they have lost much more than a valued colleague. The loss to science will be appreciated by those of other countries who came in contact with him, for one could not meet Rubens without feeling the forcefulness of a striking personality. Until his death he maintained none but the friendliest of feelings towards his colleagues in England, and during the long years of the great war he took a human interest in the well-being of those of our scientific nationals whose lot it was to be detained in enemy territory. For these he did what he could. Science mourns his loss, and the record of his active life will occupy a prominent place in the annals of science.

R. W. L.

THE opportunity is most welcome to add my expression of deep regret for the loss of Prof. Rubens at an age when much might still have been expected from his scientific activity. I well remember the enjoyment of the hospitality of himself and his family in days now past, in the residence attached to the Physical Institute of the University of Berlin, where memories of Helmholtz were evoked at every turn. One can recall the simplicity of the apparatus used in his personal investigations, in keeping with the directness of his main results. In these respects he retained throughout his career the stamp of the school of his early master Kundt.

The existence of sharply defined ranges of intense

optical reflection, even of the metallic type, from some crystals had been known and understood in its main features for a long time.[1] It was left for Rubens to develop it into what amounted to a new kind of spectrum analysis for invisible rays far down in the infra-red, by sifting the radiation by successive reflections. By this means he discovered and isolated precise narrow bands of dark radiation (*Reststrahlen*) very remote from the visible spectrum: just what was most needed at that time for the wider verification and consolidation of ideas regarding the general laws of radiation. In collaboration with Rubens in these investigations his friend E. F. Nichols first made his mark, soon to be followed up at home in America.

In later years by use of the *Reststrahlen* he was able to discover that in metals the defect from perfect reflection, for radiation of great wave-length, depended on their conductances alone. This was readily intelligible in a general way: for the square of the complex index of refraction for rays of frequency $p/2\pi$ is of the form $K - 4\pi c^2 p^{-1}\sigma\iota$, and as both terms of it are found to be effective in metals for ordinary light, the second term, involving p^{-1} and the specific conductance σ, must predominate far in the infra-red. But the entirely unexpected feature was that the agreement was so close that optical observations by themselves could give a good value for the ordinary conductance σ of a metal for continuous currents. In other words, the response to electric force in metals is so prompt that the mechanism of conductance becomes completely established within the fraction 10^{-13} of a second of time, thus giving an essential datum for the understanding of the process of transfer of electrons in metallic bodies.

The decisive completeness of this incidental verification of the Maxwellian scheme of radiation naturally attracted general attention, in its contrast with the long years that elapsed in the early time before the cause of the imperfect correspondence of the refractive index with $\sqrt{K}$ for transparent media was fully appreciated.

One was struck with the ease and simplicity of Rubens' modes of thought. The problems which he wished to attack came naturally to him, without any incrustation of theoretical complexities. Like Faraday and many another experimenter, he was an example of how far simple physical intuition could lead. The directness and cordiality of his personal qualities must have won and retained the regard of all who knew him.

JOSEPH LARMOR.

LIEUT.-COL. G. L. TUPMAN.

LIEUT.-COL. GEORGE L. TUPMAN, who died at Harrow on November 4 at an advanced age, was for many years a devoted amateur astronomer. He was elected a Fellow of the Royal Astronomical Society in 1863, being one of the oldest Fellows at the time of his death. He was on its council from 1873 to 1880, and secretary from 1884 to 1889. His earliest astronomical work was on meteor radiants; he made numerous observations of meteors while on service in the Mediterranean, 1869–1871, and published a catalogue of radiants in Mon. Not. R.A.S., vol. 33. Tupman observed the transits of Venus in 1874 and 1882 from Honolulu and New Zealand respectively. He worked for some time at Greenwich Observatory as a volunteer, both in preparation for the transits and in their subsequent discussion; his preliminary result from a discussion of the 1874 transit, 8″·813, is very near the value now accepted. Since many of the stations were dependent on lunar observations for longitude, he studied carefully the errors of the lunar ephemeris from the results of all the leading observatories.

Tupman had a well-equipped observatory at Harrow, with two equatorials, reflector and refractor, and a transit circle. He made many meridian observations of stars, also occultations (especially during the lunar eclipses of 1884, 1888, 1895 for the determination of the moon's diameter), comets, transit of Mercury, etc.; he also frequently invited other astronomers to use his instruments.

A. C. D. CROMMELIN.

[1] Cf. *ex. gr.* Stokes in discourses at the Royal Institution and to the Chemical Society, as early as 1864: "Math. and Phys. Papers," vol. iv. pp. 244, 261.

H. J. POWELL.

BY the death of Harry J. Powell, on November 26, at the age of sixty-nine years, the country has lost one of the earliest pioneers in the scientific manufacture of glass. For some years he lived in the works at Whitefriars, and during this time, and for many years afterwards, he superintended personally the weighing out and mixing of the material for the next week's batch of glass. For forty-five years he was making experiments with the object of improving the quality of the flint glass made at Whitefriars, and attaining perfection of colour in the glasses. These have led to the magnificent results seen in the windows of the cathedrals of Salisbury, Liverpool, and New York, and in those of many churches in this country and abroad. He not only improved the nature and colour of the glass, but he was a designer of the first rank. Few of the art museums of this country are without specimens of his artistic skill.

Mr. Powell was well known to most scientific men, and was always ready to put his knowledge and technical skill at their disposal. The vacuum flask, the idea of which was conceived by Sir James Dewar, was made first by him, and it was to his experiments that the success of Sir William Crookes's cerium glass, for cutting off the ultra-violet and heat rays, was mainly due. At the outbreak of war, foreseeing the shortage of glass for chemical purposes, he worked out, in conjunction with his son-in-law, a soda-lime glass with very great resistance to changes of temperature and action of water. This glass was used by the Admiralty for the construction of the horns of submarine mines.

Mr. Powell retired from the business three years ago, and devoted his time to an attempt to make generally known the results of his knowledge and experience. He worked up to the last, the final revision of a book, "Glass-making in England," and of an article for Sir Richard Glazebrook's "Dictionary of Applied Physics," in which he propounded a new theory of the origin of colour in glass, being completed only a few days before his death.

BY the death of Dr. Herbert Langton on October 12, in his seventieth year, the Museums Association loses its honorary treasurer, the museum sub-committee of Brighton its chairman, and the British Ornithological Union a valued member. A portrait appears in the *Museums Journal* for November.

Current Topics and Events.

THE dyeing of artificial silk at one time presented many difficulties, which have, however, been overcome so far as the silk made by the Chardonnet and Viscose processes is concerned. On the other hand, the new "acetate silk" does not lend itself with equal readiness to the dyeing operation and, hitherto, some difficulty has been experienced in producing an adequate range of fast and pleasing colours. The "acetate silk" arose as an outcome of the war, when the general opinion was reached that the method of the Dreyfus Brothers for producing aeroplane dope from acetyl cellulose was the best. The large factories which were then built for the preparation of this substance had, when the war ceased, to turn their energies for the most part into other directions, and the manufacture of artificial silk was one of these. The silk is of great lustre and beauty, but as the composition of the acetyl cellulose remains unaltered even in fibre form, it does not possess any marked affinity for that large and important class of colouring matters which are substantive to cotton. This affinity can, however, be imparted to the fibre if conditions are present which cause it to undergo hydrolysis in the dye-bath, and Prof. A. G. Green, working in the Research Laboratories of British Dyes Ltd., has now succeeded in isolating a new and curious series of colouring matters which are apparently particularly suited for the purpose of dyeing acetate silk. These colouring matters belong to a class of compound which is readily hydrolysed in solution, and in that form can be fixed on the acetate silk. Moreover, the "Ionamines," as Prof. Green has named the new colours, can be made to possess a diazotisable amino group, and many beautiful shades can be obtained by diazotisation and development on the fibre. It follows also that, since the ionamines possess no affinity for the cotton fibre, it is possible to dye a fabric composed, for example, of cotton and acetate silk, two colours in one bath. Thus, in a bath containing a mixture of chlorazol green BN (a substantive cotton dye) and ionamine KA, the cotton will be dyed green and the acetate silk red. The effects, which are very striking, should go far to render the new silk popular.

AN International Aeronautical Exhibition will be held at the Grand Palais, Paris, during the second half of this month, commencing on December 15. As is to be expected in view of the great interest aroused by the remarkable records set up during the past few months, particular attention will be devoted to motorless or wind-flight. Gliders that were used in the recent contests will be exhibited, including the machine in which Maneyrol so dramatically beat the German duration record, just at the end of the gliding week on the South Downs. A particularly interesting feature of the exhibition will be the attempt to illustrate the scientific principles underlying wind-flight, both as regards the results already achieved and the problems that yet remain to be solved. Thus, in addition to showing the wings of such birds as the albatross, eagle, condor, etc., the promoters will illustrate the way in which the presence of wind renders motorless flight possible. Such winds are (1) vertical convection currents in the air due to the sun's heat; (2) upward currents due to the existence of undulations in the ground, like hills and valleys, the main feature of the flights executed during the past few months; and (3) varying horizontal currents, which are known to aid motorless flight. Some use of the latter appears to have been made in a recent flight in Germany.

A FILM record of the Mount Everest Expedition of 1922 was shown for the first time at a joint meeting of the Royal Geographical Society and the Alpine Club held on Tuesday, November 21, at the Central Hall, Westminster. The film, which is one of exceptional interest and permanent value as a record of life in Tibet and the conditions of mountain exploration in 1922, is the work of Capt. J. B. L. Noel, who succeeded in operating his kinematograph at an altitude higher by many thousands of feet than any to which such an instrument has previously been carried. He made sure of good results by developing his films, under great difficulties, partly in a tent by the Rongbuk glacier torrent at a height of 16,500 feet, and partly in a dark room he built in the old fort at Gyantse. The conditions were such that when the film was wet it froze; when dry it sparked with the slightest friction and could not be kept free from dust. In spite of these difficulties, however, a good film-record was obtained. The subjects of the film include the scenery of the forest belt beyond Darjeeling; the bare and dry plateau of Tibet; the mode of life of the Tibetans; the Rongbuk monastery with its sacred Lama and ritual dances; the approach to Mount Everest along the Rongbuk glacier; and the assault on the mountain by the climbing parties, by way of the North Col. The effects of the terrible wind, flinging clouds over the North Col and tearing the snow from the mountain, were well shown on the film. Capt. Noel took his kinematograph to Camp III. (21,500 feet), and, using a telephoto lens, photographed the descent of the first climbing party, who had discarded oxygen and reached a height of nearly 27,000 feet. He ascended to Camp IV. (22,500 feet) on the North Col with the second party, who carried oxygen, and photographed them next day during the first 2000 feet of their ascent to 27,235 feet, the highest point reached. The Mount Everest Committee has arranged for the film to be shown to the public for a season at the Philharmonic Hall, as well as in the principal cities of Great Britain. The proceeds will be devoted to the cost of a third expedition.

IN his interesting and suggestive presidential address to the Surveyors' Institution on November 13 Mr. J. McClare Clark discusses the effect of post-war conditions on agriculture and shows that the sequence of events since 1918 is exactly parallel to that after 1818, and that in many respects events of 1922 closely resemble those of 1822. During the

Napoleonic wars the prices of wheat rose enormously; in 1800 it was 113*s*. 10*d*. per Imperial quarter. Under this stimulus farmers made great efforts to increase production, and in spite of depleted supplies of labour they kept the country provided with food. Soon after the peace, however, there set in a severe break in prices due to the general financial dislocation. Unemployment was rife in all parts of the country and Poor Law methods added to, rather than mitigated, the difficulties. To make the resemblance between 1822 and 1922 even closer, there was a remarkable similarity in the seasons. The history of the years following 1822 affords hope for the future. Agriculture improved with the gradual readjustment in the financial and commercial position, while the introduction of railways proved of enormous benefit. From 1836 onwards progress was unmistakable, while the founding of Rothamsted in 1843 and of the Royal Agricultural College, Cirencester, in 1845 marked the introduction of scientific methods which completely revolutionised British agriculture and opened up an era of prosperity that closed only when the new countries of the West flooded our markets with produce at prices with which the British farmer could not compete. It is a hopeful augury for the future that the scientific organisation is already well developed. Colleges and new research stations have been opened, Rothamsted has been reorganised and greatly extended during the last few years, while Cirencester was reopened a few weeks ago.

IT is difficult for any one who has received a scientific training to believe that anything can be said in favour of our cumbersome and complicated system of weights and measures, or to understand the difficulties which are advanced against the adoption of the metric system, which has become the international language of quantity. In his presidential address to the Decimal Association on November 23, Sir Richard Gregory pointed out that in forty-six countries of the world the system is now obligatory, the latest addition being Japan, which adopted metric measures in April last. The United States and the British Empire are the only two civilised nations which remain outside this circle, and they must come within it eventually, as there is no possibility of the Imperial system being adopted internationally. With every development of electrical science metric measures come into increasing use; for all the units employed are based upon the metric system. In wireless communication, and for broadcasting, wave-lengths are expressed in metres, and in aviation international regulations are similarly described. Even among English-speaking peoples there is much diversity in the weights and measures employed. The standard gallon in the United States is the old wine gallon of 231 cubic inches instead of the Imperial gallon of 277·274 cubic inches; the hundredweight there and in Canada is the cental of 100 lb. instead of the Imperial cwt. of 112 lb.; and the ton is the short ton of 20 centals or 2000 lb. instead of the ton of 2240 lb. The simplest way to avoid the confusion consequent upon these and other diversities would be to adopt the metric system, and the Decimal Association and American Metric Association working for this end may be assured that their efforts must finally achieve success.

IN order to demonstrate some of the minor uses of home-grown timber a special exhibit is on view in Museum iv, in the Royal Botanic Gardens, Kew, of requisites commonly used in kitchen, laundry, and dairy. Among them are bread boards, rolling-pins, towel rollers, measures, scoops, bowls for milk and pastry, butter knives and pats, butter prints, dishes for skimming milk, potato mashers, steak beaters, brushes and brush backs, spoons, mangle rollers, a washing dolly, egg-cups, a plant-tub, and some wood wool. The last-named is a most useful substance for packing fruit, glass, and crockery. The principal woods used for these articles are beech, lime, sycamore, birch, elm, poplar, and willow. A number of articles are shown in various stages of manufacture, thereby demonstrating the immense amount of work that is required to produce a common utensil that may be purchased for a few pence, and at the same time indicating what an important part is played by the manufacture of home-grown timber, even into minor articles, in the provision of employment for large numbers of men and women.

SOME interesting figures are given in the issue of the *Engineer* for November 17, which show the relative costs of transport by different agencies working at their normal speeds. The list opens with the barge, with a speed of 1 mile per hour at an estimated cost of 0·0004*l*. or $\frac{1}{10}d$. per ton-mile, and at the other extreme is the maximum expenditure per ton-mile of the R.A.F. in England, with the cost for a speed of 100 miles per hour of 9·3*l*. or 2232*d*. Between these extremes are some surprising results, some of which are based on official figures while others are estimates. The London motor omnibus at 10 miles per hour costs 0·016*l*. or 4*d*. per ton-mile. An electric passenger train (3rd class) at 25 miles per hour costs 0·018*l*. or 4*d*. per ton-mile, while the corresponding steam train at 40 miles per hour costs 0·024*l*. or 6*d*. With these figures can be considered the cost per ton-mile at 12 miles per hour of a liner (1st class), which is 0·22*l*. or 53*d*., though for the liner (3rd class), it is only 0·1*l*. or 24*d*. The London-Paris passenger aeroplane service, assumed to travel at 100 miles per hour, at present rates costs 0·33*l*. or 80*d*. per ton-mile, though the estimate of the Advisory Board for Civil Aviation is 0·7*l*. or 168*d*. The cost of running a Rolls-Royce car, assuming a speed of 22 miles per hour, is estimated, at the maximum, to be 1·0*l*. or 240*d*. per ton-mile. Turning now to carrying services, it is interesting to find that parcel post, for a speed of 12 miles per hour, costs 0·07*l*. or 17*d*. per ton-mile, while letters, at 17 miles per hour, cost 0·55*l*. or 132*d*. per ton-mile, and the postman himself, travelling at 3 miles per hour, is estimated to cost 4·85*l*. or 1164*d*. per ton-mile. Estimates for the rigid airship vary from 0·016*l*. or 4*d*. per ton-mile at 80 miles per hour to 1·8*l*. or 432*d*. per ton-mile at 40 miles per hour, the latter figures referring to a machine assumed to carry a load of 10 tons.

THE issue of *Science* for November 3 contains a paper by Dr. J. R. Schramm of the National Research Council on "The Abstracting and Indexing of Biological Literature," which is of interest as it shows that in the United States the subject of the organisation of bibliography is entering the field of practical politics. Dr. Schramm's paper is eminently business-like. He first investigates the wants of the research student and decides in favour of sufficient abstracts published in book-form, with adequate indexes—"the complete subject index being perhaps of the greater importance." He then turns to the publishing aspect and points out that with adequate support in the shape of a guaranteed circulation, the cost of composition is a relatively small matter—each copy costing little more than the cost of paper, machining, binding, and distribution. From these data he goes on to advocate publication on the lines of *Chemical Abstracts*. The federation of the Biological Research Associations of the United States is, of course, a necessary preliminary, but here the first steps have already been taken under the ægis of the National Research Council. A committee has been formed to draft a constitution and to report on the whole question. Dr. Schramm does not underrate the difficulties before him, but we think that he underestimates the volume of literature with which the federated body will have to deal. If the statistics of the International Catalogue of Scientific Literature afford any guide, the federation will have to deal with an output at least double that of pure and applied chemistry. The order for the output of the International Catalogue for 1901–13 was (1) physiology, (2) zoology, (3) chemistry, (4) botany, (5) bacteriology. It is, however, premature to discuss a scheme which has not yet been definitely forwarded. We shall be content to express a hope that we may be favoured with a copy of any further report of the committee's activities.

THE Iron and Steel Institute, 28 Victoria Street, S.W.1, is prepared to receive before the end of February next, upon a special form obtainable from the secretary, applications for grants from the Andrew Carnegie Research Fund in aid of research work on the metallurgy of iron and steel.

CAPT. H. RIALL SANKEY will deliver his presidential address to the Junior Institution of Engineers on Tuesday, December 12, at 7.30, taking as his subject "The Utility of Theory to the Practical Man." The address will be given at the Royal United Service Institution, Whitehall.

A COURSE of twelve free public Swiney lectures on "Fossils and what they teach" will be given in the lecture theatre of the Imperial College of Science and Technology, South Kensington, by Prof. T. J. Jehu at 5.30 on Tuesdays, Thursdays, and Fridays, beginning on Tuesday, December 12.

THE gold medal of the Ramsay Memorial Fund, which the Prince of Wales would have received after unveiling the memorial in Westminster Abbey if he had been able to be present, was presented to him on November 22 by the French Ambassador, the Comte de Saint-Aulaire, who was accompanied by the officers of the memorial fund.

IN connexion with the Institute of Industrial Administration a lecture on "Standardisation of Repairs in Relation to Industrial Economy" will be delivered at the London School of Economics, Houghton Street, Aldwych, on Tuesday, December 12, at 8 o'clock, by Mr. R. Twelvetrees. The meeting will be open to all, and the lecture will be followed by a discussion.

THE council of the Institution of Electrical Engineers of London at the last meeting announced that Dr. J. A. Fleming had been elected an honorary member of the Institution. Dr. Fleming has accepted the invitation to give the fourteenth Kelvin lecture to the Institution in May next. The Royal Society of Arts recently awarded Dr. Fleming a silver medal for the fifth Henry Trueman Wood lecture he delivered on November 23, 1921, "On the Coming of Age of Long-Distance Wireless Telegraphy and some of its Scientific Problems."

THE Committee of the Norfolk Agricultural Station, Norwich, will shortly appoint a director and solicits applications for the post, which will be of the annual value of 600*l.*, plus travelling and incidental expenses. In the first instance the appointment will be for one year only. Applicants must possess a modern scientific training in agriculture, with university degree or diploma, practical knowledge of mixed farming, organising ability, and be qualified to lecture. Applications, with testimonials, must reach the honorary secretary of the committee, 32 Prince of Wales Road, Norwich, by, at latest, Saturday, December 9.

THE first country meeting of the Association of Economic Biologists since pre-war days will be held in the Botanical Department of the University of Manchester on Friday, December 15, when Dr. W. Lawrence Balls will open a discussion on "Genetics in Relation to Applied Biology." Dr. S. G. Paine will read a paper on "Internal Rust Spot (Sprain and Net Necrosis) in the Potato and the Possible Association of this Disease with Leaf Roll," followed by informal discussions on "The Place of Applied Biology in Universities," and "The Relation of Biology to Medicine." On Saturday, December 16, a visit will be paid to the British Cotton Industry Research Association, Shirley Institute, Didsbury.

THE suggestion made by Mr. F. Gill, president of the Institution of Electrical Engineers, in his recent address, that an international European conference should be held with the view of establishing on a commercial basis a practical system of long-distance telephony in the European trunk lines, has now been realised by M. Paul Laffont, the French Minister of Telegraphs and Telephones. He proposes to invite a conference at Paris of the technical administrators of the Western European countries, and he urges that France would naturally be the centre of the vast telephone system formed by combining the systems of these countries. The long-distance

telephone calls in daily use in America show that, from an engineering point of view, the scheme presents few difficulties. Thus the New York-San Francisco call (3000 miles) is equivalent to communication between London and Baghdad; the Key West (Florida) and Los Angeles call *via* New York and San Francisco is equivalent to a London-Delhi communication. English engineers all welcome the conference, as they have good hopes of arriving at a satisfactory international agreement.

THE *Quarterly Summary* of the Royal Botanic Society, Regent's Park, for October contains a list of some of the recent interesting accessions to the gardens, and a short account of the experimental work in genetics being carried out there. Another item of interest is an account of the Indian Mahwa tree, *Bassia latifolia*, a member of the Sapotaceæ, the flowers of which have the remarkable property of showing no deterioration even after being stored for a year or two in England, nor are they attacked by moulds. They contain quantities of sugar and have been suggested as a source of alcohol, but their peculiar preservative powers have apparently not been investigated.

A NOTEWORTHY departure was taken at the meeting of the Royal Institute of British Architects on November 20, when a paper on "Illuminating Engineering in Relation to the Architect" was read by Mr. L. M. Tye. A vote of thanks to the lecturer was proposed by Sir John Herbert Parsons, president of the Illuminating Engineering Society, who referred to the good results that had followed from the co-operation of the medical profession and the lighting expert in dealing with the effects of light on the eye, and expressed the conviction that similar benefit would be derived from the concerted efforts of architects and illuminating engineers. Mr. L. Gaster suggested that courses of instruction on artificial lighting should be included in the curriculum of architectural students, and Mr. Paul Waterhouse, who presided, received these suggestions with sympathy. There is no doubt that the lighting of many public buildings, schools, etc., would gain by closer co-operation of this description, and the Illuminating Engineering Society should do good public service by its efforts to enlist this new ally in its campaign for more scientific methods of lighting.

THE opening meeting of the session of the Illuminating Engineering Society took place on November 14, when Mr. L. Gaster read the usual report of progress during the vacation. An event of outstanding importance has been the third Report of the Home Office Departmental Committee on Lighting in Factories and Workshops. Mr. Gaster directed attention to an important "access of light and air" judgment in Bradford, which illustrated the importance now attached to scientific measurements of daylight illumination in such cases. It was mentioned that a commission on illuminating engineering has now been formed by the Central Electrotechnical Council in Russia. In accordance with custom, there were a series of exhibits illustrating developments in lighting. A new and simple illumination photometer was exhibited by Capt. Stroud, and an improved form of inspection lamp for use in hospitals by Mr. Hobson. Mr. S. O. Pearson demonstrated an interesting "blinking" phenomenon when neon lamps are shunted by a condenser on direct-current circuits, and Capt. W. J. Liberty presented some photographs showing the artificial lighting arrangements at the new Port of London building. Some novel forms of illuminated signs, based on total internal reflection in a sheet of plate glass, were exhibited by Mr. E. T. Ruthven Murray.

AT the Royal Academy, on November 22, Prof. A. P. Laurie, in a lecture on "The Preservation from Decay of Stone on Buildings," dealt with the general causes of stone decay. He showed by experiments the distinctions to be made between limestone, sandstone with a calcite cement, and sandstone with a silica cement, and described the different methods necessary to make complete laboratory tests with a suggested preservative, and illustrated by photographs some of the difficult problems which have to be faced. Prof. Laurie described a new preparation recently discovered by him, which deposits hydrated silica as a cement between the particles of the stone, and he stated that, while not solving the problem of the preservation of limestones, he hoped that it would prove successful in the preservation of sandstones. He further suggested that the Royal Institute of British Architects might find it worth while to experiment with this new preservative.

THE annual Progress Report of the Geological Survey of Western Australia for the year 1921 contains a useful summary of economic minerals known to exist in that State. Among these are, in the first place, gold, then copper ores, lead ores, tin ores, iron ores, and manganese ores, together with a number of rarer minerals such as wolfram, scheelite, stibnite, barytes, monazite, tantalite, glauconite, salt, gypsum, etc.; coal of different geological ages is known, although only permo-carboniferous coal has been worked to any extent.

SOME papers of much interest to marine biologists are contained in the recently issued number of the Journal of the Marine Biological Association (vol. xii. No. 4, October 1922). Mr. R. S. Clark gives descriptions, illustrated by beautiful photographs, of the egg capsules and young of various species of rays and skates. This work was badly wanted. Miss Lebour and Mr. Andrew Scott write on the food organisms of young edible fishes, and Miss Lebour and Mr. R. Elmhirst make a very useful contribution to parasitology in the form of an account of the life-history of *Parorchis acanthus*, a trematode inhabiting the herring gull.

IN further reference to the obituary notice of Dr. Alexander Graham Bell in NATURE of August 12, p. 225, Mr. F. De Land, of the Hubbard Memorial Hall, Washington, writes, giving us quotations from English papers of 1877, of telephone transmission over distances greater than 100 miles. He also gives a quotation from our own columns (November 15, 1877,

vol. 17, p. 49) of a report of a lecture by Graham Bell, stating that on one occasion the lecturer had been able to converse over a distance of about 250 miles. Our reference, however, in the obituary notice of Graham Bell, was to *commercial* telephony. In the Journal of the Institution of Electrical Engineers, April 1922, p. 429, Mr. Kingsbury gives the following quotation from the first business circular issued by Graham Bell and his associates. They state that they were "prepared to furnish telephones for the transmission of articulate speech through instruments not more than 20 miles apart."

PROF. H. E. ARMSTRONG asks us to say that in his letter published in NATURE of November 25, p. 700, he wrote Babelonian, which was altered without his approval to Babylonian—thus obliterating his point.

AMONG the books to be published by the Cambridge University Press during December is "Prolegomena to Analytical Geometry in Anisotropic Euclidean Space of three Dimensions," by E. H. Neville, the first half of which will be an account of the principles underlying the use of Cartesian axes and vector frames in ordinary space. The second half will describe ideal complex Euclidean space of three dimensions and develop a system of definitions in consequence of which the geometry of this space has the same vocabulary as elementary geometry, and enunciations and proofs of propositions in elementary geometry remain so far as possible significant and valid. The same publishers also promise for this month "A Summer in Greenland," by Prof. A. C. Seward. It will contain some 30 maps and illustrations.

Our Astronomical Column.

POSSIBLE RECURRENCE OF A METEOR SHOWER.—On the morning of December 5, 1921, there was observed a very rich shower of meteors from Leo Minor at 156° +37°. The event was witnessed at the Astronomical Observatory at Tokyo by the observers there, who recorded 44 meteors in 55 minutes, radiating from the special shower alluded to. The position in the N. part of Leo Minor from which the meteors were directed has been known for many years as the centre of a rich shower of swift, streaking meteors in October, November, and the first half of December. It was well observed at Bristol in 1876, November 20-28, from the point 155° +36° (21 meteors), and is especially described as a possibly new and very active shower in NATURE for December 21, 1876, p. 158. Should this meteoric display recur in the present year it may be looked for in England at about midnight and the two hours immediately following, on December 4. The moon will, however, be nearly full and will moderate the character of the display. It will certainly be important to observe it if possible, and it is hoped that the sky will be attentively watched on the date in question.

CALENDAR REFORM.—Mr. Charles F. Marion, of the U.S. Weather Bureau, has published a leaflet strongly urging the adoption of a 13-month calendar, each month to consist of 4 weeks exactly. One day in the year, preferably the last, would be outside week and month. In leap-year there would be another such day, which might conveniently precede the first day of the seventh month. The names "Sol" or "Mid-year" are suggested for the seventh month, the other months having their names unchanged. It is pointed out that meteorology would be greatly simplified by such a system, since records at present are complicated by the unequal months. Further, since each particular week would then always occupy the same place in the solar year, monthly records could be supplemented by weekly ones.

The chief objection brought against the 13-month year is that it does not divide into quarters. But it is to be noted that the existing quarter-days are not at the ends of months. To place them after the first week of the fourth month, the second of the seventh month, etc., would be very little more complicated than the present system. Monthly payments would be made 13 times per annum instead of 12, and the anomaly of paying the same for 28 days as for 31 would be removed.

Astronomers would welcome the equalisation of the months and the removal of leap-day from its present awkward position. The year 1928 begins with a Sunday, so the change might then be made with a minimum of dislocation.

A bill has been introduced into the United States Congress authorising and requesting the President to call an international conference on the subject in 1923. It is suggested that the dates of religious festivals are best left to the religious bodies to determine: it introduces needless difficulties to superpose these questions upon changes in the civil calendar.

THE BRIGHTNESS AND ROTATION OF URANUS.—*Astr. Nachr.* No. 5184 contains a paper on this subject by C. Wirtz. He has made a very careful series of magnitude determinations with a Zeiss field-glass from July 1921 to January 1922. The mean magnitude, reduced to mean opposition, is 5·64. The magnitudes of the six comparison stars were taken from Harvard; small corrections, leaving the mean magnitude unchanged, were deduced from his own observations. The author is evidently a skilled observer and the probable error of each night comes out as $0{\cdot}04^m$, that of the mean being less than $0{\cdot}01^m$. He has grouped them in accordance with the rotation period of $10\frac{3}{4}$ hours given by the spectroscope, and finds a sine-curve with an amplitude of $0{\cdot}02^m$, which he regards as too small to receive with confidence; in 1917, L. Campbell found a curve with an amplitude of $0{\cdot}15^m$, but if the physical state of Uranus is like that of Jupiter, changing spots might well alter the amplitude.

Wirtz suggests that it is worth while to keep up the investigation of the magnitude of Uranus from year to year, as it may throw light on the oblateness of the disc. He estimates that when the pole is near the centre, the magnitude should be about $0{\cdot}1^m$ brighter than when it is on the edge; this is an amount within the reach of delicate photometry. He thinks, however, that the apsidal motion of the inner satellite Ariel should give a more trustworthy value.

MISCONCEPTIONS ABOUT RELATIVITY.—Since the verification of the Einstein bending of light by gravitation in 1919, many speculations on the subject have appeared in astronomical publications. A letter in the Journal of the R.A.S. of Canada (September–October 1922) suggests that the Gegenschein is the result of the bending of sunlight by the earth's attraction so as to come to a focus. The amount of bending of a grazing ray is proportional to mass/radius, so that the bending at the earth's surface is 1″·75/3000 or 1/1900 of a second of arc. It is manifest that such an infinitesimal bending could produce no discernible optical effects, and it seems inadvisable to print such suggestions without comment, since their appearance in such a weighty journal is calculated to mislead.

Research Items.

SOME ROMAN ANTIQUITIES.—Two articles in the *Journal of Roman Studies* (Part 1, vol. 10 for 1920) refer to antiquities in England. In the first, Mr. A. M. Woodward describes a decorative bronze Silenus mask found at Ilkley during excavations conducted by the Yorkshire Archæological Society. This was probably used as a jug-handle, and that a bronze vessel so elaborate should be found at the quarters of an auxiliary cohort is at first surprising. But the site seems to have been long occupied, and the inhabitants included a civilian settlement. The vicinity of York, a great military station, may have led to the introduction of articles of luxury. In the second paper Mr. C. D. Chambers remarks that, although the Romans valued pigeon manure, it is strange that so few dovecots of that period have been discovered. Though octagonal foundations like those of medieval dovecots have been found at Great Witcombe and Stroud, rectangular dovecots, though probably numerous, cannot be identified with certainty, except where the pigeon-holes actually exist, as at Caerwent. If excavators were to look for dovecots rather than shrines, it is not unlikely that further evidence would be forthcoming.

THE PITUITARY BODY.—A paper by Bailey and Bremer ("Experimental Diabetes Insipidus," "Archives of Internal Medicine," vol. 28, p. 773) serves as a timely warning against hasty conclusions of the existence of internal secretions when the results have been brought about by injury or disease supposed to be limited to a particular organ. There are three symptoms supposed to be produced by injury of the pituitary body—increased urinary secretion, hypertrophy of fatty tissue, and atrophy of the testis. Camus and Roussy had already brought evidence that these effects were due to injury of that part of the brain, the hypothalamic region, in close contact with the pituitary body, but they do not appear to have been altogether successful in avoiding some injury to the latter also. The work of Bailey and Bremer was done in the laboratory of Prof. Harvey Cushing, and the pituitary region was reached by a slight modification of the operation described by Crowe, Cushing, and Homans. The pituitary body itself and the neighbouring parts of the brain can be clearly seen, and it was found that a small injury to the hypothalamus, leaving the pituitary completely intact, was sufficient to bring about the three symptoms above mentioned, which are supposed to be due to injury to the pituitary body itself.

STERILITY IN SPECIES-CROSSES.—Results have been accumulating for a number of years, showing that in species-crosses in various animals one sex is either absent, rare, or sterile. Such disturbances of the sex-ratio, or sterility of one sex in the hybrids, have been observed by Tutt, Harrison, Goldschmidt, and others in Lepidoptera, by Whitman, Riddle, and others in birds, by Sturtevant in Drosophila. Among mammals, guinea-pigs and Bovidæ show similar distortions of the sex-ratios. Mr. J. B. S. Haldane, in an interesting review of all these and similar results (*Journ. of Genetics*, vol. 12, No. 2), shows that in every case it is the heterozygous sex which is deficient in numbers or sterile in such species-crosses. Thus in mammals and flies this applies to the male sex, which is the heterozygous sex, while in birds and butterflies it applies to the female sex, which is known from breeding experiments and cytological study to be the heterozygous sex in these groups.

CHROMOSOMES OF THE "MILLIONS" FISH.—In two papers on the cytology and genetics of the little "millions" fish, Lebistes, Dr. Ö. Winge (*Journ. of Genetics*, vol. 12, No. 2) finds the number of chromosomes to be 46 in both sexes, and concludes that the males must therefore have an XY pair of sex-chromosomes. In extending the breeding experiments of Dr. J. Schmidt, who showed that certain colour markings of the males are inherited only from male to male (hence through the Y-chromosome), he finds four such colour-marking factors in the Y-chromosome of different races of this fish. In addition, Dr. Winge makes the interesting discovery that in the "Magdeburg race" the X-chromosome contains a factor which gives a sulphur-yellow colour to various parts of the body and a red colour to the lower margin of the caudal fin. This factor is inherited in the usual fashion of sex-linked factors, except that all these characters are invisible in the females. Some evidence is also obtained of crossing-over between these factors in the X- and Y-chromosomes. This, if confirmed, will furnish an interesting extension of our knowledge of sex-linked inheritance. When colour-marking factors are present in the X- and Y-chromosomes of a male they both show in its visible pattern, but one is transmitted, like the X-chromosome, through the daughters to their sons, while the other is transmitted (in the Y-chromosome) directly from father to son.

COTTON RESEARCH IN EGYPT.—The second annual report, for 1921, of the Cotton Research Board, issued by the Egyptian Ministry of Agriculture, indicates clearly that the improvement of the cotton crop, with which the prosperity of Egypt is so closely connected, is being seriously dealt with by methods of research. The Board has given special consideration, among other matters, to the decline in yield, two-year *v.* three-year rotations, and control of seed used for sowing. A summer fallow appears to be of great value in maintaining the fertility of the soil, as the temperature of the surface soil rises sufficiently high to have a partial sterilisation effect by suppressing the harmful factor which has been shown to exist in Egyptian soils. The value of Nile silt as a fertiliser seems hitherto to have been exaggerated. Yield may not be much affected by reduced watering, but quality may be adversely influenced. Work is being done on the extraction of pure lines, propagation of selected strains and field tests of commercial varieties, in order that types may be selected that shall be most suitable for the purpose required. Special efforts have been made to find a method of controlling the sore-shin disease, the usual means being ineffective or impossible of application on a large scale. Various reagents have been used for soaking the seeds, and the effect of sowing on different dates has been tested, but no conclusive results are yet available. Insect pests are also receiving attention, pink boll-worm and cotton-seed bug being under investigation.

THE CRANIAL MORPHOLOGY OF FISHES.—Two important papers on the anatomy and morphology of fishes appear in the *Journal of Anatomy* (vol. 56, Pts. 3 and 4). In the first of these Mr. E. Phelps Allis, junior, describes in great detail the cranial anatomy of Polypterus, illustrated by twenty-two beautifully executed plates, all except two of which are in colour. In the second paper Dr. H. Leighton Kesteven strongly criticises Huxley's interpretation of the bones in the palate and upper jaw of bony fishes and offers a new concept of their significance and homologies. He regards the premaxillæ and maxillæ of the majority of teleostean fishes as constituting

an adventitious jaw which is homologous, not with the similarly named bones in other vertebrates, but with the labial cartilages well developed in most Elasmobranchs, present in Polypterus and evanescent in the Amphibia. The vomer, anterior portion of the parasphenoid and palatine of the teleostean skull are regarded as homologous respectively with the premaxillæ, vomer, and maxilla of other vertebrates. This new interpretation of the upper jaw of the teleostean fishes necessitates changes in the concept of the homologies of other bones in the palate of these fishes, which the author states briefly and analyses in detail. The quadrate bone of teleosteans is the only bone which the author regards as correctly homologised.

JAPANESE GEOLOGY.—The National Research Council of Japan has instituted a *Japanese Journal of Geology and Geography*, of which the second number lies before us. In addition to various abstracts it contains two original papers. The first, by Prof. I. Hayasaka, treats of "Some Permian Brachiopods from the Kitakami Mountains." Only six species are described, none being new to science, but there is a promise of more when the additional material shall have been worked out. The second paper is on "Uhligina, a New Type of Foraminifera found in the Eocene of Japan and West Galicia," by Prof. H. Yabe and S. Hanzawa. The authors consider this new form to be a close ally of the Carpathian species *Rupertia incrassata*, Uhlig, and since both differ in important characters from Rupertia, the new genus Uhligina, having as genotype *U. boninensis*, n.sp., from the Middle Eocene nummulitic tuff of Oki-mura, is established for their reception.

WIND VELOCITY AND DIURNAL RANGE OF TEMPERATURE.—A discussion on diurnal variation of temperature as affected by wind velocity and cloudiness, Professional Notes, No. 30, has just been issued by the Meteorological Office of the Air Ministry. The observations from the Eiffel Tower have been used in conjunction with those at Parc St. Maur by Captain J. Durward. The object of the discussion is to get an idea of the magnitude of the rise and fall of temperature at different levels under different weather conditions. Observations are compared for the five months, May to September, and for the five years, 1905 to 1909. The respective heights above sea-level of the thermometers at the two stations are 335 metres and 50 metres, a difference of 285 metres or 935 feet. The lower station, Parc St. Maur, is 11·5 km. to the east-south-east of the centre of Paris. Among the principal results may be mentioned the temperature distribution on fair nights. When the radiation is unimpeded the layer of air in contact with the ground is cooled more quickly than the layers immediately above, and being cooled it tends to remain near the earth's surface. This leads to an inversion in the lower layers of the atmosphere, the magnitude depending on the wind velocity, as the layers not in immediate contact with the ground are cooled greatly by turbulence; the results are given in a table.

OIL-DRILLING IN GALICIA.—Mr. Albert Miller's recent paper read before the Institute of Petroleum Technologists dealt with the Canadian pole-tool system of drilling for oil, as almost exclusively employed in Galicia at the present time. Notwithstanding the increasing popularity of the rotary system in other oil-fields, this system has proved unsatisfactory in Galicia, where the formations to be penetrated frequently change with surprising rapidity within a small vertical distance; this necessitates a high degree of flexibility of drilling plant. The paper included details of the tackle in use, and the different types of drilling-bits and fishing-tools were discussed, particular stress being laid on the need for standardisation of tool joints, the lack of which had proved almost disastrous in the past. Some useful information was given in connexion with casing and with its recovery when "frozen" in a well; a somewhat novel method of overcoming such freezing is to insert tubing connected to the steam-line and thus heat the casing for twenty-four hours; by this expansion, with subsequent contraction on cooling, the casing can often be moved; this method is also applicable in cases where accumulations of paraffin wax are the cause of such freezing. Methods of production of oil in Galicia were also considered, and these included, besides flowing wells, both deep-well pumps and "swabbing." This last practice is specially useful in wells that have stopped flowing, and in deep wells having small diameter casings but producing from compact sandstone. The swab consists of a plunger fitted with a ball-valve which works up and down inside the casing barrel; rubber packing rings are employed, and thus the swab has a suction effect on the well; an average vacuum of eight pounds can be obtained with fast running on the upward journey of the swab, and in this way several tons of oil may be won which would otherwise be left in the reservoir.

ASPHALT.—The report on the asphalt and related bitumen industries in the United States for the year 1921 has just come to hand (Asphalt and Related Bitumens in 1921, United States Geol. Sur., Mineral Resources, Pt. II.). In that year the United States marketed close on 300,000 short tons of natural asphalt (including grahamite, gilsonite, wurtzilite, impsonite, and bitumenous rock). By far the larger quantity of asphaltic material, however, is manufactured from crude petroleum during the process of refining the oil, the basis of this material being the residue resulting from distillation. The material is of two distinct kinds, asphalt and flux, the former comprising all the solid and semi-solid products of less than 200 penetration. The flux is utilised for softening natural asphalt or the synthetic product, especially for roofing purposes; it also includes the so-called "road-oil" used for spraying on the surface of metalled roads. For paving it is produced as sheet asphalt, or as asphalt concrete, or as a cement or filling for road and pavement blocks; the roofing and water-proofing material is manufactured by saturating, coating, or cementing felt or suitable fabric; in the rubber industry it is employed in many cases where a durable binding or cement is required. In other directions asphalt finds considerable use in the manufacture of insulating materials, acid-resisting compounds, mastic, paint, and varnish. In the United States, both domestic and Mexican petroleum are used as sources of the manufactured asphalt, the latter rather more than the former; in 1921 more than 600,000 tons of asphaltic material were produced from domestic petroleum, this representing about two-thirds of the amount obtained from imported oil from Mexico. The report also makes brief mention of the importation of natural mineral waxes, such as ozokerite, into the United States (which during the year under review increased more than 100 per cent.), while the manufacture of ichthyol compounds from a Texas oil is a noteworthy development. Ichthyol (a sulphonated hydrocarbon largely used in medicine) has in the past been produced from treatment of a fossiliferous deposit in the Austrian Tyrol; its manufacture from natural petroleum constitutes a factor of more than mere commercial interest.

The Society of German Men of Science and Physicians.

CENTENARY CELEBRATIONS AT LEIPZIG.

IT is a hundred years since the Society of German Men of Science and Physicians held the first meeting, also in Leipzig, on September 18, 1822. Only eighty-seven meetings have taken place in this period, as in the years of great national calamities, such as war or epidemics, no meetings were held. Though the first meeting after the World-War, at Munich in 1920, was well attended, the society resolved to meet only every two years, so long as the present economic distress in Germany prevails.

Among the scientific workers who attended this year's meeting there were represented not only the great seats of learning of Germany and the German-speaking countries, but also most of the countries who had in former times sent their representatives to this meeting. The president was the distinguished Berlin physicist, Prof. Max Planck, Nobel prizeman in 1918 for physics. The committee included, among others, Prof. Palthauf, the great Vienna pathologist; von Dyck, the Munich mathematician; Profs. Gottlieb (Heidelberg), Willstätter (Munich), His and Bonhöffer (Berlin), Rinne (Leipzig); Privy Councillor Duisberg (Leverkusen). The arrangements for the meeting were carried out under the supervision of Prof. von Struempell and Prof. Wiener, both of Leipzig.

After the opening address by Prof. von Struempell, on September 18, in which he expressed his satisfaction at the great new tribute paid to German science, addresses were given by representatives of educational authorities, teaching institutions, and learned societies. Among the foreign representatives were: Prof. Becke (Vienna), Prof. Schlosser (Prague), Prof. Hagenbach (Basel), Prof. Sigrist (Bonn), Dr. Sven Hedin and Prof. Svante Arrhenius (Sweden), Prof. Goldschmidt (Christiania), and Prof. Bokay (Budapest). Congratulatory messages were also sent from Holland, Spain, U.S.A., and other countries.

After expressing his thanks for the addresses and messages Prof. Max Planck gave a survey of the development of German science during the past hundred years. Referring to the World-War, he said that one possession has not been lost by the German nation, namely, its national unity. The reconstruction of Germany's prosperity and the rebirth of German culture are not possible without German science. Many of the most important inventions which are used in modern industrial life, such as wireless telegraphy, the fixation of atmospheric nitrogen, the Röntgen rays, had been discovered in purely scientific laboratories. It is necessary to spread among all the nations of the world the conviction that the preservation and extension of purely scientific research in Germany is as necessary for the welfare and happiness of that country and the whole world as the development of industry and the production of raw materials. Scientific work is international in its nature, and therefore well fitted for creating and furthering mutual understanding and peaceful co-operation among the peoples of the world. The German men of science and physicians were ready to respond to frank and honest approaches made by foreign fellow-workers, but they would naturally not think of begging for admission where they were not wanted.

The subject of the first general address was the theory of relativity. Prof. Einstein himself had originally intended to be present, but he was prevented from appearing by his journey to the East. It may be mentioned that a protest against this subject, as not yet ripe for scientific discussion, had been lodged by a number of well-known men of science of Germany and other countries. The lecturer was Prof. von Laue (Berlin), and he stated that the questions with which the theory of relativity is concerned are as old as science and scientific research. The modern problem is whether it is possible to ascertain an absolute velocity of any moving body. The transmission of light and electricity through space, even in a vacuum, has led to the assumption of an æther. All experiments, however, which have been made in order to discover how great is the velocity of the earth with respect to the æther have failed. The special or restricted theory of relativity, which maintains that it is impossible to ascertain any absolute velocity, has therefore been generally accepted by physicists.

It is a different question with the much more complicated and difficult general theory of relativity of Einstein. This is concerned with the old problem of the force of gravitation. Here mathematical processes have to be introduced which no physicist had thought of applying before Einstein. Though this part of the relativity theory has not yet been established so as to exclude every possibility of doubt, it can be regarded as an extremely valuable stimulus to further research.

This lecture was followed by an address by Prof. Schlick (Kiel) on the philosophical importance of the theory of relativity. He stated that the theory, though originally devised only to explain physical phenomena, has a great philosophical importance. The philosophical tendencies of Einstein's thinking pointed to a kind of positivistic philosophy, a philosophy of pure experience which takes no account of so-called elements or substances, and regards as the ultimate facts of all happening the observed events themselves. We may say that the period of the separation of philosophy and science is ended and that they are beginning to approach each other again.

On September 19 the first subject treated was that of heredity, and Prof. Johannsen of Copenhagen gave a survey of the work done during the past century in this field. The conclusion he comes to is that no positive result has been obtained in regard to the great questions of the origin of species and their evolution. A destructive criticism, however, of the chief ideas of both Darwin and Lamarck has been achieved, and the belief in natural selection as well as in a gradual fixation by heredity of qualities obtained by adaptation has been thoroughly shaken. Prof. Meisenheimer of Leipzig showed the results of experiments in crossing flowers, insects, and guinea-pigs. He explained the various connecting links, the mixed types, and described cases of reversion. His conclusion is that the experiments are subject to many chance influences and not very certain. It has been impossible, so far, to carry out all the calculable experiments; in many cases it will be necessary to resort to statistics.

Great interest was aroused by the lecture of Dr. Lenz of the University of Munich, on heredity in the human race. In this field, he stated, no experiments are possible. The only materials available are comparative observation of animals and plants and vital and genealogical statistics. The validity of Mendel's law has also been proved in the case of man; further, it is certain that no acquired qualities are inherited. In regard to the determination of the sex of unborn children, Dr. Lenz said that we can to-day already predict with a great degree of accuracy

the inherited qualities of children. There is no spontaneous degeneration and no ageing of a race, though the transmitted substance may be damaged by such poisons as alcohol and tobacco. Race-suicide among the educated classes is threatening the continuance of our civilisation. In order to lead to practical results in improving the race, racial biology must be supported by the State.

A very interesting series of lectures was given on the action of electrolytes on the organism. The first of these, entitled "Colloids and Ions," was delivered by Prof. Wo. Ostwald of Leipzig, and it provided the starting-point for a number of addresses. Prof. Hoeber, Kiel, dealt with the effect of the ions on physiological surfaces. We know to-day that no organ of the human or animal body, no plant, and no micro-organism reacts normally if the ions in the neighbourhood of the cells are not present in the proper proportions. The heart beats abnormally if it is surrounded by a minute excess of potassium ions or calcium ions. The corpuscles of the blood, in the same circumstances, may perish prematurely, or in the plant, growth may be abnormal. The ions are carriers of electric charges and they are active in all processes of stimulation of living tissues by means of electric currents. Their movements are also the cause of the curious electric currents which all living beings are capable of producing, and which represent the highest degree of excitement. The explanation of the nature of the effect of the ions is of the greatest importance for the proper understanding of the phenomena of life.

It is a curious fact that the ions need not penetrate into the living cells themselves. The conclusion is that they react with the surfaces of the cells, the "physiological boundaries." Three groups of phenomena were discussed. In the first instance, the cells themselves carry electric charges, and they interact with the charges of the ions. A result of this may be clotting, or "agglutination," as, for example, in the well-known case of the clotting of the blood-corpuscles during pregnancy. Secondly, the interaction of the salt-ions and the cell-surfaces produces the bio-electric currents which have been referred to above. In a model the substance of the cell-surfaces may be replaced by organic oils, and by bringing these oil films in contact with various salts the electro-physiological phenomena may be well imitated. Thirdly, a change in the composition of the normal mixture of ions on the surface of the cells alters the power of transmission of the surface, so that the normal diffusion between the inside of the cell and the surrounding fluid is disturbed. These results show that medical science will have to study these purely physico-chemical phenomena in order to be able to explain fully and deal properly with the processes of life.

Prof. Spiro of Basel, in dealing with the same subject, stated that every electrolyte seems to play a special part in the organism. Especially the effect of the small ions of water and of the colloid electrolytes must be studied. For health there must be a proper equilibrium of all the necessary ions.

Quite a sensation was caused by the lecture of Prof. Mayer of Hamburg on the new preparation against trypanosome diseases, "Bayer 205," produced and manufactured by Friedrich Bayer, Leverkusen (near Cologne). This new drug, which is said to contain neither arsenic, antimony, mercury, nor any other inorganic therapeutic reagents, has been extensively tested, both in Europe and tropical countries, and found to give excellent results in advanced stages of sleeping-sickness and other trypanosome diseases. A station for further experiments has been fitted up in South Africa.

In the geographical section Dr. Sven Hedin lectured on his travels in Tibet, summarising the results contained in his various works and producing a great number of fine lantern-slides. The lecture was enthusiastically received.

A great number of papers was read by eminent medical workers on special subjects. Prof. Flechsig gave a survey of his well-known studies in mental pathology in a lecture on the localisation of the brain functions. Many lectures were also delivered on technical and industrial subjects, such as workshop control by means of optical measuring instruments and modern methods of rapid reception and despatch of wireless messages.

The two lectures on enzymes, by Profs. Willstätter of Munich and von Euler of Stockholm, were well attended and full of interest. Prof. C. Neuberg of Berlin lectured on recent advances in the study of fermentation.

A special feature of the congress was the lecture by Prof. Wilhelm Ostwald of Leipzig on his new methods of quantitative determination of colours. Based on the Law of Fechner, his system of colours includes the dull colours which Helmholtz excluded. The colours of our environment cannot be measured by wave-lengths, but only by means of revolving coloured discs with a variable black sector. New was the communication that we nowadays no longer distinguish six principal colours, but must assume eight, which number agrees with Fechner's Law.

Space forbids more than a short reference to the valuable lecture by Prof. Svante Arrhenius of Stockholm on physical law in the cosmico-chemical processes, by Prof. V. M. Goldschmidt of Christiania on the metabolism of the earth, and by Prof. Nernst of Berlin on photo-chemical processes. In the last of these it was stated that Einstein's law of photo-chemical equivalents no longer holds good. Light does not produce a primary splitting up of the chemical substance, but an addition of energy. Our photographic plates would have to be 6000 times more sensitive in order to approach to the ideal.

Many more valuable lectures on special subjects were delivered. The town of Leipzig showed its splendid hospitality and provided entertainments and many occasions for social and personal intercourse.

B. RASSOW.

The Present Position of Darwinism.

ONE of the discussions which aroused most interest during the British Association meeting at Hull was that held jointly by the botanical and zoological sections on "The present position of Darwinism." There was a large attendance, the discussion being presided over by Prof. H. H. Dixon, who was supported by Dr. E. J. Allen. The theory of the origin of species by natural selection, which has already been assailed by the geneticists, was attacked from a different point of view by Dr. J. C. Willis and Mr. Udny Yule, who treated the subject with special reference to geographical distribution and the statistical analysis of genera and species. During the discussion the older view as to the significance of natural selection was stoutly maintained by some speakers.

After a few introductory remarks by Prof. Dixon, the discussion was opened by Dr. J. C. Willis, who

spoke of "The inadequacy of the theory of natural selection as an explanation of the facts of geographical distribution and evolution." Dr. Willis pointed out that Darwin's immortal service to science consisted in the firm establishment of the doctrine of evolution. This was effected by devising the mechanism of the natural selection of infinitesimal variations, the principle usually known under the name of Darwinism. This theory involves many assumptions: among others, that such variations are (1) continuous, (2) hereditary, (3) differentiating, (4) selected, and (5) that the necessary differentiating variations for the associated characters appear together. For all of these the proof is as yet insufficient.

Dr. Willis proceeded to consider the extent to which natural selection of small variations could be held to explain the facts of geographical distribution, morphology, and evolution, special reference being made to the grasses and to the Chrysomelid beetles. It was then pointed out that natural selection was helpless to explain the differences in distribution of closely related species, which, on the other hand, could be explained on the hypothesis of "Age and Area"—*i.e.* that the area occupied by any group of allied species (at least ten) depends chiefly upon the ages of the species. On this hypothesis predictions could be made which were found to be justified by facts. Dispersal of species is held to be mainly mechanical: so much dispersal in so much time. This suggested the further hypothesis of "Size and Space"; that, in groups of ten allied genera, the total space occupied goes with the total number of species. If this be true, whatever phenomena are shown by "Area" should also be shown by "Size." This in fact is shown to be the case when the number of allied species occupying areas of increasing size and the number of species in allied genera are plotted in the form of curves. The shape of the curves is invariably uniform. But sizes of genera are clearly the result of evolution. According to the theory of natural selection, the sizes of genera must depend upon their success, and it is, therefore, inconceivable that they should show such uniformity of expression. Such facts, however, are easily explained by the hypothesis that geographical distribution and evolution extend with age—*i.e.* that the factors causing them act at a more or less uniform rate. Natural selection, which is essentially differentiating, cannot explain these facts.

In consequence, however useful it may be to explain details of certain adaptations, and although everything at birth must pass through the sieve of natural selection, it seems that the latter principle must be abandoned as an important factor in geographical distribution and evolution. Finally, Dr. Willis considered it necessary to accept large mutations as being of greatest importance in evolution. In his opinion Guppy's theory of differentiation should replace the Darwinian position that evolution has proceeded from individual through variety to species, genus, etc., for the theory of "Age and Area" showed clearly that the family is older than the genus, and that the genus is older than the species.

Mr. G. Udny Yule spoke upon "A mathematical conception of evolution based on the theory of Age, Size, and Space." He suggested that if the size of the genus be considered an index of its age, species might be regarded as thrown by the genus much as offspring are thrown by a stock, and that the number of species originating from a given initial species will increase in geometric ratio with the time. The forms of frequency distribution for numbers of genera with numbers of species were shown to be in accordance with the facts, and the possibility was suggested of determining from such distributions the ratio between the rates of increase of genera and species and the age of the family in terms of the doubling period for species.

Mr. C. Tate Regan stated that in his special study of fishes he had formed conclusions as to the origin and relationships of species and genera which were quite different from those of Dr. Willis. He pointed out that the hollow curves of the previous speakers were extreme types of asymmetrical curves which could also be obtained from many sorts of data—*e.g.* by plotting graphically the wealth of the community, grading from many poor to few very rich, or from the numbers of occurrences of surnames in the London Telephone Directory. All these curves were simply graphic representations of certain facts the meaning of which could be ascertained only by detailed analysis. According to his own view, the first step in the origin of a species had been not a change of structure but some form of isolation. The extreme mutationists, who thought that adaptations originated as large transformations without relation to use or environment, seemed to have returned to the special creation theory. Darwin's theory of evolution was that species had been modified by the natural selection of slight variations, aided by the inherited effects of use and disuse, and, in an unimportant manner (so far as adaptations were concerned) by the direct action of the environment. That theory was put forward by a man who knew the facts to be explained. Mr. Tate Regan claimed that Darwin's theory explained them and that no other theory stood the test.

Prof. W. Johannsen spoke from the point of view of a geneticist. He pointed out that selection could not produce anything, but it should be borne in mind that Darwin's belief in a productive power of selection was fully logical from the naive view of his time. The mutations which we knew did not explain the nature of evolution or the origin of large differences such as the differences between families. Modern genetics could scarcely contribute to a solution of the main problems of evolution, but it seemed to have cleared the ground from the erroneous Lamarckian and Darwinian views. He himself and, he thought, most geneticists were agnostics as to the mechanism of evolution.

Mr. J. T. Cunningham thought that natural selection was "as extinct as the dodo," and that the origin of species was due to mutations. Specific characters were for the most part useless, but other groups might be distinguished by adaptive and non-adaptive characters. He discussed adaptation, which he considered to have arisen in a Lamarckian manner. Modern discoveries concerning internal secretions showed how many adaptations exhibiting recapitulation might have been produced by stimuli and functional exercise.

Dr. H. Wager urged that there was more in the theory of natural selection than was implied by Dr. Willis and Mr. Cunningham. Fluctuating variations were dismissed from having evolutionary significance, but mutations were not necessarily large. He reminded the audience that an alternative title given by Darwin to "The Origin of Species by means of Natural Selection" was "The preservation of favoured races in the struggle for life," which might be interpreted in modern terms as "The preservation of favourable mutations."

Prof. E. B. Poulton discussed the theory of "Age and Area" in relation to mimicry, and pointed out that in certain African butterflies the younger form is distributed over a much wider area than the ancestral type.

Dr. Chalmers Mitchell supported Mr. Tate Regan, and considered that Dr. Willis had presented merely

a caricature of natural selection. He appealed for the study of individual life forms.

Prof. A. C. Seward considered that the great uniformity of the curves presented by Dr. Willis and Mr. Udny Yule was suspicious, for Nature had not been uniform. He pointed out that, as regards conifers and ferns, study showed that the forms existing now in restricted areas were the oldest and not the youngest.

Mr. Julian Huxley contended that many factors played a part in evolution. Species characters should be analysed by the methods of genetics and physiology before it could be said which were useless. Apparently useless characters in the Gipsy moth were correlated with physiological differences, such as rate of growth, which harmonised with the environment.

Prof. R. Ruggles Gates considered that Dr. Willis's view was a corollary of the mutation hypothesis, and emphasised the importance of the extinction of forms as a factor in evolution.

Prof. W. J. Dakin suggested that biologists were on the threshold of a new line of study of evolution from the physico-chemical side. He believed that the faculty of evolution was as much a character of the organism as irritability or reproduction, and pointed out that natural selection was really natural elimination, the production of characters being inherent properties.

Dr. A. B. Rendle said it was almost impossible to say what characters were useful or not, and, in view of the limited space available, considered that the multiplication of genera and species in geometrical progression was unlikely.

Prof. J. Stanley Gardiner agreed that evolution was an inherent property of protoplasm, and raised the question as to why forms of life died out. He expressed approval of the main thesis of "Age and Area."

In reply, Dr. J. C. Willis pointed out that there must be some reason for the uniformity of expression as given in his statistical work. He accepted the phrase "Natural Elimination" instead of "Natural Selection."

In concluding the discussion, Prof. H. H. Dixon pointed out that both "Natural Selection" and "Age and Area" were essentially truisms, but none the less required explicit statement and demonstration.

Effects of Local Conditions on Radio Direction-finding.

THE methods used for finding the direction in which Hertzian waves are incident at a radio station have now attained a high accuracy, the maximum error being well under one degree. It does not follow, however, that the methods give the direction of the sending station to the same accuracy. The waves sent out may have suffered reflections from all kinds of conductors before they reach the receiving station. Hence, especially at night-time, the apparent direction generally differs very appreciably from the true direction. A preliminary report on this subject, communicated by the Radio Research Board, was read on November 8 to the Radio section of the Institution of Electrical Engineers by Messrs. Smith-Rose and Barfield. They classify the causes of distortion under two heads: First, those which are vaguely classed as night-effects and occur between sunset and sunrise. They are sometimes as large as 20°, and little is known as to their cause. Hence in practice radio-direction finding is restricted to day-time. The second causes of error are those due to conducting substances in the immediate neighbourhood of the search coil. In one experiment a metal tube 50 ft. long, semicircular in cross-section, and of radius 3 ft. 6 in. was used. When the coil was at a distance of 15 ft. from either end errors became appreciable, and when placed 15 ft. inside the tube the error was as great as 29°.

Experiments were also made on board ship, as radio-direction finding is of great value in navigation. It was found that when the waves came fore-and-aft or athwart the ship there was no error, but that in intermediate positions the errors were sometimes as great as 22°. As these errors are approximately constant, corrections can be applied as in the case of the magnetic compass. Curiously enough it was found that underground metal work in the neighbourhood had a very appreciable effect on the apparent direction of the incoming waves. The Aberdeen University direction-finding station, for example, was erected on what was thought to be a favourable site. The errors found, however, indicated the existence of a long strip of metal in the neighbourhood in a definite direction. The authors investigated the cause and found that a sewer in the neighbourhood, which was in the given direction, was supported by a strip of steel 6 ft. wide, 300 ft. long, and 8 ft. below the surface.

Overhead wires also caused appreciable but variable errors, which the authors traced to variations of the telegraph and telephone circuits when in use. They investigated the errors produced by tuned aerials and trees. Trees when damp have small resistance, and so the oscillations set up in them affect the direction of the waves. A row of damp trees forms a very good conducting screen. It was noticed that the waves showed a tendency to move round large conductors. Owing to variable meteorological conditions a very large number of experiments had to be made before definite results were obtained. The authors are continuing theri investigations.

New X-ray Department at Manchester.

SIR HUMPHRY ROLLESTON, president of the Royal College of Physicians and of the Röntgen Society, opened on November 18 the new X-ray department of the Manchester Royal Infirmary, which is probably the most completely equipped department of its kind in this country. This has been made possible by two separate gifts of 5000*l.*, one by Mr. Robert McDougall and the other by an anonymous benefactor.

The occasion coincided with a joint provincial meeting at Manchester of the Röntgen Society and the Electrotherapeutics Section of the Royal Society of Medicine; and a considerable number of members took the opportunity of inspecting the new equipment, which has been installed by Messrs. Watson and Sons under the direction of Dr. A. E. Barclay, senior radiologist to the Infirmary

The new department is on the ground-floor, is well lighted and ventilated, possesses generous head room, and is cheerfully decorated, all features which are

stressed in the recommendations of the X-ray and Radium Protection Committee. Indirect lighting is employed, the ceilings being painted with white enamel.

Throughout the building high-tension wires are abolished. They are replaced by stout aluminium tubing, which eliminates brush discharges and prevents the formation of ozone, now known to be prejudicial to the health of the operators.

Most of the X-ray bulbs are contained in boxes which are covered with an adequate thickness of sheet lead. In addition, the walls are coated with a plaster containing a large admixture of barium sulphate, the result being a wall giving protection equivalent to that of about 8 mm. of lead.

Coolidge tubes and closed-core high-tension transformers are the order of the day, except in the treatment department, where the existing induction coils have been brought up-to-date.

In the screening-room a Sunic 10 K.V.A. oil-immersed transformer is installed. The new intensive deep therapy treatment of cancer is catered for by two separate 200,000-volt outfits, each of the twin-coil type—one a German set with dry insulation by Maison Schaerer, the other of the oil-immersed type by Newton and Wright.

There are a number of unusually elaborate screening-stands and couches, a novel development being the Potter Bucky couch, in which a lead grid is inserted between the patient and the photographic plate. The grid, while allowing direct X-rays from the bulb to pass, prevents the majority of the scattered radiation from reaching the plate, to the marked benefit of definition. A special portable X-ray equipment is provided for use in the wards of the hospital in cases where it is inadvisable to move the patient.

The lay-out of the department is well-nigh a model of its kind, being arranged so that the work progresses automatically to its finality. The day of black-painted walls for dark rooms is over; instead, we find a cheery lofty room which can readily be flooded with daylight when the room is not in use. Thermostatic control of the developing and fixing solutions, etc., is provided. There is also a fully-equipped demonstration room, so that doctors and students can watch the examination of cases without hampering the work. This demonstration room is also provided with a stereo-motorgraph, an ingenious instrument which automatically changes lantern slides by a press-button, so that the lecturer is independent of a lantern operator. The proportion of infirmary patients requiring X-ray examination is one in five, so that business-like and orderly arrangements are very essential.

At the joint meeting Prof. Jacobaeus of Stockholm, Prof. W. L. Bragg and Prof. A. V. Hill, among others, contributed papers; and the enterprise of the two societies in departing from precedent by holding a meeting in the provinces met with great local appreciation and support.

University and Educational Intelligence.

ABERDEEN.—Dr. A. W. Gibb has been appointed to the newly founded Kilgour chair of geology. This foundation is derived from a bequest under the will of the late Dr. Alexander Kilgour of South Loirston, supplemented in the will of his son, through whose death it has now become available. In accordance with the terms of the trust deed, junior and senior scholarships in natural science have also been instituted. Prof. Gibb, who has an intimate knowledge of the geology of the north of Scotland, has been in charge of the teaching of the subject since 1899, first as a member of the staff of the natural history department, and since 1908 as head of an independent department of geology. The teaching of the subject in Aberdeen is associated with the names of James Nicol and Alleyne Nicholson.

Prof. E. W. Hobson has completed, during the present month, his second series of Gifford lectures on "The Domain of Natural Science." In this series, which concludes the course, he has reviewed the whole field of natural science, and has dealt with its relation to general thought and to theism. The lectures will appear in book form.

LIVERPOOL.—We understand that Prof. F. Carey is to retire at the end of the present session. Prof. Carey is head of the department of pure mathematics at the University, and was one of the original professors on the first staff of the University College.

THE Strasbourg correspondent of the *Times* states that the diploma of doctor *honoris causa* of the University of Strasbourg has been conferred upon Sir James Frazer, author of "The Golden Bough."

ACCORDING to the Paris correspondent of the *Times*, the degree of doctor *honoris causa* of the University of Paris has been conferred on the following: Prof. Bordet, professor of bacteriology in the University of Brussels; Prof. M. Lugeon, professor of geology in the University of Lausanne; and Prof. A. Michelson, professor of physics in the University of Chicago.

BY the will of Sir William Stevenson Meyer, High Commissioner for India and formerly Chief Secretary to the Government of Madras, who died on October 19 last, sums of 3000*l.* each are bequeathed to University College, London, "for the encouragement of proficiency in European history and in the history and geography of India," and to the University of Madras "for promoting the study of history and economics."

A CONFERENCE on the teaching of science in schools and colleges, which owed its initiation to Miss Winifred Smith, president of the Association of University Women Teachers, and its organisation to the joint efforts of the Association of Science Teachers and the A.U.W.T., was held on Saturday, November 25, at University College. During the morning session, with Miss Smith in the chair, the more general aspects of science teaching and the relationship between the work in the school and in the university were discussed. In the opening paper Sir William Tilden dealt with science in the school and raised a plea for work of wider and less specialised type, with a place for the history of the growth of knowledge. His personal reminiscences added much to the interest of the paper. Sir William Bayliss and Prof. J. R. Partington both expressed themselves in hearty support of wider range in the science work. The last speaker, from the point of view of university work, considered that the more specialisation was pushed in the school, the worse the result later. The condemnation of specialisation was continued in the papers of both Miss Thomas and of Miss Drummond. The first speaker dealt with the preparation of the student for the work of teaching science and deplored the tendency to specialise too early at the university; she considered the conditions of the Burnham scales enhanced this. The afternoon session included a paper upon the teaching of biology by Mr. A. G. Tansley, and papers upon

schemes of work in physics and nature study by Miss Lees and Mr. Latter respectively. The duty of the school to instruct future citizens regarding the functions of their own bodies was raised by several speakers. During the day, through the kindness of the college authorities, there was an opportunity to visit the laboratories, which was greatly appreciated by the members of the well-attended conference.

THE *Chemiker Zeitung* of September 28 publishes particulars as to the number of students in German universities. The total number had increased from 40,000 to 60,000 at the outbreak of war. At the end of the war the number was 90,000, and in the summer of 1921 it was 87,147. At present it is 82,668. The Technischen Hochschulen had 12,000 students before the war, in 1920 they had 22,976, and last winter 25,556. The division into faculties has undergone changes; the warnings of overcrowding in some faculties have had some effect but the stream of superfluous students has mainly been diverted into other faculties, which are also now hopelessly overcrowded. The following comparison is given with pre-war conditions:

Faculty.	1914.	1922.
Evangelical Theology	4,370	2,974
Catholic Theology	2,050	1,795
Legal Science	9,840	16,834
Medicine	16,048	15,110
Dentistry	976	4,167
Philosophy and Philology	14,400	12,823
Mathematics and Natural Sciences	8,132	9,257
Pharmacy	1,100	1,112
National Economy	3,836	17,714
Forestry	..	490

The following refer to technical students:

Faculty.	1914.	1922.
Architecture	2,193	1,811
Constructional Engineering	2,767	3,311
Mechanical Engineering	3,118	8,306
Electrotechnics	1,307	5,129
Mathematics and Natural Sciences	1,544	3,735
Mining and Metallurgy	576	1,234
Naval Engineering	234	365
General	493	1,483

It is further stated that the present-day student does not tend to the same extent as before the war to study in the large cities.

LIFE in the universities of Russia to-day is described by Harold Gibson, Chief Administrator, International University Relief in Russia, in a brief note circulated for the purpose of obtaining further help for their professors and teachers. While conditions in Moscow and Petrograd are said to have improved materially during the past year, they are still deplorable in the provinces. Professors and teachers have been receiving from the Government food packets (academical *pyok*), but it is doubtful whether this supply, inadequate and irregular during the summer, will not cease altogether during the winter. In addition they receive, but not regularly, pay on a scale sufficient to provide food (millet gruel with sunflower oil, soup made from salt fish, and potatoes fried in oil) for about one week per month. All clothing they could possibly do without during the summer is said to have been sold. As for housing, it is seldom that a professor's family has more than two rooms to live in and very frequently they have only one, while in some universities the professors live in their lecture-rooms or laboratories. It is astonishing that under such conditions work of any value can be done, but we are assured that not merely is a respectable standard of instruction maintained but valuable research work has been done. An appeal by the Universities Committee of the Imperial War Relief Fund issued in September last met with an immediate and generous response, but much more is needed urgently—money, gifts in kind of food, clothing, and clothing material, books, scientific journals, and laboratory equipment. Full particulars can be obtained from Miss Iredale, Organising Secretary of the Committee, General Buildings, Aldwych, London, to whom cheques made payable to the Hon. Cecil Baring should also be sent.

THE Council of the League of Nations has approved and published a report on "The condition of intellectual life in Austria," specially prepared by Prof. de Reynold, of the University of Berne, during the month of August. It describes a struggle for existence carried on in circumstances of increasing difficulty which threaten to overwhelm completely Austrians who are dependent for their means of livelihood on intellectual work. "The winter of 1922–1923 will without a doubt be decisive." The University of Vienna is at present saved from having to close its doors by a Government subsidy of 1000 million crowns (the purchasing power of which is about one-twentieth part of the subsidy it was receiving before the war), but all practical scientific work has become impossible owing to lack of funds for the purchase of essential requisites. The Universities of Graz and Innsbruck and other institutions of higher education are in a similar or worse plight. Innsbruck formerly attracted many foreign students, but last year none except Austrians attended, and there is talk of closing, if not the whole university, at least the school of medicine. Academies and scientific societies continue to meet but are unable to publish reports except when, as occasionally happens, a foreign patron provides funds for the purpose. The monthly salary of a university professor is on an average about enough to live on for twenty days, and he may receive students' fees up to a sixth of his salary. Lectures go on in Vienna up to 10 P.M. to enable students to earn money by manual work (the only kind that is well paid) during the day. In the circumstances it is surprising that last year the University of Vienna still had nearly 10,000 students.

IN "Home Economics in Rural Schools" and "Modern Equipment for One-Teacher Schools" (Home Economics circular 13 and Rural School leaflet 3, 1922, of the Bureau of Education, Washington) a prominent place is given to the provision of hot lunch for the pupils. It has been found that in such schools the most satisfactory method of imparting a knowledge of foods and household sanitation and inculcating right health habits is in connexion with the preparation and service by groups of children of a hot lunch for the whole school. It is claimed that the time taken from the regular school work is not more than ten minutes daily, and that the beneficial physical effects of the hot food itself, and the moral effect of the co-operative social activity involved, have been very marked. It is recommended that the instruction in home economics should be related to the geography, arithmetic, and physiology lessons. In "Reorganization of Home Economics in Secondary Schools" (Bulletin 5, 1922) it is stated that the most satisfactory and economical management of the school lunch in any school, large or small, is attained by placing it under the direction of the head of the home economics department.

Calendar of Industrial Pioneers.

December 3, 1863. John Watkins Brett died.—A pioneer of submarine telegraphy, Brett obtained permission in 1847 from Louis Philippe to establish connexion by cable between England and France, a project which was first carried out in 1850.

December 4, 1804. Philippe Le Bon died.—In France, Le Bon is regarded as the inventor of lighting by gas. Educated for the Government service, in 1794 he became a professor in the École des Ponts et Chaussées. Three years later he was able to light his house at Bruchay by the distillation of wood, and in 1799 he was granted a patent. On December 4, 1804, he was found in the Champs-Elysées murdered by an unknown hand.

December 6, 1777. Johann Andreas Cramer died.—Regarded as the greatest assayer of his time, Cramer was born in Quedlinburg in 1710, taught assaying in Leyden and London, and afterwards was councillor of mines and metallurgy at Blankenburg. His "Docimasia" was published in 1736 and his "Elementa Artis Docimasticæ" in 1739.

December 6, 1892. Werner von Siemens died.—The eldest of the famous Siemens brothers, Werner Siemens was born at Lenthe, Hanover, on December 13, 1816, and in 1838 became an artillery officer. Distinguished for his scientific attainments, with John Georg Halske (1814–1890) he founded in 1847 the firm of Siemens and Halske at Berlin, and the following year with Himly laid the first telegraph line in Germany. He made many discoveries in electricity, in 1866 gave half a million marks for the founding of an Imperial Institute of Technology and Physics, and in 1888 was ennobled.

December 7, 1880. Henry R. Worthington died.—The original inventor of the direct-acting steam pump, of which many thousands of various types are manufactured annually, Worthington took out his first patent in 1841, and in 1845 founded the Worthington Hydraulic Works of New York, which became the leading establishment for the construction of steam-pumping machinery in the United States.

December 7, 1894. Ferdinand Viscomte de Lesseps died.—The originator and constructor of the Suez Canal, one of the great engineering works of last century, de Lesseps was born at Versailles in 1805, and at the age of twenty joined the French diplomatic service. Among other places he served at Cairo and Alexandria. Obtaining a concession from Said Pasha in 1854, he started the canal in 1858; a vessel of 80 tons passed from the Mediterranean to the Red Sea in 1867, and on November 17, 1869, the canal was formally opened. A colossal statue of de Lesseps stands at Port Said. De Lesseps also launched the scheme for the Panama Canal, and when an old man of eighty-eight was with the other directors found guilty of mismanagement and sentenced to a term of imprisonment, which, however, was not enforced.

December 8, 1870. Thomas Brassey died.—At a period when railways were first coming into extensive use, Brassey with various partners carried out some hundreds of important contracts including railways in England, France, Italy, Canada, Australia, Argentine, and India.

December 9, 1814. Joseph Bramah died.—Known for his invention of a safety lock, a beer engine, the hydraulic press, and a machine for numbering and dating banknotes, Bramah was a native of Yorkshire, but for many years was one of the leading mechanicians in London. E. C. S.

Societies and Academies.

LONDON.

Linnean Society, November 2.—Dr. A. Smith Woodward, president, in the chair.—A. B. **Rendle**: Early specimens of the dahlia and chrysanthemum from the Banksian Herbarium.—J. S. **Huxley**: The courtship of birds.—B. Daydon **Jackson**: The use of the name Forstera or Forsteria. Both names were used by Linne on a sheet in his herbarium with his note *Fostera vaginalis* on a sheet which formerly had a grass-like plant glued upon it and therefore was widely separated from the Stylidiaceous genus which at the present day bears the name Forstera.

Aristotelian Society, November 6.—Prof. A. N. Whitehead, president, in the chair.—A. N. **Whitehead**: Uniformity and contingency (presidential address). Our awareness of Nature consists of the projection of sense-objects into a spatio-temporal continuum either within or without our bodies. But "projection" implies a sensorium which is the origin of projection. This sensorium is within our bodies, and each sense-object can be described as located in any region of space-time only by reference to a particular simultaneous location of a bodily sensorium. The process of projection consists in our awareness of an irreducible many-termed relation between the sense-object in question, the bodily sensorium, and the space-time continuum, and it also requires our awareness of that continuum as stratified into layers of simultaneity, the temporal thickness of which depends on the specious present. If this account of Nature be accepted, then space-time must be uniform, for any part of it settles the scheme of relations for the whole irrespective of the particular mode in which any other part of it, in the future or the past or elsewhere in space, may exhibit the ingression of sense-objects. Accordingly, the scheme of relations must be exhibited with a systematic uniformity. We have here the primary ground of uniformity in Nature.

Mineralogical Society, November 7 (anniversary meeting).—Dr. A. Hutchinson, president, in the chair.—W. A. **Richardson**: The frequency-distribution of igneous rocks in relation to petrogenic theories. The distribution of igneous rocks shows a separation into two primary types, probably corresponding to two primary earth shells, which have originated under early planetary conditions. All other rocks are normally distributed about the two primaries, and the probable cause of such a distribution is fractional crystallisation. The frequency-distribution likely to result from different petrogenic processes is examined and discussed.—Miss I. E. **Knaggs**: The connexion between crystal structure and chemical constitution of carbon compounds. In certain simple substitution products of methane, the crystal symmetry may be predicted from the known configuration of the chemical molecule. The symmetry of a molecule of the type CX_4 is that of a regular tetrahedron, X being either a univalent atom or a group of atoms, which does not destroy the trigonal symmetry about the bonds from the central carbon atom. Compounds of this type crystallise in the cubic system. Compounds in which X is a more complex group, but sufficiently symmetrical to maintain tetragonal symmetry, crystallise in the tetragonal system, most frequently in the holohedral class, in which case the crystal is considered to be built up of cells each containing eight molecules. Molecules of the type CX_3Y have one axis of trigonal symmetry, and this symmetry is preserved in the crystal, except when X is hydrogen. The orthorhombic symmetry of molecules of the type CX_2Y_2

is maintained in the crystal.—Dr. G. T. **Prior**: The meteoric iron of Karee Kloof, Cape Province, and the meteoric stone of Leeuwfontein, Pretoria, South Africa. The meteoric iron, of which a mass of 92 kgm. was found at Karee Kloof, is a coarse octahedrite containing 8·27 per cent. nickel; the Leeuwfontein meteoric stone of 460 gm. which fell on June 21, 1912, is an intermediate chondrite.

Zoological Society, November 7.—Prof. E. W. MacBride, vice-president, in the chair.—C. S. **Elton**: The colours of water-mites.—E. B. **Poulton**: Commensalism among Crustacea. An account of experiments conducted at the Laboratory of the Marine Biological Association, Plymouth, in 1890, showing commensalism may be beneficial to Crustacea.—G. M. **Vevers**: Nematode parasites of mammals from the Zoological Society.—W. J. **Kaye**: New species of Trinidad moths.—C. F. **Sonntag**: On the myology and classification of the wombat, koala, and phalangers.—E. G. **Boulenger**: Description of a new lizard of the genus Chalcides, from the Gambia, living in the Society's Gardens.

Geological Society, November 8.—Prof. A. C. Seward, president, in the chair.—R. D. **Oldham**: The earthquake of August 7, 1895, in Northern Italy. This earthquake, although nowhere more than a feeble shock, was felt over an area measuring about 160 miles across and covering some 15,000 to 20,000 square miles in Lombardy and Tuscany. There is no indication of a central area of greatest intensity; reports indicating an intensity of IV° (Mercalli scale) are scattered over the whole area, and reports of sounds and of noticeable vertical movement are similarly distributed. The nature of the disturbance was akin to that in the outer parts of the seismic area of great earthquakes. The depth of the ultimate origin of the earthquake must have been of the order of 100 miles or more.—R. D. **Oldham**: The Pamir earthquake on February 18, 1911. This earthquake was felt over an area of about 250 miles in diameter; the region included by the VIII° R.F. isoseist measured about 40 miles across. Over the greater part of this area destruction was extreme, and the hillsides were seamed with landslips. Aftershocks were recorded, providing further evidence that the earthquake had its origin at a considerable depth below the surface. The great landslip, though determined by, and not determining the earthquake, as has been thought in the past, may have influenced the distant seismograms by setting up surface-waves which, superimposed on those directly due to the earthquake, may account for the unusual size of the long (or surface-) waves, as compared with the preliminary tremors.—F. **Dixey**: The geology of Sierra Leone: About half of the Protectorate of Sierra Leone is composed of potash-bearing granites and granite-gneisses, while the remaining areas are occupied equally by older schists and gneisses and the ancient sedimentary Rokell River Series. The older schists and gneisses, including a charnockitic series similar to that of the Ivory Coast, represent a complex of highly metamorphosed sedimentary and igneous rocks. The Rokell River Series has a lower conglomeratic division that rests unconformably upon the crystalline rocks. The rocks of the series are usually much disturbed, and show every gradation from slight deformation to intense dynamic metamorphism. The southern margin of the great series of horizontal sandstones of French Guinea forms, near the Anglo-French boundary of the Protectorate, the Saionia Scarp, and thus the formation within the Protectorate bears the name Saionia Scarp Series. It rests alike with striking unconformity upon the Rokell River Series and the crystalline rocks.

Association of Economic Biologists, November 10.—E. S. **Russell**: The work of the Fisheries Laboratory at Lowestoft. The main task of the past two years of the Laboratory and research ship *George Bligh* has been the working out of the life-history and food supply of certain economic fishes. Investigations on plaice in the North Sea have shown that there are more plaice than before and they were markedly larger and older than the pre-war plaice. In connexion with cod and herring investigations a quantitative study of the bottom fauna, carried out by Petersen's method on an area of the Dogger Bank, showed that the food supply was very patchy. Large patches of *Mactra* (*Spicula*) *subtruncata*, which is a plaice food, were found. The fauna belonged generally to the Venus community, with a tendency to deep Venus. Investigations of the early stages of the herring led to searching for spawning areas. Useful pointers have been the catches of spawn-gorged haddocks landed on the East Coast. Larval and post-larval forms were secured chiefly by using the Petersen young fish trawl. There is a spawning ground off the Lincolnshire coast, and others off the Northumberland coast, on the W. edge of the Dogger, and in the Southern Bight, etc. At an early stage young herring concentrate in inshore waters and go in shoals, which complicates quantitative investigations. The failure of last year's herring fishery on the E. coast of England is thought to be related to an abnormal influx of Atlantic water into the N. Sea. Concomitantly, changes occurred in temperature, salinity, and plankton fauna. Very young herring, even before the yolk sac is absorbed, prefer Pseudocalanus as food; a later stage takes Temora, and herring of whitebait size take Eurytemora.—S. F. **Harmer**: The present position of the whaling industry.

Linnean Society, November 16.—Dr. A. Smith Woodward, president, in the chair.—A. J. **Wilmott**: *Orchis latifolia*, Linn. (marsh orchis) from the Island of Öland, Sweden, obtained from the station in which it was found by Linnæus in 1741. *O. latifolia*, L., 1753, was a general name for marsh orchids, but in 1755 this name was limited without varieties, and separated from *O. incarnata* and *O. sambucina*. The diagnosis is general, and comes from Linnæus's article in Act. Upsal. 1740, where it applies mainly to unspotted-leaved plants. Linnæus, referring to *O. latifolia* in 1755, says that the leaves are slightly spotted. This may refer to the decay spots on the plant in his herbarium, or to the hybrid forms with spotted leaves which occur where *O. prætermissa* and *O. maculata* occur together.—T. A. **Sprague**: Twin-leaves and other abnormalities in the common ash, *Fraxinus excelsior*. Specimens were shown with fasciated stems, bud-variation, accessory leaflets, confluent leaflets, twin-leaves and triplets, and other abnormalities. Twinning is probably caused by hypertrophy. Complete or partial suppression of one leaf of a pair does not necessarily disturb the opposite-decussate phyllotaxy.

Faraday Society, November 20.—Sir Robert Robertson, president, in the chair.—T. M. **Lowry**: Intramolecular ionisation. The introduction of electronic formulæ based on the theory of octets has made it necessary to postulate a condition of intramolecular ionisation in a large number of compounds where the charges on the nuclei are not balanced by the enveloping electrons. Stability in oxy-acids depends on the presence of a positive charge on the central atom of the ion. This also increases the strength of the acid. A maximum of stability and

of strength is reached in acids containing four atoms of oxygen round the central atom of the ion.—C. J. **Smith**: On the viscosity and molecular dimensions of hydrogen selenide. Attention has recently been directed to the relations which exist between the molecular dimensions of those gaseous hydrides which have the same molecular number. In the series krypton, hydrogen bromide, hydrogen selenide, and arsine there were no data for hydrogen selenide. Two factors are necessary for the proper estimation of dimensions of a gaseous molecule, namely, the coefficient of viscosity, and its rate of variation with temperature. The viscosity of hydrogen selenide at atmospheric temperature has been measured, but the almost complete decomposition of the gas at steam temperature has prevented any trustworthy experimental determination of the temperature variation being made. The numerical results obtained confirm the supposition that the gaseous molecules HBr, H_2Se, and AsH_3 have a central atom which resembles an atom of krypton, and that the increase in A in passing along the series is to be attributed to the hydrogen nuclei which have become attached to the central atom. As the hydrogen atoms in the molecule multiply, the distance of each hydrogen nucleus from the centre of the molecule increases more and more rapidly.—W. R. G. **Atkins**: The hydrogen concentration of natural waters and some etching reagents in relation to action of metals. The results obtained are summarised as follows: Natural waters are usually between *p*H6 and *p*H8·3, unless when rendered more acid by oxidation of sulphur from pyrites or by metallic salts. Bog pools may be as acid as *p*H5. Photosynthesis increases the *p*H value. Ferrous salts in solution become more acid on standing, with precipitation of ferric hydroxide. The latter is completely precipitated before ferrous hydroxide, as the solution is made progressively more alkaline. Even at *p*H7·1 the precipitation of ferrous hydroxide is incomplete. Hence a trace of acid suffices to attack iron, and the hydroxide produced through hydrolysis is oxidised and precipitated. The hydrolysis equilibrium is thereby upset and acid is regenerated. Buffer mixtures and acids of relatively low hydrogen ion concentration might be used as etching agents.

CAMBRIDGE.

Philosophical Society, October 30.—Prof. A. C. Seward, president, in the chair.—H. **Hartridge** and F. J. W. **Roughton**: Determinations of the velocity with which carbon monoxide displaces oxygen from its combination with the blood pigment hæmoglobin. The velocity of the reaction, which is considerable, was measured by utilising the fact that light displaces the system from equilibrium by reducing the amount of the carbon monoxide hæmoglobin in a solution of hæmoglobin containing oxygen and carbon monoxide. The relationship between the amounts of the oxy- and carbon monoxide hæmoglobin at any moment was determined by the reversion spectroscope, which makes use of the fact that the wave-length of the α band of the mixed pigment varies with the relative concentration of the pigments. Two methods of measuring the velocity of reaction were employed:—(*a*) The solution was caused to flow turbulently from a glass tube exposed to light, down a second glass tube in the dark. In this tube the equilibrium returned to its "dark" position, and from the rate of flow measurements by the spectroscope give the relative amounts of oxy- and carbon monoxide hæmoglobin at any moment. (*b*) The solution remained in one vessel, the exposure to light being suddenly cut off, and the time measured with a chronometer for the relationship between the oxy- and carbon monoxide hæmoglobin to reach a definite value as shown by the spectroscope. Velocity constants were calculated, assuming the reaction to be expressible by a simple chemical equation. The temperature coefficients calculated from the results obtained at other temperatures agree closely, the mean value being 2·5. These results fit in with the view that the combinations of oxygen and carbon monoxide with hæmoglobin are of a simple chemical nature.—G. H. **Hardy** and J. E. **Littlewood**: Some problems of Diophantine approximation.—**J. Chadwick** and C. D. **Ellis**: A preliminary investigation of the intensity distribution in the β-ray spectra of radium *B* and *C*.—C. G. **Darwin** and R. H. **Fowler**: Partition functions for temperature radiation and the internal energy of a crystalline solid.—J. E. **Littlewood** and E. A. **Milne**: On an integral equation.—E. V. **Appleton**: The automatic synchronisation of triode oscillators.—P. L. **Kapitza**: Note on the curved tracks of β-particles.—G. T. **Walker**: Meteorology and the non-flapping flight of tropical birds.—Major P. A. **MacMahon**: The algebra of symmetric functions.

DUBLIN.

Royal Irish Academy, November 13.—Prof. Sydney Young, president, in the chair.—S. **Young**: A note on azeotropic mixtures. It is now possible to predict, either with certainty or with considerable confidence, whether an alcohol of the methyl alcohol series not yet investigated can or cannot form a binary mixture of minimum boiling-point with hexane, benzene, or toluene, or a ternary azeotropic mixture with one of these hydrocarbons and water.

PARIS.

Academy of Sciences, November 6.—M. Albin Haller in the chair.—The president announced the death of E. Bouty.—L. **Lindet**: Concerning the coagulation of latex. Remarks on a communication by M. Vernet on the effects of adding calcium chloride solution to the latex of rubber plants. In 1914 the author published an account of a similar action of calcium chloride in the coagulation of milk casein.—Jean **Effront**: The absorption of pepsin and hydrochloric acid by foods. Starting with the observation that certain filter papers proved to be active absorbents of pepsin, experiments have been carried out on the absorptive powers of various fruits and vegetables for pepsin and also for hydrochloric acid. The amounts absorbed were considerable, and vary with the fruit and with the acidity of the medium. The therapeutical aspects of these facts are discussed.—Serge **Bernstein**: The asymptotic development of the best approximation by polynomials of rational functions of degrees indefinitely increasing.—Birger **Meidell**: A problem of the calculus of probabilities and of mathematical statistics. A discussion of Tchebycheff's theorem on the probabilities of errors greater than the average error with special reference to the calculus of probabilities and mathematical statistics.—P. J. **Myrberg**: The singularities of automorphic functions. A correction to the note of October 23 on the same subject.—J. **Le Roux**: Gravitation in classical mechanics and in Einstein's theory.—Louis **de Broglie**: Interference and the quanta theory of light.—Paul **Pascal**: The magnetic analysis of silicates and the silicic acids. From measurements of magnetic susceptibility of silicic acid in varying degrees of hydration it is concluded that all the forms of "hydrated silica" studied behave magnetically as mixtures of anhydrous

silica and water. There is no evidence in favour of the existence of any definite silicic acids in the hydrated silica.—André **Brochet**: The preparation of active nickel for organic catalysis. Three methods are described, the reduction of black nickel oxide by electrolytic hydrogen at 350° C. (an operation requiring 48 hours), or by heating either nickel formate or nickel oxalate to 250°–300° C. These three varieties of active nickel possess practically identical catalytic properties.—A. **Aubry** and E. **Dormoy**: An arsenical glucoside: diglucosidodioxydiamino-arsenobenzene. The compound "606" has been made to combine with glucose and the reactions of the diglucoside formed are given. For therapeutic purposes the glucoside has the advantage as compared with "606" of being very soluble in neutral medium: it is also less alterable in air than the dioxydiamino-arsenobenzol.—Pereira **de Sousa**: The eruptive rocks of the Mesozoic and Cainozoic border of Algarye and their geological age.—C. **Kilian**: General sketch of the structure of the Tassilis of Ajjer.—Albert **Baldit**: Magnetic measurements in the south of France.—Sabba **Stefanescu**: The velocity of evolution and the general plan of structure of the crown of the molars of mastodons and elephants.—Marc **Bridel** and Camille **Charaux**: Centaureine, a new glucoside, extracted from the roots of *Centaurea jacea*. Details of the extraction and properties of the new glucoside are given. On hydrolysis, centaureine gives 33·7 per cent. of glucose (and no other sugar) and 70·8 per cent. of centaureidine.—E. and G. **Nicolas**: The action of hexamethylenetetramine on the higher plants.—Marin **Molliard**: The influence of salts of copper on the yield of *Sterigmatocystis nigra*.—Adrien Davy **de Virville** and Fernand **Obaton**: The opening and closing of persistent meteoric flowers. Persistent meteoric flowers are defined as those the floral parts of which show opening and closing movements during several days. These movements depend almost entirely upon the temperature. A reduction in the relative humidity of the air favours the opening of the flowers, but the effect is slight. Contrary to the views expressed by some physiologists light is without action.—Alphonse **Labbé**: The variations in the concentration of hydrogen ions in the salt marshes, considered as a biological factor.—M. **Bezssonoff**: The effect on guinea-pigs of an antiscorbutic preparation.

SYDNEY.

Linnean Society of New South Wales, August 30.—G. F. **Hill**: A new species of Mordellistena (Coleoptera, Mordellidæ) parasitic on termites. Description of a new species from Palm Island, N. Queensland, distinguished from all other Australian species of the genus by its large size and bright red prothorax. It is improbable that this parasite, of which the only known host is *Calotermes* (*Glyptotermes*) *nigrolabrum* Hill, could become a factor in controlling injurious species of termites.—W. W. **Froggatt**: Description of a new Phasma belonging to the genus Extatosoma. A female obtained at Gosford, N.S.W., differing from *Extatosoma tiaratum* W. S. Macleay, in its much more slender form, many more spines, different flanges on abdomen, and shape of legs.—W. A. **Haswell**: On Astacocroton, a new type of acarid. It is a parasite of the common spiny crayfish (*Astacopsis serratus*) of the rivers of New South Wales. It lives permanently in the gill-cavities of its host, and the mature females become permanently attached to the gills and incapable of active locomotion. The food consists solely of the blood of the crayfish. In structure Astacocroton is related to the hydrachnids, but shows certain special features, particularly in the female reproductive apparatus.—Vera **Irwin-Smith**: A new nematode parasite of a lizard. It possesses an asymmetrical row of spines down one side. Nothing like it has been found previously in reptiles. It is assigned, provisionally, to the genus Rictularia, a genus recorded, hitherto, only from mammals. Only two females have been found.—A. J. **Turner**: Revision of Australian Lepidoptera: Saturniadæ, Bombycidæ, Eupterotidæ, Notodontidæ. Of the first three families only fifteen Australian species are at present known. The fourth family, the Notodontidæ, is enlarged by the inclusion as a subfamily of the Cnethocampinæ, a small natural group of which the European Procession Moth is the type. Nearly seventy Australian species are recognised.

September 27.—Mr. J. J. Fletcher, vice-president, in the chair.—T. **Steel**: Chemical notes: General. Some curious ferruginous concretions surrounding twigs, leaves, and fruit of Hakea, from a chalybite pool near Fitzroy Falls, N.S.W., are described and figured, and an analysis given; also stalagmite from a grotto at Wentworth Falls, having a similar composition. Analyses are given of cubical pseudomorphs of pyrites, from Western Australia, called locally "Devils' Dice"; of lime prepared by the Fijians from coral and used for plastering the hair; of the shells of *Helix aspera*, the urinary secretion of birds and reptiles, the fruit of the banana, and milk of unripe coconuts.—Margaret H. **O'Dwyer**: A note on protein precipitation in grasses. Stützer's reagent (copper hydroxide), tannin salt solution, Barnstein's reagent (a variation of the copper hydroxide method) and alcohol (85 per cent.) were used as precipitants. Tannin salt solution and alcohol appear to give the best results.—Margaret H. **O'Dwyer**: Further report on the nutritive value of certain Australian grasses. Analyses are given of grasses at the early flowering period and when the seed is set. The protein present decreases with the age of the grass, while crude fibre is higher in the older stages. Diseased grasses showed slight divergences from normal.—W. F. **Blakely**: The Loranthaceæ of Australia (contd.), Pt. iii. Eight species and five varieties of the subgenus Euloranthus, of which one species and three varieties are new, are described.—M. B. **Welch**: The occurrence of oil-glands in the barks of certain Eucalypts. Oil-glands occur in the secondary bast of certain species of Eucalyptus (stems and roots). The contents of the secretory cavities become resinous and insoluble towards the outside of the bark. The function of the glands is probably protective.

Royal Society of New South Wales, October 4.—Mr. C. A. Sussmilch, president, in the chair.—H. G. **Smith**: On the occurrence of lævo-phellandrene in the oil of *Melaleuca acuminata*. The species occurs in South Australia and is locally known in Kangaroo Island as "Lavender bush." The yield of oil is about 2 per cent., and this consists principally of phellandrene and cineol, the latter to the extent of 44 per cent.—A. R. **Penfold**: The essential oils of two varieties of *Leptospermum flavescens*. The northern form of this species, *var. microphyllum*, was obtained from Frazer Island, and the other new variety, called *leptophyllum* (Cheel), from Narrabri. Both oils consist essentially of alpha and beta pinene, sesquiterpenes, and sesquiterpene alcohols, with small amounts of cineol; terpineol is present in the latter oil.

Official Publications Received.

Proceedings of the Cambridge Philosophical Society. Vol. 21, Part 3 (Easter Term, 1922). Pp. 129-296. (Cambridge: At the University Press.) 7s. 6d. net.

Proceedings, Asiatic Society of Bengal. (New Series.) Vol. 17, 1921, No. 4: Proceedings of the Eighth Indian Science Congress. Pp. lxxvii-ccxlviii. (Calcutta.)

Observations made at the Royal Magnetical and Meteorological Observatory at Batavia. Vol. 40, 1917, containing Meteorological and Magnetical Observations made in 1917. Pp. xx+106. (Batavia.)

Records of the Indian Museum. Vol. 21: Catalogue of the Planorbidæ in the Indian Museum (Natural History), Calcutta. Part 2. By Louis Germain. Pp. 81-128. (Calcutta: Zoological Survey.) 2 rupees.

Uganda Protectorate. Annual Report of the Department of Agriculture for the Year ended 31st December 1921. Pp. 87. (Entebbe.)

Diary of Societies.

MONDAY, DECEMBER 4.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Rev. C. Gardner: Romance and Mysticism.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 5.—A Twenty-one Minute Period in Earthquakes. *Chairman*: Prof. H. M. Macdonald. *Speakers*: Prof. H. H. Turner; Dr. J. H. Jeans.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

SOCIETY OF ENGINEERS, INC. (at Geological Society), at 5.30.—W. Dinwoodie: Wave-Power Transmission.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—F. A. Sclater, and others: Discussion on an Electrical Installation at a Model Farm.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—G. Cator: The One and the Many.

ROYAL SOCIETY OF ARTS, at 8.—Prof. W. A. Bone: Brown Coal and Lignites (Cantor Lecture).

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Engineers' Club, 39 Coventry Street), at 8.—Dr. G. S. Robertson and F. Dickinson: The Valuation of Insoluble Phosphate by Means of a Modified Citric Acid Test.

ROYAL SOCIETY OF MEDICINE (Tropical Diseases and Parasitology Section) (Informal Meeting), at 8.30.—Prof. R. T. Leiper: Kinematograph Film of British Guiana: Its People, Natural History, and Scenery.

TUESDAY, DECEMBER 5.

ROYAL SOCIETY OF ARTS (Dominions and Colonies Section), at 4.30.—Major O. Rutter: North Borneo.

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 5.30.—H. A. T. Fairbank and others: Discussion on The Operative Treatment of Dislocation of the Hip, Congenital and Pathological.

INSTITUTION OF CIVIL ENGINEERS, at 6.

BRITISH PSYCHOLOGICAL SOCIETY (Annual General Meeting) (at London Day Training College), at 5.30; at 6.—Dr. E. O. Lewis: The Memory of Feeble-minded Children.

INSTITUTE OF MARINE ENGINEERS, INC., at 6.30.—A. J. Brown: Marine Diesel Engines.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—C. L. Hind: The Lesson of Photography.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Miss E. Kemp: The Aborigines of Western China.

RÖNTGEN SOCIETY (at Institution of Electrical Engineers), at 8.15.

ROYAL SOCIETY OF MEDICINE (Pathology Section) (at St. Mary's Hospital), at 8.30.—Sir Almroth Wright: Immunisation *in Vitro*.—Dr. J. Freeman: Protein Sensitisation Experiments.—C. G. Schoneboom: Intertraction.—A. F. Hayden: Classification of Acne Bacilli.—Dr. A. L. Punch: Tubercle Complement Fixation with Cow's Serum.—Dr. A. Fleming, C. B. Dyson, and V. D. Allison: Anti-bacterial Properties of Egg White.—W. D. Newcomb and Dr. J. M. Ross: Demonstration of Pathological Specimens.

WEDNESDAY, DECEMBER 6.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—H. A. Baker: Final Report on Geological Investigations in the Falkland Islands. Prof. A. C. Seward and J. Walton: Fossil Plants from the Falkland Islands.

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 5.30.—The President and others: Discussion on Mistakes in Diagnosis and Treatment and the Lessons to be Learned from Them.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—E. B. Moullin: A Direct-Reading Thermionic Voltmeter, and its Applications.

WOMEN'S ENGINEERING SOCIETY (at 26 George Street, Hanover Square), at 6.15.—E. S. Andrews: Patent Work for Women.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—E. W. Blair and T. S. Wheeler: A Note on the Estimation of Form- and Acet-aldehydes.—C. H. D. Clark: A Sliding Scale for the Convenient Titration of Strong Liquids by Dilution and Use with Aliquot Parts.—H. A. Peacock: Note on the Presence of Sulphur Dioxide in Cattle Foodstuffs after Fumigation.—D. W. Steuart: Some Observations with regard to the Unsaponifiable Matter and Sterols of Edible Fats.—N. Evers and H. J. Foster: Note on the Sulphuric Acid Test for Fish Liver Oils.

ROYAL SOCIETY OF ARTS, at 8.—H. E. Chubb: Recent Developments in the Manufacture of Safes and Strong Rooms.

THURSDAY, DECEMBER 7.

ROYAL SOCIETY AT 4.30.—*Probable Papers.*—Lord Rayleigh: Spectrum of Active Nitrogen as affected by Admixture of the Inert Gases.—Dr. G. H. Henderson: Changes in the Charge of an α Particle passing through Matter.—W. T. Astbury: The Crystalline Structure and Properties of Tartaric Acid.—J. N. Mukherjee: Sources of Error in the Measurement of the Electrical Charge of Colloidal Particles by the Method of Moving Boundaries. An improved Method based on a Direct Measurement of the Potential Gradient across the Boundary.—J. Heyrovský: The Significance of the Electrode Potential.—A. M. Mosharrafa: On the Quantum Theory of the Simple Zeeman Effect.—Dr. S. Brodetsky: Discontinuous Fluid Motion past Circular and Elliptic Cylinders.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—Prof. C. F. Jenkin: Fatigue in Metals.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—A. M. Taylor: The Possibilities of Transmission by Underground Cables at 100,000/150,000 volts.

CHEMICAL SOCIETY, at 8.—S. O. Rawling and W. Clark: The Isoelectric Condition of Gelatin.—H. J. S. Sand, E. J. Weeks, and S. W. Worrell: Studies on Metal Hydrides. The Electrolytic Formation of Stibine in Sulphuric Acid and Caustic Soda Solution.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology, Therapeutics and Pharmacology Sections), at 8.—Dr. H. H. Dale: The Value of Ergot in Obstetrical and Gynæcological Practice, with Special Reference to its Present Position in the British Pharmacopœia. To be followed by a discussion.

CAMERA CLUB, at 8.15.—B. Cox: Landscape—a Pot-pourri.

FRIDAY, DECEMBER 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir William Thorburn: The Surgery of the Spinal Cord (Bradshaw Lecture).

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.—J. E. H. Roberts: Thrombo-angeitis obliterans.—Dr. G. Evans: Thrombo-angeitis obliterans.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—J. Ward: The Michell Thrust Bearing.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science and Technology), at 5.—G. Shearer: The Relation between Molecular and Crystal Symmetry as shown by X-Ray Crystal Analysis.—Dr. E. A. Owen and G. D. Preston: Modification of the Powder Method of determining the Structure of Metal Crystals.—Dr. A. B. Wood: The Cathode Ray Oscillograph.—A Demonstration of a low-voltage Oscillograph will be given by the Western Electric Company.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS, INC. (at Engineers' Club, Coventry Street), at 7.—Prof. A. H. Barker: Centrifugal Pumps as Applied to Heating Installations.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 8.—C. P. Crowther: The Man Behind the Camera and the Making of Portraits.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—Continuation of discussion on the Significance of Vascular and other Changes in the Retina in Arterio-sclerosis and Renal Disease.

PUBLIC LECTURES.

SATURDAY, DECEMBER 2.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. E. Marion Delf: Vitamins and Health.

MONDAY, DECEMBER 4.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 5.—Prof. T. Madsen: Antitoxic Treatment (Harben Lecture).

CITY OF LONDON Y.M.C.A. (186 Aldersgate Street), at 6.—Gen. W. W. Ogilvy Beveridge: The Physique of the Nation.

TUESDAY, DECEMBER 5.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 5.—Prof. T. Madsen: The Influence of Temperature on Antigen and Anti-bodies (Harben Lecture).

UNIVERSITY COLLEGE, at 5.15.—A. J. Davis: The Principles of Architectural Planning.

WEDNESDAY, DECEMBER 6.

UNIVERSITY COLLEGE, at 5.30.—T. G. Hill: Illustrations of Books. Succeeding Lecture on December 13.

THURSDAY, DECEMBER 7.

BARNES HALL, ROYAL SOCIETY OF MEDICINE, at 5.15.—Sir Arthur Newsholme: Relative Values in Public Health (Chadwick Lecture). (1) Value of Vital Statistics, Sanitary Surveys and Professional and Popular Education. Historical Influence of General Sanitation, Specific Sanitation and Combined Action.

CITY OF LONDON Y.M.C.A. (186 Aldersgate Street), at 6.—Prof. H. C. H. Carpenter: What Metals Look Like Inside.

CENTRAL LIBRARY, FULHAM, at 8.—Prof. C. N. Bromehead: A Geologist's History of London.

FRIDAY, DECEMBER 8.

LEATHERSELLERS' HALL (St. Helen's Place), at 2.15.—Prof. G. H. Carpenter: The Warble Fly: Its History, and Methods of Exterminating it.

UNIVERSITY COLLEGE, at 5.15.—Sir William H. Beveridge: The Civil Service.

BEDFORD COLLEGE FOR WOMEN, at 5.30.—Prof. H. E. Butler: Timgad: The North African Pompeii.

SATURDAY, DECEMBER 9.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Ancient Egypt and the Bible.