NATURE

THURSDAY, OCTOBER 21, 1920.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters should be addressed to the Publishers.
Editorial communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

Methods and Aims of Anthropology.

PROF. KARL PEARSON'S presidential address to the Anthropological Section of the British Association at the recent Cardiff meeting sounded a note of challenge which it is not usual to hear from the chair. Yet perhaps few of his audience were inclined to agree with him in this case that "a Daniel had no right to issue judgment from the high seat of the feast." In science, perhaps even more than in other departments of human affairs, criticism is the breath of life, and perfection, if it were attainable, might prove perilously akin to stagnation.

Although Prof. Pearson disclaimed any intention of speaking in a controversial spirit, his address was in fact a severe indictment of the traditional subject-matter and methods of anthropology. "Why is it," he asked, "that we are Section H and not Section A?" Anthropology should be the "Queen of the Sciences," the crowning study of the curriculum. If, in fact, it does not occupy this position, whose is the responsibility and what is the reason? His address was at once an answer to these questions and an attempt to suggest a remedy for what he feels to be the present unsatisfactory position of the science.

Anthropologists will cordially endorse Prof. Pearson's contention that the claims of anthropology as a leading science have not received full recognition, either from the State or the universities: they are unlikely, as a body, to agree with him as to the cause. For in his view the responsibility lies with the tradition of the orthodox school, in respect both of subject-matter and of method. Anthropology, and in particular anthropometry, he maintains, has produced no results of utility to the State, and its methods are not of such a kind as to afford either the training of the mind or the doorway to a career which would attract young men entering the universities. His chief criticism was directed against the subject-matter of anthropometry, the multitudinous observations on "height-setting," and the censuses of hair and eye colour, "things dead almost from the day of their record." But further, he went on to say, the bulk of the recorders were untrained, and the associated factors, without which the records were valueless, were usually omitted. The anthropologist, seizing the superficial and easy to observe, had let slip the more subtle and elusive qualities on which progress depends. It was the psycho-physical and the psycho-physiological characters, and not the superficial measurements of a man's body, which carry the greater weight in the struggle of nations. On this ground Prof. Pearson refused to admit the plea of the supporters of "science for its own sake," who argue that researches not immediately "utile" will be useful some day, as has happened in the case of the study of hyperspace. Anthropometric studies, he holds, must turn to more certain appreciations of bodily health and mental aptitude if they are to be useful to the State.

It is perhaps worth while to note that the two points to which Prof. Pearson directs attention are not entirely in the same category. One is a question of the subject-matter of the science, the other of method. In the case of the latter it is true that anthropometric records have sometimes been vitiated by lack of training in the observer; and it is equally true that associated factors have not always been recorded. But both these are remediable defects which will tend to disappear with increased facilities for training and increasing knowledge of essential relations in the facts to be observed. Neither, unless shown to be inherent in the subject-matter or unavoidable, can permanently affect the position of the science.

But Prof. Pearson went further. He was not prepared to allow that the material furnished by the present methods of anthropometrics was even indirectly of value as an indication of a close association between physical characters and soundness both of body and of mind. His grounds for this view were twofold. In the first place, he maintained, purity of race is merely a relative term; but even granting the hypothesis of pure races, it is known by mass observation that (as a result of interbreeding) elements belonging to one race are found in association in the same individual with those belonging to others. A tall but brachycephalic individual will combine Alpine mentality with blue eyes. Prof. Pearson also referred to the case of Charles Darwin, whom he took as a typical English individual, purely English in mentality, and showed that his ancestry contained elements from every race in Europe. Even if at any time there had been association of physical and mental characters, it would break down by intermingling, except in cases specially isolated by natural or social conditions, as, for instance, in the non-intermarrying caste groups of India.

Having demonstrated the failure of the orthodox school of anthropologists, Prof. Pearson put forward three propositions as a basis of reform. "Anthropologists must not cease," he said:

"(1) To insist that our recorded material shall be such that it is at present, or likely in the near future to be, utile to the State.

"(2) To insist that there shall be institutes of anthropology . . . devoted to the teaching of and research in anthropology, ethnology, and prehistory.

"(3) To insist that our technique shall not consist in the mere statement of opinion on the facts observed, but shall follow, if possible with greater insight, the methods which are coming into use in epidemiology and psychology."

Anthropologists will agree, it may be assumed, as to the desirability of the object set out in the second of these propositions; they may even be prepared to give to the third a qualified support. But to confine scientific research to aims immediately recognisable as utilitarian, as Prof. Pearson's first proposition would seem to suggest, is a limitation which very few scientific workers, anthropologists or others, would, and none should, accept. Nor in this case is it necessary. The study of ethnological problems on the lines at present pursued by physical anthropology does not necessarily exclude the study of what Prof. Pearson calls vigoriometry and psychometry—the science of man is wide enough to embrace them both. Is it not a little premature to condemn anthropometrics? The study is not of great age; it is still at the stage of gathering evidence, and as this accumulates the problems change in character; methods are being tested and varied, and data are re-examined continuously. Finally, anthropologists themselves are convinced that the problems they hope ultimately to solve are worth while.

On the other hand, anthropologists deplore the fact that the State does not make greater use of their results. The claims of the science as a basis of legislation, and as an essential preliminary in the training of those who have to administer the affairs of, at any rate, our subject races, have repeatedly been urged upon the Government. There is, however, justice in Prof. Pearson's criticism that the anthropologist too often has omitted to show that his problems have a very close relation to those of the statesman and reformer. On this ground alone Prof. Pearson deserves well of the science if, as a result of his strictures, he should succeed in inducing anthropologists to state from time to time the broad issues involved in their research. In support of his views, Prof. Pearson states that the Governments of Europe have had no highly trained anthropologists at their command, and, as a consequence, the Treaty of Versailles is ethnologically unsound. Is this in accordance with the facts? It was surely the case that when the terms of that treaty were under consideration each country interested in the settlement of international boundaries produced masses of facts based upon the researches of skilled ethnologists. Unfortunately, the facts were selected or distorted to suit the ends of the parties interested. Where impartial conclusions were available, as in the case of the Balkans, they had to be set aside on political grounds. The defects of the Treaty of Versailles are defects of the politician, and do not lie by default at the door of the man of science.

The extensive political propaganda based upon a distorted ethnology which followed the Armistice illustrates one aspect of a flagrant misuse of scientific data. Prof. Pearson refers with approval to the manifesto of the German anthropologists, in which is sketched a programme of study in ethnology and folk-psychology of savage and civilised peoples, by which they hope to aid their country to recover its lost position in the world. Science is made subservient to a purely political end. Prof. Pearson himself speaks of speeding up evolution as an outcome of anthropological studies, and of breeding out the troglodyte mentality in man. But by whom and on what grounds is the direction of the evolutionary process to be determined? The end of science is truth, and its function is the investigation of facts and their relations, and not the formulation of ideals. The past history of anthropology teaches us that it has not been to its advantage that it has meddled in politics or in humanitarianism. To say that this or that type is desirable, that this or that mentality should be cultivated, is not the work of the anthropologist, but of the social reformer.

The Durability of Maritime Structures.

Committee of the Institution of Civil Engineers. appointed to Investigate the Deterioration of Structures of Timber, Metal, and Concrete Exposed to the Action of Sea-water. First Report of the Committee. Edited by P. M. Crosthwaite and Gilbert R. Redgravè. Pp. 301+xxxiii plates. (London: The Institution of Civil Engineers; H.M.S.O., 1920.) Price 30*s*. net.

THE deterioration of buildings from ordinary physical causes has always been one of the most important considerations before the engineer and the architect, and in preparing their designs they have been under the necessity of adopting precautions and protective measures of various kinds. But the destructive influences which have to be counteracted under ordinary atmospheric conditions become tenfold more active and pernicious in a marine environment. The acidity and salinity of sea-water; the fluctuations of tidal level; the alternations of wetness and dryness in rapid and rhythmic sequence; the impact of waves, producing vibration; the penetration of wind-driven spray and the insidious attacks of marine organisms—all these result in an intensification of the ordinary process of decay. Although the phenomena are well known and their effects only too patent, yet until recently definite and trustworthy evidence as to the rate and extent of deterioration was not readily obtainable. Conditions varied greatly with the locality. Counteracting agencies, some obscure in origin, necessitated modifications in general conclusions. Records were but indifferently kept. For these and other important reasons, the Institution of Civil Engineers felt it imperative, in a matter of such vital concern, to set to work to collect such data as were available, and to institute investigations and experiments on a scientific basis. It accordingly appointed a committee of thirteen engineers of high standing and reputation, who co-opted four additional members, and these gentlemen have just issued their first report. Some forty ports in various parts of the world were selected as the field of inquiry, and memoranda furnished by the respective local engineers, or abstracts therefrom, as to the condition of typical existing structures, are incorporated in the report.

The volume commences with an abstract from the Proceedings of the Institution of Civil Engineers of information contained in various papers relating to the subject. This has been prepared by Mr. G. R. Redgrave, who collates the data under the heads of timber, concrete, iron and steel. Mr. H. W. FitzSimons, in conjunction with Mr. F. T. Brooks, contributes a useful article on the value of timber as a material for marine structures, with botanical observations and notes. Next is a short monograph on marine boring animals, prepared by Dr. Calman, of the department of zoology, British Museum. This classifies the information at present available relative to the Teredo and its allies, their habits and distribution. Dr. Friend follows with a paper on the corrosion of iron and steel, and the remainder of the book is taken up with the special reports (fifty-two in all) from engineers in different localities. There are two summaries at the end of the volume; the first, prepared by Mr. M. F. G. Wilson, is a synopsis of the local reports in regard to special features, and the second is a general report embodying the findings of the committee on the investigations as a whole.

The volume is, undoubtedly, a most useful collection of data and results, collected at considerable trouble, and for the first time collated in order and degree. At the same time, the diversity of testimony is so evident, and the lacunæ are so considerable, that the preliminary impression created is one of greater perplexity than before. Even Mr. Wilson has found it difficult in several cases to reconcile conflicting statements, nor can the local engineers always explain certain inconsistencies in the records of their experience. This is, perhaps, most particularly noticeable in regard to the depredations of marine organisms. Thus, of the activity of Limnoria on creosoted pitchpine, it is recorded that of two 14-in. square piles, located only 40 ft. apart in Holyhead Harbour, within a period of nine years one was reduced to 9 in. in diameter, while the other showed no sign of attack. In the estuary of the Mersey, adjacent to the open sea, the Teredo has been found only "in a few cases," and causes no trouble; at Bombay its ravages have been so devastating as to lead to the abandonment of timber for permanent sea works. Thus at the present stage it is only possible to form conclusions of a somewhat broad and tentative character, which will be the subject of closer investigation and later review.

The idiosyncrasies of timber-destroying organisms are particularly stimulative of inquiry, and not the least interesting feature of the report is Dr. Calman's study of their anatomical structure, development, and method of attack. The organisms include the ship-worm (Teredo), the gribble (Limnoria), Sphæroma, and Chelura. The first is a mollusc, the others are crustaceans. The family Teredinidæ is a comprehensive one, and includes not only the typical genus Teredo, but also the allied genera, Xylotrya and Nausitora. Species of the same genus, moreover, differ widely in habits, in habitat, and in geographical distribution. The "Teredo," as so designated by the engineer, may comprise at least some twenty or thirty different species. Some thrive in brackish water; others do not; *Teredo navalis* is intolerant of it. *Nausitora Dunlopei,* a tropical species, commonly lives in perfectly fresh water. Generally, it has been found that timber piles in muddy, or sewage-contaminated, water are least subject to attack, from which it seems evident that shipworms require clear and fairly pure water for their effective development. Notwithstanding the advantage derived in certain cases by the treatment of timber with creosote, it is noteworthy that no completely protective antidote has been discovered. Greenheart is the timber which offers most effective resistance to attack.

The corrodibility of iron and steel is a branch of the subject admitting of but slow determination, so-called "acceleration tests," having proved untrustworthy. The percentage of impurities and the precise composition of alloys are of fundamental importance. The first effect of chromium is that of increasing corrosion, but a further addition effects a retardation. Sir Robert Hadfield has informed the committee that he is experimenting with an alloy of iron and chromium which manifests considerable resistance to sea-water corrosion. The committee details certain arrangements which they have made with Sir R. Hadfield and Dr. Friend for testing the rate of corrosion of medium carbon steel, mild steel, "Galahad" non-corrosive steel, nickel steel, Swedish charcoal, iron, and cast iron. The duration of the experiments may extend to twenty years.

The most important findings of the committee include the following: Creosoting as a protective treatment for Baltic timber is justified at the home ports, but not in tropical waters; reinforced concrete is a more suitable material for adoption where the sea-worm is very active; and ordinary concrete, whether in block form or in mass, produces thoroughly permanent work, if carried out in the properly specified manner.

BRYSSON CUNNINGHAM.

Tropical Disease and Administration.

War against Tropical Disease: Being Seven Sanitary Sermons addressed to all interested in Tropical Hygiene and Administration. By Dr. Andrew Balfour. Pp. 219. (London: Baillière, Tindall, and Cox, 1920.) Price 12*s*. 6*d*. net.

AN essential in medical treatment is that the patient shall have faith in the professed healer; his rulings must be accepted as well as his drugs. Hence, in a period when empirical observations were the necessary substitute for scientific investigation, occasionally it might not have been conducive to the bodily safety of the physician were the patient to doubt the soundness of the deductions therefrom. Argument was therefore successfully evaded by an assumption of mystery too deep for ordinary mortals to fathom; drug roots were gathered with incantations by moonlight—the fever-stricken patient submitted to being deprived of a breath of fresh air. With the physician of the present day, so far as drugs are concerned, the awe inspired by mysticism to some extent remains; professional ethics—to the advantage of the patient—ordain secrecy, but the crude rulings of the past have been superseded by the dicta of the science of hygiene, which insist that "prevention is better than cure." Its devotees demand, not professional mysticism, but world-wide propaganda. Nowhere, in the interests of life, is this more necessary than in those portions of the world vaguely termed the "tropics," where even useful, though ancient, empirical sanitary deductions have been forgotten, or have become inapplicable in the press of life accompanying modern civilisation.

It is a matter of common experience that whilst the average educated layman is capable of discussing the *rôle* of certain mosquitoes, flies, fleas, lice, and ticks in the spread of disease, he fails to understand that, not only philanthropy, but also the prosperity of commerce, facilities for intercommunication with areas supplying raw material and the availability of suitable labour therefor, very largely depend upon the prevention of preventable diseases in the tropics. Hence, if it were possible to convey to the busy layman where action is requisite and what measures are applicable, undoubtedly a great impetus would be given to applied hygiene. To this end that well-known authority upon sanitation in the tropics, Dr. Andrew Balfour, director of the Wellcome Bureau of Scientific Research, London, has written the work under notice.

The larger part of this work is occupied by a record of travels in Africa, Mesopotamia, the West Indies, and South America. *Inter alia,* much interesting information is given as to make-shift sanitary methods employed during the late war. The final chapters deal with the necessities and measures requisite for the central administration of public health, as exemplified by a suggested Ministry of Health for Egypt on lines proposed by a Commission appointed for that purpose.

Throughout the lightly written and interesting pages of this book Dr. Balfour has steadily maintained the underlying object of his travels, namely, taking his reader from area to area of the tropics, demonstrating existing sanitary defects and the possibilities of improvements were the existing fruits of medical research applied, and showing where further light on disease ætiology is requisite. He has thus met a long-felt want by placing at the disposal of both the medical and the lay reader valuable information hitherto unobtainable without toiling through masses of scientific publications or dry official reports. No politician need reflect that the matter thus condensed does not concern the prosperity of the Empire; no administrator dealing with tropical races will fail to perceive that there is here much matter that will aid decision when the multitude of counsellors confuse with diverse schemes to the same end, and demand finance instead of conferring wisdom; nor need the man of commerce hesitate in arriving at the conclusion that there is an indissoluble connection between production and the health state of labour. To the intending tourist the word pictures of scenery and the description of the characteristics of races must be a source of much interest. Indeed, even the humorist will find that there is scarcely a page which does not yield a specimen of that genial "pin-prick" banter with which the Scot is wont to drive home truths he conceives his audience has failed sufficiently to evaluate.

W. G. K.

Yearbooks of Universities.

(1) *Athena: A Yearbook of the Learned World. The English-speaking Races.* Edited by C. A. Ealand. Pp. viii + 392. (London: A. and C. Black, Ltd., 1920.) Price 15*s*. net.

(2) *The Yearbook of the Universities of the Empire,* 1918–1920. Edited by W. H. Dawson. (Published for the Universities Bureau of the British Empire.) Pp. xiv + 503. (London: G. Bell and Sons, Ltd., 1920.) Price 15*s*. net.

(1) SIMULTANEOUSLY with the publication of the first volume of "Athena," "Minerva: Jahrbuch der gelehrten Welt" has made its reappearance after the war. It is described as the twenty-fourth yearly issue, 1920, the previous edition being for the year 1913–14. "Athena" is a stately volume (8½ in. by 5½ in.) of 392 pages. "Minerva," of just half the cubic capacity, contains 1148 (*plus* 118) pages. "Athena's" learned world is restricted to the English-speaking races. "Minerva" takes cognisance of all civilised peoples; although, as was inevitable, the editor has but little information to give regarding the universities and other institutions of higher learning of the countries with which, until recently, Germany was at war. Italy is an exception. The *personnel* and other particulars of the Italian universities and learned societies are given as fully as in pre-war editions. Of the great majority of British and American institutions the permanent features alone are set forth in a few lines. The editor is careful to state that figures, *e.g.* the number of books in a library, relate to the year 1914. In the rare instances in which a calendar of a British or a catalogue of an American university has been obtained, the names and offices of the members of the staff are set forth; but a study of the list will, usually, reveal its date.

Nevertheless, in accuracy, the advantage does not in all things lie with the English book. Turning first to the account in "Athena" of our two most famous universities, we read that Cambridge numbers 2700 students, Oxford 4582. The Vice-Chancellor of Cambridge is still Sir Arthur Shipley, although his successor, elected on June 1, 1919, entered upon office the following October. None of the names of the proctors and pro-proctors of Oxford tally with the University Calendar, 1920. Looking up the obituary notices of university professors which have appeared in NATURE during the past twelve months, we miss but one name from the lists given in "Athena" as those of members of existing university staffs. Some names of men who died still earlier are retained. It is not remarkable that "Minerva's" keen-sighted eyes have failed to discover the existence of the universities of Benares (1916) and Patna (1917); but such an oversight is less excusable in Ἀθήνη, who is not γλαυκῶπις only, but also νικηφόρος. The information given regarding the constitution and functions of the universities is very scanty. Under the names of the various British universities at home and overseas, we are told the number of terms in the year (without dates), the number of students (frequently omitted), in some cases the budget, and in all the degrees conferred and the colours of the hoods appropriate to each degree.

The statement that in the University of Durham the D.D. hood is of "scarlet cassimere, lined with palatinate purple silk," is, no doubt, of general interest, but the half-page devoted to the hoods of this university might possibly have been more profitably used. Even in this connection there are some curious irregularities. The hoods of the University of Wales (Cardiff) are carefully described as to form, material, and colours; but we find the list repeated under the heading "University College of North Wales, Bangor," which is not a degree-giving institution. The "University

College of Wales, Sea Front, Aberystwyth," is not similarly distinguished. No development of the past three years has so greatly interested the universities of the United Kingdom as the institution of the Ph.D., yet there is, so far as we can find, no reference to this new degree. The budgets of some of the American universities are likely to make a Briton envious—Wisconsin, for example, has a revenue of 3,532,306 dollars; but it may well be for his peace of mind that Columbia, Harvard, Leland Stanford Junior, and others have modestly declined to disclose their wealth. The statement "No particulars received" follows the names of a large number of American and some British universities overseas.

(2) The aim of the "Yearbook of the Universities of the Empire" is different from that of the other two books. Each of the fifty-nine universities of the Empire finds it necessary to publish a calendar; the stouter, the more dignified. In the Yearbook all essential information regarding the origin of the university, its history and equipment, admission, faculties, degrees, scholarships, fees, hostels, etc., from each of these calendars, is reduced to a few pages. The names and offices of all members of the staff are recorded, and "since a statement of the sources of the various degrees held by university teachers gives, in small space, information regarding the educational history of their holders, much trouble has been taken in ascertaining their source." Under the heading "The Years 1916–19" events of interest in the life of the university, such as benefactions received, new posts created, alterations of curricula, etc., are recorded.

Comparing the present edition with the one which preceded it (1916–17), we note that the universities are no longer placed alphabetically throughout, but arranged in groups—England and Wales, Scotland, Ireland, Canada, Australasia, South Africa, India—with an admirable introduction preceding each group. A feature of the book which will make it of great and permanent interest is the Appendix on the Universities and the War. It is a summary of the services, other than combatant (these had been, in part, dealt with in the 1915 edition), rendered by the universities. "So numerous and varied have these been that it is impossible, in looking back, to picture the war as progressing towards a successful issue without them." This record, brief as it is, persuades the reader of the justice of the editor's remark. The compression within a book of this size of so much and such varied information reflects great credit not only upon the editor's diligence, but also upon his skill.

Encyclopædic Chemistry.

Phosphore, Arsenic, Antimoine. By Dr. A. Boutaric and A. Raynaud. (Encyclopédie Scientifique: Bibliothèque de Chimie.) Pp. iii+417. (Paris: Octave Doin, 1920.) Price 9.50 francs.

THIS book is one of the forty volumes on chemistry forming part of an encyclopædia of science which is expected to run to about a thousand volumes. The treatment aims at a compromise between text-books and dictionaries—the books being intended at the same time for reading and for reference. This is obviously a very ambitious scheme, and it raises the question as to whether such a compromise between matter and style is one which is likely to be useful. In the opinion of the reviewer, books intended for reference should aim at giving the fullest possible information in the smallest possible space. If the elementary rules of grammar are satisfied, the busy worker will be content, and questions of style have little interest for him. The references to original literature should in each case be checked carefully with the originals, and no differentiation should be made between the nationalities of the various discoverers. Although the well-known treatises compiled by German authors are not perfect, they are all we possess which have any pretension to completeness, and have proved of inestimable service to thousands of chemists of all nationalities. A proposal to publish such works in English has not proceeded beyond the stage of discussion, great as are the possibilities of success if trustworthy compendia could be issued within a reasonable period.

The book under review is written in a clear and readable style, and the descriptions and references are such as might be expected in a moderately advanced text-book. They are not nearly so complete as might reasonably be required in an encyclopædic work. The index is also far from satisfactory. The bulk of the references are to publications in the French language, and in more than one instance grave injustice is done in the text to workers of other nationalities. This is much to be regretted; science has no nationality, and in a search for information such questions have not the slightest interest for the reader. If this inclination is to be followed in further volumes to be issued, the reviewer has no hesitation in saying that the usefulness of the work will be profoundly prejudiced. It may, for instance, be more gratifying to the author to attribute the formulation of the equation for a unimolecular reaction to Berthelot, but as the prior publications of Harcourt and Esson and of Wilhelmi are readily accessible, and well known, at least to English chemists, the impression on the reader is far from satisfactory. Other instances of like nature could be quoted.

J. R. P.

Our Bookshelf.

The British Charophyta. By James Groves and Canon George Russell Bullock-Webster. Vol. i. Nitelleæ. With Introduction. Pp. xiv + 141 + xx plates. (London: The Ray Society, 1920.) Price 25*s*.

THIS monograph of the British Charophyta is a valuable addition to the literature of British botany. It has also a personal interest for many British botanists as representing the work on this group, embracing much of the leisure of forty years, of the brothers Henry and James Groves, to the former of whom the volume is fittingly dedicated. In 1880 Messrs. H. and J. Groves published in the *Journal of Botany* a "Review of the British Characeæ," in which an attempt was made to give an account of all the then-known British species, with illustrations and some particulars as to their variation and distribution. This was the first of a series of papers by the same authors, in which have been included descriptions and figures of fresh species added from time to time to the British list, records of distribution, and other notes. The present monograph, in which Canon Bullock-Webster co-operates, is the carefully considered outcome of these years of work. The systematic portion, which includes the first of the two subdivisions (Nitelleæ and Chareæ) of the group, is preceded by an introductory section dealing with the growth and structure of the Charophyta generally, and their distribution and affinities; this is well illustrated by numerous text-figures from various sources, and several plates. Each of the species is beautifully represented in a lithographed plate, mainly from drawings by Miss Mary Groves. The authors recognise six genera of Charophyta, five of which, Nitella and Tolypella, comprising the Nitelleæ, and Nitellopsis, Lamprothamnium, and Chara, included in the Chareæ, are represented in Britain. The key to all the British species, which precedes the general systematic account, includes thirty-two species, in several of which distinct varieties are recognised. Under each species there is a complete account of the synonymy with reference to previous publications, a full description in English, and an account of the distribution; notes on variation, affinities, and nomenclature are also added.

Monografia de l'Ordre dels Rafidiòpters (Ins.). By R. P. Liongí Navas, S.J. (Publicacions de l'Institut de Ciències.) Pp. 93. (Barcelona: Institut d'Estudis Catalans, 1918.)

FATHER NAVAS is well known as a student of the taxonomy of that miscellaneous assemblage of insects formerly included in the old Linnean order of the Neuroptera. In the monograph before us he deals with the curious and remarkable "snake-flies." Their position in any scheme of classification has long been a difficulty, and opinions thereon are very diverse. Father Navas prefers to follow Handlirsch and to regard them as constituting an order of their own—the Raphidioptera. Others merge them along with the "alder-flies" (Sialidæ) to form the order Megaloptera, while a third alternative is that followed by some entomologists of combining the Megaloptera with the Plannipennia into a single order, Neuroptera. We are inclined to follow the intermediate course, as there is little doubt that the Raphidiidæ have their nearest allies in the Sialidæ, although they are more highly specialised than the latter.

The present monograph is exclusively systematic—only eight lines are devoted to the larval stages, for example—and the sole observations on structure deal entirely with those characters of the external anatomy which are utilised by the systematist. Two families are recognised, comprising thirteen genera and seventy-one species. The greater number of genera occur in Europe and North America; only one genus is African, and four are Asiatic, but none are peculiar to either of those continents. In Britain we have four species comprised within three genera, but the group has been hitherto so little collected that in the next decade we shall probably totally revise our views on its geographical distribution. The author has done a service in bringing together the various species within a single memoir, and his keys and descriptions will enable the different forms to be identified. Of the forty odd figures, many are sketchy and rather deficient in detail.

A. D. I.

Some Famous Problems of the Theory of Numbers and in particular Waring's Problem: An Inaugural Lecture delivered before the University of Oxford. By Prof. G. H. Hardy. Pp. 34. (Oxford: At the Clarendon Press, 1920.) Price 1*s*. 6*d*. net.

THE theory of the integral numbers is a subject in which it is frequently easy to conjecture new results and extremely difficult to prove them. An example of a result which must have been based on conjecture is known as Waring's theorem, that every positive integer is the sum of nine (or fewer) positive cubes, of nineteen (or fewer) biquadrates, and so on. A proof of this result, asserted in 1782, was first approached by Prof. Hilbert, of Göttingen, who showed in 1909 that every integer n is the sum of a finite number not exceeding $g(k)$, independent of n, of exact kth powers. It has been established, by transcendental analysis developed long since the days of Waring, that $g(3)=9$ as asserted by him, but whether $g(4)=19$ is still uncertain, though this number has been shown not to exceed 37. The only positive integers known to be inexpressible as a sum of eight cubes (at most) are 23 and 239.

Prof. Hardy and Mr. Littlewood have recently developed a new method of applying properties of the Riemann zeta function to the type of problem to which Waring's theorem belongs. In his inaugural address to the University of Oxford on his appointment as Savilian professor of geometry, Prof. Hardy gives a most lucid account of the work on which he has been engaged along with Messrs. Littlewood and Ramanujan. The whole of it is expressed in non-technical language, and many gaps in the theory are explained. We specially note the first few pages as forming a model introduction to a professor's inaugural address. A statement on p. 15 needs amendment, integers expressible as a sum of two squares being of either of the two forms

$$M^2P \text{ or } 2M^2P,$$

where P is a product of positive primes $4k+1$.

W. E. H. B.

On Gravitation and Relativity: being the Halley Lecture delivered on June 12, 1920. By Prof. R. A. Sampson. Pp. 24. (Oxford: At the Clarendon Press, 1920.) Price 2*s*. net.

THERE is a special appropriateness, as Prof. Sampson points out, in choosing a gravitational subject for the Halley Lecture, in view of the important part that Halley played in securing the publication of the "Principia." The lecture is an able *résumé* of the various speculations on the subject, from Galileo's "Dialogues" and Newton's hypothesis of æther-pressure down to Einstein's theory. The author evinces the highest admiration for Einstein's skill in devising a formula which expresses his results "without redundancy, defect, or effort, and whose boldness, range, brilliance, and resounding successes" have commanded universal attention; but on proceeding to examine the formula in detail he confesses to his dislike of some of the devices employed, in particular imaginary time and the obliteration of the distinction between past and future. He alludes to Newton's experiment of the rotating bucket and to Foucault's pendulum experiment as establishing the possibility of detecting the absolute direction of an axis of rotation. It will probably be admitted, even by the convinced relativist, that it is of advantage to students to have the claims of the older "common-sense" kinematics placed before them in an attractive form, which the author has certainly done.

A. C. D. CROMMELIN.

A Primer of Air Navigation. By H. E. Wimperis. Pp. xiv+128. (London: Constable and Co., Ltd., 1920.) Price 8*s*. 6*d*. net.

THIS book provides an interesting and sound introduction to the subject of finding one's way in the air. In many ways the investigation of methods of air navigation is based on nautical experience, but the author points out that the reverse process is beginning to apply. The chief differences appear to arise from the greater speed of aircraft as compared with the steamship, and the considerable altitudes above sea-level reached by the aeroplane and airship. Height in itself gives a wider range of vision, and in clear weather allows a greater permissible error in dead-reckoning without loss of port than is required for a ship seeking harbour. These points are clearly brought out in the little book under notice, and the various steps involved, both of observation and calculation, are developed simply. Whilst non-mathematical in character, we suggest that "Air Navigation" would provide a suitable starting-point for the more complex studies of advanced works and, what is perhaps more important in the present state of aeronautics, encourage capable students to extend the subject into regions yet unexplored. The main ideas of navigation are illustrated by examples from the great flights of the post-war period—Atlantic and Australasian. The correction for wind for aircraft is more important than that for tide and steamship, and clouds interfere with surface observations to an undesirable extent. Such difficulties, at any rate near land, will be countered by the use of direction-finding wireless telegraphy, a subject dealt with in one of the chapters of the book, which may be recommended as covering the essentials of present-day knowledge.

A Junior Inorganic Chemistry. By R. H. Spear. Pp. viii+386. (London: J. and A. Churchill, 1920.) Price 10*s*. 6*d*. net.

ALTHOUGH this does not seem to possess any features differentiating it from many other elementary text-books on chemistry, it is clearly written, and obviously the work of an experienced teacher. In some cases the information is not up-to-date, as on p. 128, where it is stated that "experiments carried out with the most elaborate precautions have shown that 1 grm. of hydrogen combines with 7·98 grm. of oxygen." Ozone is said (p. 177) to have "a faint, peculiar smell." Although molecular formulæ and equations are used freely from p. 152, the molecular theory is not explained until p. 278 is reached. Instructions for experiments are given throughout the book, which provides a good introduction to chemistry.

Part i. of the book, containing the first thirteen chapters, which lead up to, but do not include, the atomic theory, is published separately at the price of 5*s*. net. It provides an introductory course for junior forms in schools.

Atomic and Molecular Theory. By D. L. Hammick. Pp. 82. (Winchester: P. and G. Wells, 1920.)

As an exposition of the simple applications of the atomic theory to chemistry, this account leaves little to be desired in clearness and accuracy. Nothing, however, is said of the recent work which has put the atomic theory on an entirely new basis, and the point of view is that of twenty years ago. One cannot now truthfully say that "Dalton's hypothesis merely restates the facts about the elements and their modes of combination in terms of atoms and, as an 'explanation,' is not very satisfying."

Organic Chemistry for Medical, Intermediate Science, and Pharmaceutical Students. By Dr. A. Killen Macbeth. Pp. xi+235. (London: Longmans, Green, and Co., 1920.) Price 6*s*. 6*d*. net.

As an introductory text-book for the classes of students indicated in the title, this should be very useful. It is clearly written, and provided with exercises. One might have wished for a little more experimental detail; beginners in organic chemistry are liable to get into the habit of "removing hydroxyl groups," or "adding halogen atoms to double-bonds," or similar hypothetical operations, when they are asked to describe some simple laboratory operation. Chap. xviii., on "Schematic Representation," should be found helpful by students, as the subject is not usually dealt with in text-books. Slight weakness in physico-chemical theory is sometimes detected—*e.g.* on p. 5, with reference to fractional distillation, one finds only the misleading statement that "the more volatile vapour passes on to the condenser, and a sharp separation is effected." The elementary facts of fractional distillation are not often explained in text-books on organic chemistry.

Lead: Including Lead Pigments and the Desilverisation of Lead. By Dr. J. A. Smythe. (Pitman's Common Commodities and Industries.) Pp. vii+120. (London: Sir Isaac Pitman and Sons, Ltd., n.d.) Price 3*s*. net.

DR. SMYTHE's interesting account of the mining, extraction, and uses of lead should be found useful by teachers and students of chemistry, as well as entertaining by the general reader. The illustrations, partly reproductions of old cuts from Agricola and partly of modern plant, add considerably to the interest and value of the book. A good description is given of the manufacture of white lead, and of the methods of separating silver from argentiferous lead.

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.]*

"Momiai."

IN Gen. Alexander Cunningham's "Ladak," 1854, p. 237, we have probably the first mention of this substance among the mineral productions of that country. Gen. Cunningham says: "The common *momiai* of Indian medicine is, of course, a manufactured article; although not made, as generally asserted, of the melted fat of Abyssinian boys who have been roasted for the purpose. . . . The original *momiai* was only mummy, which at one time was held in much repute in Europe."

It is interesting to note that the extraction from young children still finds belief in India; further, that it is made again a strong lever in the hands of dangerous agitators to disturb and rouse the feelings of the people and set them against their rulers.

I am led to write on this because in the *Morning Post* of September 29 there is a communication from its Calcutta correspondent (dated September 3) which is worth reading just at present, when all is not going well in India, events taking place which recall the days before the Mutiny of 1857. "A crazy rumour and its effects" is the subject I especially notice, a part of which I must quote; it is so similar to what was in circulation in the Mutiny year:

"At Khargpur, the Swindon of one of the largest railways in India, the ignorant people, including some of the workmen in the railway workshops, had been for some time much excited over a ridiculous and false rumour which still obtains currency all over the country wherever large building works are in contemplation, to the effect that the Government wanted a number of children for sacrifice, without which the buildings of the new district headquarters could not stand. In this instance the people believed that several men had been authorised by the District Magistrate to wander throughout the district kidnapping children. The rumour obtained such wide currency that the District Magistrate went to Khargpur several times, and both the executive and the railway authorities did their best to remove the superstitious belief. The District Magistrate also issued notices in the vernaculars contradicting the rumour."

History is repeating itself. In April, 1857, I was on my way to join the Kashmir Survey Party at Rawul Pindi; there the first rumblings of the coming Mutiny were heard by me. Very few Europeans then had a notion that such a conflagration was soon to come. Warnings were not taken seriously, and were more often received with ridicule. There was unrest in many forms, not so widespread as it is now. To give an idea of the reports then in circulation, one of my servants, on returning from the city where he had gone to make purchases, came at once to ask me whether it was true that the Queen of England was sending out to India an army of several lakhs of men to force the population of India to be Christians. I told him it was nonsense, and asked where he had heard it. He said two Faqirs (religious mendicants) were preaching on the invasion in the streets of the city. The story had evidently made an impression on him, and it led to my having a conversation with another native, in which I heard for the first time of *momiai*, and was told that we sahibs made it. He gave me a very circumstantial account: that children were kidnapped, hung up by the heels, head downwards, and an incision made in the breast from which flowed the wonderful substance which gave us so much power. To prove his words, my informant, who was a Kashmiri resident in Rawul Pindi, said he could show me the very bungalow in which all this was done. It turned out to be the Masonic Lodge—"The Star in the East," I think it is called—situated in the cantonment of Rawul Pindi—the "Jadu Ghur," or mystery house, as it is always called by the natives. In my wanderings in the Kashmir Himalaya up to 1863 the story of the "Jadu Ghur" would crop up. It was thoroughly known in Kashmir, on into Ladak, and extended, I believe, into Central Asia, wherever Kashmir merchants are to be found.

I much fear my explanation of what is done in a masonic lodge, and of what its use is, did little to alter whatever was in the mind of my informant. I do know that these impossible tales carry enormous weight for evil among the mass of the people, both male and female. Their dissemination should be watched and met. "The Viceroy's suggestion that a dangerous agitation in India can be allowed to take its own course unguided and unimpeded by those in authority" is folly, and shows utter ignorance of the people he has been sent to rule.

H. H. GODWIN-AUSTEN.

Nore, Godalming, October 3.

Ewing's "Thermodynamics."

THE very appreciative review of my book on "Thermodynamics for Engineers," which appeared in NATURE of September 16 over the well-known initials "H. L. C.," points out what is certainly a misstatement. Will you kindly allow me space to correct it?

On p. 123, in speaking of the Mollier chart, the co-ordinates of which are the total heat I and the entropy ϕ, I should have said that the critical point is "near," not "at," the point of inflection of the boundary curve. It is, as "H. L. C." suggests, a little above the point of inflection. The isothermal line which passes through the critical point suffers inflection in touching the boundary curve there. The line of constant pressure which passes through the critical point also has a singular point there, namely, a point at which

$$\left(\frac{d^2\mathrm{I}}{d\phi^2}\right)_p=0, \text{ and } \left(\frac{d^3\mathrm{I}}{d\phi^3}\right)_p=0.$$

Without undergoing inflection, it has a "stationary tangent" at the critical point. These features of the curves of constant temperature and of constant pressure which pass through the critical point are apparent in the Iϕ chart for carbonic acid, given on p. 148. It will also be apparent from that chart that the point at which both these singularities occur lies a little above the point of inflection of the boundary curve itself.

The following corrections should therefore be made on p. 123 of my book:

In line 1, for "at" read "near."

In the footnote, delete the last two sentences and substitute: "Hence also, at that point,

$$\left(\frac{d^2\mathrm{I}}{d\phi^2}\right)_p=\left(\frac{d\mathrm{T}}{d\phi}\right)_p=0, \text{ and } \left(\frac{d^3\mathrm{I}}{d\phi^3}\right)_p=\left(\frac{d^2\mathrm{T}}{d\phi^2}\right)_p=0,$$

since on the Tϕ chart the constant-pressure line through the critical point runs level and suffers inflection there. Thus on the Iϕ chart the constant-pressure line through the critical point has zero curvature there, though it does not suffer inflection."

Also, on p. 149, line 1, for "coincides with" read "is a little above." J. A. EWING.

The University, Edinburgh, October 13.

A Diver's Notes on Submarine Phenomena.

SIR RAY LANKESTER in one of his delightful popular papers describes how he found that the glowing light produced by rubbing quartz pebbles together could still be got when the rubbing was done under water, as, for example, when holding the pebbles submerged in a bucket. On the supposition that if the effect were connected with entangled or surface-adhering air it should be enhanced under a high pressure, an experiment was made. My occupation involves a good deal of diving work, and on a recent occasion I took down a few suitable pebbles to a depth of 21 fathoms. On rubbing them together sparks were produced to just about the same extent as when tried in a few inches of water. The light on the bottom was dim enough to allow of the sparks being seen, yet visibility was relatively good.

Wave-action at this depth can be very violent. The wreck of a freshly sunk Atlantic liner at the same place was battered to pieces in the course of a single gale, and the large stones strewing the bottom are flung about amongst her remains whenever there is a big, long swell running. As many of these stones are quartz, there may probably be considerable illumination on such occasions.

In connection with light under water, I may mention that if, as often happens, one's hand gets cut when working at a fair depth the blood streaming out into the water looks quite black, like ink, at the source, thinning out to a bluish cloud as it gets more diluted with sea-water. No trace of redness can be made out. Similarly, an abrasion looks like a dab of tar on one's hand. I presume that this effect is caused by the absence of red rays, which are cut off by the upper layers of water, and that it could be predicted; but I do not understand why in the same circumstances crabs (*C. pagurus*) look as red as they do on deck.

The volume of air in his dress at a given time is a matter of much importance to a diver. He has to control his buoyancy to suit the work in hand, and on a change of depth must rapidly adjust the valve to maintain the same volume during and after the change of pressure. Failure to do so results in a "squeeze" or a "blow-up," either of which may be fatal.

Fish with swim-bladders must have a similar practical interest in this application of Boyle's law, and a diver who considers the matter will be able to sympathise with them in the difficulties they must often encounter from their relatively slow means of adjusting volume.

Usually when a mine or similar explosion takes place under water numbers of swim-bladdered fish float to the surface. Stunned or injured, they have risen above the depth for which they were adjusted, and the resulting expansion of the bladder gases then overcomes any efforts they may make and surges them upwards, hopelessly out of control. In addition to the distension so often described, many of them, as I have found, are killed by rupture of the bladder and resulting internal hæmorrhage. It is curious that the escaped gas from the bladder often finds its way into the heart and great vessels, producing a condition like that due to compressed-air illness.

The diver going down to a wreck where blasting has been going on generally finds that numbers of fish have fallen to the bottom through a converse process and are lying there dead. On a recent occasion where blasting was going on almost daily the accumulation of dead pollack, pout, horse-mackerel, etc., on the bottom attracted swarms of spotted and spiny dogfish, which could always be seen cruising about among the wreckage, often with dead fish in their mouths. The blasting, of course, went on just the same, and heavy charges were often fired in the midst of these shoals, but I have never been able to find a dead dogfish on the bottom (having constant negative buoyancy, they always sink when dead). On the contrary, I have (from the ship) seen them rise to the surface immediately after an explosion in pursuit of the stunned swim-bladdered fishes and tear them to pieces as if nothing had happened. Dogfish have no swim-bladder, and its absence enables them, as in this case, to dash from a hydrostatic pressure of 57 lb. per sq. in. to atmospheric pressure and back again with their prey without ill-effects. Moreover, it is probably this absence of an included gas space which renders them so immune to submarine explosions.

Another point about swim-bladders. In the North Atlantic sunfish and basking sharks idling at the surface of deep water, with positive buoyancy yet without swim-bladders, are familiar and somewhat puzzling objects. With such means as one has aboard ship I find the specific gravity of skates to be 1063 and of spotted dogfish 1068; the latter sink quite fast when they stop swimming for a moment. Presumably a basking shark would have a similar specific gravity, yet it floats. To catch one and solve the problem is not easy, but a friend kindly harpooned a sunfish for me. It was 3 ft. long and weighed 115 lb. The body was completely enclosed in a rigid case of some tough tissue resembling cartilage to the naked eye, but extraordinarily light. This shell varied from 0·75 to 1·25 in. in thickness except about the head, where it was very massive. It could be dissected off in slabs, and the thicker of these floated when thrown overboard. With the absence of bone, an immense fatty liver, and this queer, buoyant cuirass, I think we have the solution in the case of the sunfish.

G. C. C. DAMANT.

H.M. Salvage Ship *Racer,* Portsmouth.

Old Irish Maps.

THE fact that I have been able to refer your reviewer to an important map with which he was previously unacquainted is some compensation for the necessity for his last sentence (NATURE, October 7, p. 180).

A few years ago I spent some weeks among the maps in the library of the Geological Society of London, and tried to settle the question of the dates and editions of Griffith's maps. Since your issue of October 7 I have re-examined the evidence, with the additional help of a volume of Dublin addresses, once the property of Prof. Phillips, which I have recently obtained. The only conclusion I have been able to arrive at is that the Irish and English literature on the subject is vague and contradictory.

The writer of Sir Richard Griffith's obituary in the *Geological Magazine*, 1878, p. 525, states: "So long ago as the year 1812 the first outlines were attempted of . . . a geological map of Ireland. No labour seemed to Griffith too great in order to carry out this great work satisfactorily. *Four editions* of it were published, the latest of which was issued in 1854." Judd (*loc. cit.*, 1898, p. 149) tells us the large map of Ireland was exhibited in 1838 and published in March, 1839, and a *second edition* was published in 1855.

On June 13, 1839, Griffith read a paper (Journ. Geol. Soc. Dublin, 1839, p. 78) on "Presenting to the Society the Geological Map of Ireland in the Large Scale, the Result of my Labours for Upwards of Thirty Years." Later (*loc. cit.*, 1857, p. 294) he read a similar paper on "Preparing the *Last* Edition of my Geological Map of Ireland dated April, 1855." Close (Journ. Royal Geol. Soc. Ireland, 1879, p. 141) stated: "Very shortly after that [April, 1838], in the same year, the large map . . . was brought out, though for some reason which does not appear it was not regularly published so as to be accessible to all until March 28, 1839, the date which is inscribed upon it"; and (p. 142): "In June, 1840, only fifteen months after the last-mentioned edition, a new issue appeared. . . . In the short time mentioned changes had been made in the map in no less than forty places." We also learn (pp. 144–45) that a small edition of the map was published, and in 1855 a revised and the last edition was issued.

Apjohn (*loc. cit.*, 1841, pp. 158–59) states that as early as February, 1841, "in point of fact, *three maps* have been published by Mr. Griffith, first, a map on a comparatively small scale . . . and subsequently a *first* and *second* edition of his large map. We have already seen how great are the discrepancies between the two larger maps"—this, be it noted, being *before* the publication of the 1853 and 1855 editions.

The Geological Society possesses a large map "revised in 1853," and a smaller map (*circa* 1860) by Griffith is "copied from the large map of 1853."

So among these conflicting contemporary statements as to dates and editions I may be pardoned, after this lapse of time, for requiring to be "corrected."

Museum, Hull. T. SHEPPARD.

A Visual Illusion.

MR. TURNER should have consulted some standard work on experimental psychology before claiming a visual illusion as "new" (NATURE, October 7, p. 180) and advancing an explanation which experiment has shown to be wholly inadequate to account for the retinal after-sensations of movement. The effects are quite independent of movements of the eyes, and as truly "sensory" in character as the after-effects of colour and brightness.

C. S. MYERS.

Gonville and Caius College, Cambridge,
October 17.

THE phenomenon referred to by Mr. Turner and by Prof. Boycott in NATURE of October 7 and 14, pp. 180 and 213, was described by Aristotle in his treatise on dreams ("Parva Naturalia") thus: "Also, the senses are affected in this way when we turn quickly from objects in motion, *e.g.* from looking at a river, and especially from looking at swiftly flowing streams. For objects at rest then seem to be in motion."

The phenomenon has since been rediscovered times out of number, *e.g.* by Purkinje in 1825, R. Adams in 1834, Johannes Müller in 1840, Sir David Brewster in 1845, etc. I reinvestigated it experimentally, and published the results of this research, together with a historical survey, as a monograph, "On the After-Effect of Seen Movement," in the *British Journal of Psychology* (Monograph Supplements, No. 1, Cambridge University Press).

A. WOHLGEMUTH.

70 West End Lane, London, N.W.6,
October 18.

THE visual illusion described by Mr. Turner and by Prof. Boycott in NATURE of October 7 and 14 was described by me in NATURE of October 18, 1917 (vol. c., p. 126), and commented on by Dr. F. J. Allen and others on pp. 146, 165, 225, and 325 of the same volume. It had also been described in NATURE, vol. lxx., p. 107, and vol. lxxviii., pp. 225, 277, and 305. It was also pointed out by me in vol. c., p. 284, that the phenomenon had been fully described by Dr. John Aitken in the *Journal of Anatomy and Physiology,* vol. xiii., p. 322. The illusion may, perhaps, be best seen by looking through a microscope and slowly rotating the stage; as soon as the rotation is stopped the field appears to be revolving in the opposite direction, and so strong is the illusion that the stage may again be rotated very slowly in the original direction for 10° or 15° and will appear to the eye to be perfectly still. The same phenomenon may be seen when a pianola roll is stopped, the roll appearing to be slowly moving backwards. In some forms of pianola there is, in front of the record, a glass panel on which is a small knob for opening and shutting the panel; if the finger is placed lightly on this knob while the roll appears to be running back, I have the very curious tactual illusion that the knob is also moving upwards, and that it presses more and more against the finger. One or two others, however, with whom I have tried the experiment do not perceive the tactual illusion.

C. J. P. CAVE.

Ditcham Park, Petersfield, October 17.

Possible New Sources of Power Alcohol.

By C. SIMMONDS.

TWO reports have recently been issued dealing with various aspects of the fuel question. The first[1] is devoted largely to a consideration of the supplies of alcohol which might be made available for use as a motor fuel; the second[2] includes a note upon the production of alcohol from coke-oven gas, with a memorandum describing the process now being developed experimentally for the purpose. In the present article it is proposed briefly to survey the position as regards alcohol, leaving aside the question of alternative motor fuels.

As noted in the first of the two reports, the enormous and rapidly increasing consumption of liquid fuels is tending to exceed production, so that it is very important to supplement those now employed by developing the use of new ones in every possible way. In the United Kingdom the quantity of petrol received during 1914 was about 120 million gallons; the imports in 1919 had risen to 200 million gallons, and the estimate for the present year is 250 million gallons.

It is now accepted that alcohol, either alone or mixed with other liquids, can be used to replace petrol in internal-combustion engines, the most suitable fuel being probably a mixture of alcohol with benzol, or with benzol and ether. But to get alcohol we must first obtain the raw materials. These are, in the main, starch- or sugar-containing plants. So far as this country is concerned, grain (barley), potatoes, and mangolds would appear to be some of the most suitable crops: the last has not hitherto been used for the purpose to any large extent. Reckoning, for present purposes, a gallon of alcohol of 95 per cent. strength as equivalent to a gallon of petrol, how much of these raw materials should we require to supply the 250 million gallons which represent our annual consumption of petrol?

We should want more than 4 million tons of barley, or 12½ million tons of potatoes, or 25 million tons of mangolds. Roughly, the total annual production of potatoes in the United Kingdom is only one-half, and of the other two materials barely one-third, of these quantities. The barley we produce is already largely used in the making of malt; the potatoes and mangolds are foodstuffs. Since this country is very far from being self-supporting in the matter of food, no considerable proportion of these crops could be diverted to increase the production of alcohol. They command a much higher price as foodstuffs than could be paid for them as sources of "power" alcohol.

Our own case is fairly typical of the position in general. Foodstuffs, whether produced at home or abroad, will probably for some time yet be too valuable for use on any large scale as sources of alcohol. Meanwhile, what of possible new sources?

As regards synthetic methods of making alcohol, there are only two which, so far, have come near to commercial success. One of these is the manufacture from calcium carbide, itself produced from coke and limestone. The carbide yields acetylene, which by appropriate chemical treatment is converted into acetaldehyde; and the aldehyde, when mixed with hydrogen and passed over heated nickel as catalyst, is reduced to alcohol. The process was to have been worked on a large scale in Switzerland, but little has been heard of it lately. It may have been remunerative during the war, but has not developed as much as was expected, and appears now to be hanging fire. In any case, cheap power for making the carbide is essential; and according to some German calculations it would be more profitable to convert the carbide into cyanamide, and use this as a fertiliser to increase the potato crop for conversion into alcohol. A much better yield would thus be obtained.

The other synthetic method is based upon the utilisation of a by-product. The gas emitted from coke-ovens consists mainly of hydrogen (50 per cent.) and methane (25 per cent.), with smaller quantities of nitrogen, water vapour, and tarry impurities, and about 2 per cent. of ethylene. After a preliminary purification of the crude gas to eliminate tarry matters, ammonia, naphthalene, and benzene hydrocarbons, the greater part of the ethylene can be absorbed in strong sulphuric acid, forming ethyl hydrogen sulphate, wnich, when diluted with water and distilled, yields alcohol. Experiments have shown the possibility of obtaining 1·6 gallons of alcohol per ton of coal carbonised, and according to some estimates the cost of manufacture would be about 2*s.* per gallon. Assuming a similar yield from all the coal carbonised in British coke-ovens (about 15 million tons per annum), the yearly supply of alcohol from this source would be about 24 million gallons. The manufacture, however, is at present only in the early stages, and it is too soon to judge what the permanent prospects are. But, even if the suggested yield of 24 million gallons is eventually reached—and this, for various reasons, is unlikely—it would be less than one-tenth of our present petrol consumption. It would be a very acceptable contribution, but insufficient. An increase of 100 million gallons or more should be aimed at.

Thus, for the moment at least, we are still dependent upon fermentation methods for any considerable increase in the supplies of alcohol. We come back, therefore, to the question of fermentable raw materials.

Still dealing with the needs and possibilities of

1 "Fuel for Motor Transport." An Interim Report by the Fuel Research Board, Department of Scientific and Industrial Research. (1920.)
2 "Fuel Economy." Third Report of the British Association Committee. (1920.)

the United Kingdom, it may be said that to produce an additional 100 million gallons of alcohol we should have either to devote about 847,000 more acres to potatoes at the present average yield of 5¼ tons per acre, or else to increase this yield to something above 9 tons on the present acreage. For the same quantity from mangolds an additional 513,000 acres would be required, or else a yield of 34½ tons per acre instead of the present average of about one-half this amount. Two suggestions have been made towards the possibility of effecting this increase. One is that by a greater use of fertilisers and better cultivation the crop yield might be raised sufficiently to meet the demand even with the present acreage, or with a relatively small increase. As regards potatoes, more than 10 tons per acre have been obtained in various Irish districts, so that an average of 9 tons does not seem impossible. The figures given by the Fuel Research Board for the mangold crop in 1919 work out to 16½ tons per acre, but some years ago the average was 20 tons, and 24–30 tons have been mentioned as obtainable. If the normal crop of mangolds under good conditions is anything like the last estimate, no very great increase in yield and acreage together would be required to give the raw material for 100 million gallons of alcohol.

The second suggestion is that, leaving apart the land at present cultivated for foodstuffs, waste land might be reclaimed and devoted to carbohydrate crops for alcohol production, so that there would be no diminution of present food supplies. Again turning to Ireland, there are, according to a recent writer, thousands, and even hundreds of thousands, of acres of waste land which could, without any great expenditure of money, be utilised for the purpose. In this country some small-scale experiments on reclamation are actually in progress at Holton Heath, where several acres of heath land have been reclaimed and planted with artichokes for a practical study of the question. At present, however, the work is not sufficiently advanced to allow of useful deductions being made.

The general conclusion arrived at in the interim report of the Fuel Research Board is that the production of alcohol in any considerable quantities from vegetable materials grown in the United Kingdom is not economically possible, owing to (1) insufficient acreage; (2) high cost of cultivation, harvesting, and manufacture; and (3) the fact that the most suitable raw materials are also important foodstuffs. The two suggestions noted above might go far to meet the first and third points, but the second still remains, and it is, of course, a crucial one. In tropical and sub-tropical countries, where land is plentiful, labour cheap, and sunshine abundant, it may be quite practicable to grow vegetable substances such as cassava, arrowroot, and maize at such a cost as will make them very important sources of alcohol. Maize has been much used in the past, but just now its price—no doubt an abnormal one—precludes its use on a large scale. In regions such as South Africa and South America, however, two or even three crops can be secured yearly, and it has been urged that with proper organisation and development this raw material could, under conditions of mass-production, become one of the most important supplies.

Turning now to other possibilities, one of the first to be mentioned is the utilisation of cellulose materials as sources of alcohol. Two processes are already well known; others are in the experimental stages only. The cellulose of sawdust and other wood waste can be hydrolysed with acids and partly converted into fermentable sugars. This process has been under trial for several years in America, but has not yet definitely established itself as a successful manufacturing operation in normal times. In countries where wood pulp is made, a considerable quantity of alcohol is obtained from waste sulphite liquor, a by-product which contains a small percentage of fermentable sugars produced during the treatment of the wood. An interesting recent proposal (Rogers and Bedford) is one for obtaining alcohol from rice straw and husk, a cheap raw material available in large quantities. The straw is softened by steaming, and treated with hydrochloric acid or with calcium hypochlorite and chlorine to disintegrate the fibres, then pulped, and the hydrolysis of the cellulose and starchy matters completed by means of diluted hydrochloric acid. After the conversion to sugar is finished, the acid is neutralised, and the solution of sugars fermented and distilled. It is understood that arrangements have been made for large-scale experimental trials of this process in India, with the view of ascertaining whether the production of fuel alcohol from these and similar cheap cellulose materials can be definitely established.

Experiments are also in progress to ascertain whether a micro-organism can be obtained which will effect the direct conversion of cellulose into fermentable sugar. Success on the lines of this or the preceding process would open out the prospect of utilising a large amount of waste cellulose substances as sources of alcohol.

Among other possible new sources may be mentioned a tuberous plant, *Polynnia edulis*, growing in the Andes, which is said to be now under trial in France. The tubers range up to 2 lb. in weight, and have a carbohydrate content comparing favourably with that of mangolds. A special sugar beet is also being experimented with. Little information, however, is available yet as to whether, in the matter of yield and cost, these plants offer any marked advantages over those now in use.

Our general survey indicates, therefore, that, although the home production may be appreciably increased, it is mainly to the organisation and development of our overseas resources that we must look for any very considerable increase in our supplies of alcohol cheap enough to be used as fuel.

The Natural History of Everyday Creatures.[1]

MISS FRANCES PITT has given us a delightful book of personal observations on the everyday creatures that may be met with in garden, meadow, and hedgerow—the mice, birds, frogs, toads, and other animals that every person comes across. She records what she has seen and learnt, and is plainly an observer of experience and insight. She shows the interest of the life at our doors, and makes it clear that there is a great deal still to be discovered. Her book is strongly to be recommended for young people, not only because of its interest and its simplicity of style, but also because of its scientific temper. We feel at every turn that here is an observer who has a great respect for facts. We recommend the book to young people—there is no writing down to them, but we are sure that many people who are not young in years will enjoy the author's observations thoroughly and learn much from them. The photographic illustrations are excellent.

FIG. 1.—A toad climbing. From "Wild Creatures of Garden and Hedgerow."

The book begins with bats, which are bundles of peculiarities and puzzles. Let us take an example of Miss Pitt's method. When a bat, hawking in the twilight, makes a dash after an insect and catches it, it often apparently tumbles through the air for a foot or two. This is because the bat, having grabbed its insect, bends its head down into its interfemoral pouch, where its prey cannot escape, and crunches it quickly as the bat goes on flying. Now Miss Pitt won the confidence of a pipistrelle to such a degree that it sat on her hand and ate all the flies it could get—making nothing of twenty to thirty at a meal. "My little pipistrelle had hitherto caught and pouched all its food when on the wing, and from habit felt compelled to try and pouch the flies I gave it, though sitting in an attitude that made this almost impossible. The result was that time after time it tumbled over, and would right itself with such a puzzled and bewildered look! However, the difficulty of doing the proper thing did not stop it eating."

The bank-vole matches the soil, dead leaves, and withered grass so wonderfully well that it is very safe so long as it does not move; but if it moves too soon the kestrel drops on it like a stone. Miss Pitt kept three in a large glass-sided cage, and proved their fear of attack from above. "They did not take any notice of things moving beside them, but the slightest thing overhead sent them dashing for cover or made them crouch like stones where they were. The cage was arranged to be as much like part of a bank as possible." Of great interest is the story of a young thrush which took about a week to learn how to deal with snails. "It was very evident that he learnt by experience, and that the snail-cracking habit of the thrush is not a specialised instinct, but arises from the tendency of this bird to beat on the ground and thus kill any food, like a big worm, which cannot easily be managed. My thrush would beat and hammer anything that was at all troublesome or which he did not understand." This is the kind of observation that gives the book a high value. Dealing with shrews, Miss Pitt says: "It is only by watching these small animals that one can gain any idea of their untiring energy, intense vitality, and their great pugnaciousness. They are perhaps the most quarrelsome creatures in the world! If lions and tigers were as fierce, active, and fearless in proportion to their size, as shrews and moles are in comparison with their little bodies, what awful creatures they would be!" In regard to the death of large numbers of common shrews in the autumn, the author favours the theory that these animals are "annuals." Here, as in some other parts of the book, there is a useful exposure of the nonsense that is often talked about the misery and cruelty of wild Nature. "If to us it seems dreadful that death should be always on the watch

[1] "Wild Creatures of Garden and Hedgerow." By Frances Pitt Pp. ix+285. (London: Constable and Co., Ltd., 1920.) Price 12s. net.

for them, it seems almost certain that the small animals enjoy their life to its utmost." We come next to a sympathetic study of frogs and toads. The toad's eyes are described as of "a pale metallic brown with reddish lights like flickering fires in their depths." This is good, but we do not like the suggestion that *iris* and *pupil* are synonymous, and we should not ourselves speak of the toad *ejecting* its poison. It is interesting to learn that toads will go over a mile to a particular breeding-pond—perhaps a sort of "homing." Miss Pitt's workmanship is first-class throughout, but she excels herself in dealing with mammals. What a fine picture she gives of the long-tailed field-mouse, with "great black eyes looking ready to jump out of its head," which washes itself when the least upset, a great climber, a burglar of bee-hives. If the tail is suddenly seized, it *skins*, and the animal escapes, very like "a special arrangement to enable its owner to get away from hawks and owls." The mouse does not bite off the skinned bone, as some books say; the caudal vertebræ dry up and fall off of their own accord.

We thought we knew something about moles, but we have learned much from Miss Pitt. For their size they are extraordinarily fierce and strong; they fight furiously, and it is doubtful whether a weasel could master one. On one occasion a mole moved a nine-pound brick, which is like a man moving more than three tons. Their rate of digestion is past belief, and they require meals almost continuously. One that was supplied with forty worms in the late afternoon was dead next morning—with an empty stomach. "Whatever you do, don't despise the 'poor little mole,' . . . in its dark tunnels it fights, hunts, feasts, mates, and enjoys life with quite as much gusto as the creatures of the light and air."

Miss Pitt made a fine experiment with a very young common rat, still blind, feeble, and very naked. She gave it in a diplomatic way to a cat, whose litter had been reduced to one—about ten days old. "I could hardly hope that the cat would be so good, or shall I say so foolish, as to nurse such an utterly different baby as the rat!" But that was what happened. The rat was accepted, cleaned, fed, fondled, tended, and treated just like the kitten along with which it was reared. Even after another family came to occupy the cat's attention, she remained on friendly terms with the rat and often paid him a visit. The cat in question had been a good ratter, but after the adoption ratting was done with!

In the study dealing with the pied-wagtails, willow-wrens, and great tits of a garden, the author notes that the parent wagtails worked for sixteen hours a day, and in that time brought food about 192 times to the nest; and it is not merely the going to and fro; there is the searching for insects in between. It is suggested, by the way, that the willow-wren's domed nest serves to keep the sun off the young birds, which are greatly distressed by heat. There is a lively account of the slow-worm, the common lizard, and the grass snake; thus in reference to the local life of the discarded tail of the slow-worm we read: "Fancy being able, when threatened by a foe, to throw off such an important part as a tail, and slip away, while it dances on the ground and occupies his attention." We have often found students puzzled by the expression "casting or shedding *the skin*"; and as Miss Pitt explains that the skinned tail of a field-mouse dies, perhaps she may be fairly asked to explain why a snake which sheds "many skins" is able to live on. It is new to us that the skeleton of the slow-worm shows rudiments of *legs*. We make such trivial observations because the book is so perfect.

FIG. 2.—The long-tailed field-mouse. From "Wild Creatures of Garden and Hedgerow."

A study of the short-tailed field-vole, prolific, harmful, greedy, but very likeable, raises a number of interesting points. The dull, dark brown fur is a good instance of prolonged sifting: "It is not that it matches either the stems of the grass, or the bare earth, but it goes wonderfully well with the shadowy places between the plants." Who can explain why a comfortably caged mother, captured along with her litter of six, will coolly and collectedly, after a careful toilet, remove one baby after another from the nest, and give each a sharp and fatal bite? The ways of mice and men! We have left to the end the story of the hedgehog, which Miss Pitt defends from many calumnies. Its appetite for a dead rabbit or the like has doubtless given some basis for misinterpretation. We doubt whether it is quite correct to say that the rolling-up musculature (*orbicularis panniculi*) of the hedgehog is also used in raising the spines, but perhaps Miss Pitt means merely that the contraction of the cap-like sheet is a factor in making the spines stand out firmly. We like what is said in regard to the individuality of hedgehogs and other beasts of the field. Miss Pitt is to be congratulated on a book which takes its place in the first rank of works on field natural history. It is a personal record of clever, patient, and sympathetic observation. J. A. T.

Obituary.

PROF. YVES DELAGE.

BY a large number of zoologists, who have known the charm of Roscoff Marine Station during the last twenty years or more, the death of Prof. Yves Delage on October 8 will be felt as a personal loss. It was not merely that Prof. Delage grudged no time or trouble if he could help one with a piece of work; it was the impressive sincerity of the man and the simplicity with which he wore his learning. He had an encyclopædic knowledge of the shore-fauna and of the literature of biology, but he encouraged the learner with a Darwin-like humility. His devotion to science was singularly complete. All through his life, with an extraordinary intensity, he was preoccupied with biological and psycho-biological problems, and he did not often unbend his bow except for the simple pleasures of domesticity and the open air.

Yves Delage was born at Avignon in 1854 and educated at various provincial schools. He was greatly influenced in his student days by de Lacaze-Duthiers, whom he afterwards succeeded both at the Sorbonne and at Roscoff. It was under this master that he acquired a great liking for "microtomy" of a rather different sort from that which the word now suggests. We mean what Delage himself called "patient dissections under the microscope," the kind of investigation which he illustrated in his thesis (1881) on the vascular system of sessile-eyed Crustaceans. That he did not, however, stand so aloof as Lacaze-Duthiers did from the use of the microtome was shown in subsequent researches, such as those dealing with the development of sponges (1887). After a period of assistantship to Lacaze-Duthiers, of whom he always spoke with great reverence, Delage became professor at Caen and director of the adjacent Marine Station at Luc. He soon returned, however, to the Sorbonne, and was actively at work there until quite recently. He was elected a member of the Institute in 1901, about the time when he assumed full charge at Roscoff; he received the degree of LL.D. from Aberdeen University when he attended the quatercentenary celebrations in 1906; and he was awarded the Darwin medal by the Royal Society in 1916. For some years past his eyesight had given way badly, but his mental vision was unimpaired.

Delage's scientific industry was at once a reproach and an inspiration to those who knew him; it was almost incredible. His great book on "Heredity and the Great Problems of General Biology" (1895, second edition 1903) is a monument. It is marked by erudition, clearness of exposition, fair-mindedness, and keen criticism. We have temperamentally a great admiration for his judicial way of balancing evidence, sometimes so judicially that the reader's mind is left in a state of indecision. His own view was definitely neo-Lamarckian, and he had many a thrust at Weismannism. Then there are the twenty volumes or so of "L'Année Biologique," a very valuable series of critical summaries of current biological memoirs, even the last volume containing many contributions from Delage himself. Again, there are the half-dozen volumes of the "Traité de Zoologie Concrète," in which he was ably assisted by M. Hérouard and others. Besides these there were smaller undertakings, such as the very successful volume, written along with M. Goldsmith, on "Modern Theories of Evolution" (1909), and a similar volume on "Parthenogenesis" (1913).

Delage's most important contributions to zoology and biology have been (1) his fine study of the life-history of the extraordinary Crustacean parasite Sacculina, (2) his precise work on the development of sponges, and (3) his remarkable experiments on artificial parthenogenesis, with which his name (along with that of Jacques Loeb) will always be associated. We recall also the strange experiments on "merogony" and researches on the semicircular canals and otocysts. The study of the ear had a great fascination for him. Nor can we forget a long paper on a whale stranded near Luc, for it was in this connection, about 1885, that we had in our student days, working at the Luc laboratory, our first knowledge of Delage. We suppose that he made mistakes in his work like other distinguished men, but surely his life was marked by what he said Lacaze-Duthiers had by example taught to his school—"la persévérance, la suite dans le travail, la conscience dans l'observation, la sobriété dans les inductions théoriques."

Delage was at work at Roscoff this summer and autumn, and it is surely not unfitting that the last subject of his eager scientific analysis should have been *dreams*, on which we believe he had recently completed a treatise. A young student who returned last month from a working holiday at Roscoff has given us a pleasing glimpse, with which we close our appreciation. Every day after lunch it was Delage's habit to sit for a while in front of the laboratory so that any student might know he was then and there at home.

J. ARTHUR THOMSON.

ASTRONOMY in Italy has suffered three heavy losses within a few months in the deaths of Riccò, Millosevich, and Celoria. GIOVANNI CELORIA, who died in Milan on August 18, was born in Piedmont in 1842, graduated at the University of Turin in 1863, and then studied astronomy at Bonn and Berlin. On returning to Italy he was appointed by Schiaparelli an assistant at the Brera Observatory, Milan, where he remained almost all his life, becoming director in 1900, on Schiaparelli's retirement, and himself retiring in 1917. Celoria's astronomical studies were devoted mainly to the structure of the star system; he repeated some of Sir W. Herschel's work on star-gauging, though with a much smaller telescope, and inferred the comparative thinness of the star-stratum in the direction of the north galactic pole from the fact that in this region he could see as many stars as Herschel had seen. He did useful work in another direction by collecting and discussing the records of several total solar eclipses the tracks of which crossed Europe in the Middle Ages, and he was able to fix the boundaries of totality with considerable precision; his work has been utilised by Dr. Cowell and others in the discussion of the secular acceleration of the moon. Celoria was also interested in geodesy, and held for a long time the chair of that subject in the Technical College of Milan. He was elected an associate of the Royal Astronomical Society in 1917.

WE regret to note that the death of MR. GEORGE TANGYE is announced in the *Engineer* for October 15. Mr. Tangye started business in Birmingham, with four other brothers, in 1858. The firm was a very modest undertaking at the start, but came rapidly into prominence on account of the successful launching of the *Great Eastern* steamship, which was accomplished by use of the Tangye hydraulic jack. The firm was one of the first to introduce steam-engines with interchangeable parts; its products in many fields of engineering have now a world-wide reputation. Mr. Tangye lived for many years at Heathfield Hall, formerly the home of James Watt. He carefully preserved Watt's garret workshop, and brought together a fine collection of relics of Boulton and Watt, which he finally gave to the city of Birmingham.

THE death is announced in *Engineering* for October 15 of SIR JOHN MCLAREN, who was well known in Leeds engineering circles. Sir John was born in 1850, and finished his education at Durham University. He started in business in 1876 with his brother, and his firm carried out many important contracts. When the war broke out he was made chairman of the board of management of the National Factories for Munitions in Leeds. He was a member of the Institution of Civil Engineers and of the Institution of Mechanical Engineers.

BY the death of MR. HENRY STEEL on October 7, chairman of the United Steel Companies, many organisations with which he was prominently connected have suffered a severe loss. Mr. Steel was educated in Brussels and at the University of London. The combine of which he was chairman included many large firms, and had a capital of more than 9,000,000*l*. He became a member of the Iron and Steel Institute in 1886.

Notes.

PROF. T. W. EDGEWORTH DAVID, C.M.G., F.R.S., professor of geology in the University of Sydney, has been appointed a Knight Commander of the Order of the British Empire (K.B.E.) for services in connection with the war.

THE gold medal of the Royal College of Physicians, which is awarded by the college every three years for distinction in public health, was presented to Dr. W. H. Hamer, Medical Officer of the County of London, on Monday, October 18.

THE Emil Fischer memorial lecture will be delivered by Dr. M. O. Forster at the ordinary scientific meeting of the Chemical Society on Thursday, October 28, at 8 p.m. By the courtesy of the Institution of Mechanical Engineers, the meeting will be held in the lecture theatre of that institution.

THE expedition sent by the Norwegian Government, in command of Capt. G. Hansen, to lay depôts for Capt. Roald Amundsen has returned safely, having accomplished its task. The *Times* announces that Capt. Hansen, after wintering in the Eskimo settlement at Thule, started northward in March this year, accompanied by several Eskimo who had previously served with Peary. The march was along the coast of Greenland by Smith Sound and Kane Basin. North of Franklin Island fast sea-ice several years old enabled the expedition to cross Kennedy Channel to Grinnell Land. With some difficulty, due to extremely rough pack, Cape Sheridan was rounded and the goal of the march reached at Cape Columbia, the most northerly point of Grant Land. There the last of a series of depôts was laid which will enable Amundsen, if his Polar drift brings him to the neighbourhood, to abandon his ship and travel southward by easy marches to the Danish settlements in Greenland.

THE first Pan-Pacific Scientific Conference met at Honolulu on August 2–20, when some noteworthy resolutions were carried (*Science*, September 24). Dealing with the promotion of scientific education, the conference recommended that the compensation for instruction and for research in science should be increased in order that young men may enter upon scientific careers without sacrificing all hopes of reasonable monetary returns; and, further, that men of exceptional attainments should be given rewards which may be comparable with those offered by commercial undertakings. A resolution was also passed advocating that efforts should be made to keep the public fully informed of the progress of science and of its bearings on the affairs of the world. Resolutions which concerned more nearly the institutes and universities of the Pacific countries dealt with the training of teachers and lecturers, with the provision of fellowships, and with the migration of research students to institutions providing the best facilities for their own class of work. The conference recommended that the exchange of teachers between institutes in different countries should be encouraged with the object of widening the outlook of these instructors. Fellowships to which adequate stipends were attached ought to be regarded as rewards for scientific work, and substantial prizes given as rewards for young investigators who achieve notable results. It was also agreed that a clearing-house of information relative to opportunities for scientific study and research in the Pacific area should be established.

SIR W. H. BRAGG delivered a public lecture at University College, London, on October 7, as a general introduction to the courses on the history of science to be delivered there. After referring to the origin of these courses, the lecturer said there must be something innate in mankind to prompt an interest in Nature and to foster a belief in cosmic order in spite of apparent chaos. Already in the earliest civilisations, in ancient Egypt and Babylonia, we see the beginnings of that close study of Nature which has continued with varying success throughout the ages. It is in the nature of things for old views to be superseded. There has, however, been more of evolution than of revolution in the history of scientific ideas. Each generation tries to correlate all the facts known to it, and it can do no more. Newton correlated all his facts; Einstein has to take into account facts unknown to Newton. There is no finality in science. A belief in finality would lead to stagnation. The history of science is interesting in many ways. It reveals the steps that have led up to our present orientation; it traces the evolution of the great scientific conceptions—like the atomic theory, for example; it shows the development of potent scientific instruments like the thermometer, etc.; it tells the story of the fruitful application of scientific discoveries—wireless telegraphy, for instance; it has the great human interest of showing how workers drawn from all sorts and conditions have co-operated in the building up of science; and it narrates many an inspiring epic of heroic struggle and perseverance, of triumph and tragedy, in the disinterested pursuit of noble ends. No wonder, then, that throughout the country there is awakening a new interest in the history of science. The subject offers a valuable educational opportunity. It merits the serious attention of teachers and journalists and all whose business it is to teach how things have come to be what they are; and it is well adapted to serve all those who seek to improve their education by non-vocational studies that will add to the interest and joy of life.

AMERICAN philologists have long been occupied in elucidating the complex of dialects spoken by the Indian tribes. The more important languages have been fully investigated, but there still remain some minor linguistic groups which are gradually coming under inquiry. The Tunica, Chitimacha, and Atakapa languages, spoken within historical times in territory now incorporated with the States of Mississippi, Louisiana, and Texas, form the subject of a monograph by Mr. J. R. Swanton, published as Bulletin 68 by the Bureau of American Ethnology. The first, the Tunica, is now spoken by only some half a dozen persons in a small reservation. For our knowledge of these languages, now practically extinct, we are indebted to Dr. A. S. Gatscher, whose collections were made in 1886, and further researches among the scanty survivors by Mr. Swanton have added little new information. This scholarly monograph gives a grammar and comparative vocabulary of these three closely allied forms of speech.

THE native tribes which occupied the vast region extending eastward from the Mississippi to the Atlantic are now understood to belong to at least seven linguistic stocks. Of these groups the Algonquian was the most numerous, followed by the Muskhogean, Iroquoin, Siouan, Timucuan, Uchean, and Tunican, all differing to such a degree that one would not have been intelligible to the other, and often within the same linguistic family the various tribes spoke different dialects. Thus such a diversity of languages and a great range of climatic conditions, mountains, prairies, swamps, and lakes produced a variety of customs influenced by natural conditions and environment. In perhaps no way are these variations more pronounced than in the forms of the dwellings of the various tribes. This subject is fully illustrated in the monograph (Bulletin 69) by Mr. D. I. Bushnell, jun., issued by the Bureau of American Ethnology. In this we have an investigation of ancient village sites occupied by the various tribes, and the nature of the buildings erected by peoples in various stages of culture, which is full of interest.

IN the September issue of the *Entomologist's Monthly Magazine*, Mr. F. W. Edwards deals with the habit of certain midges (Ceratopoginæ) of sucking the juices of other insects. This propensity has long been known, but Mr. Edwards's exact observations appear to be the first connected series conducted in this country. The blood-sucking habit among the females of this group of insects possibly first arose from the partiality of its members for attacking other insects. Few people who have used their gardens towards dusk have escaped the irritating punctures caused by these minute flies.

IN the Transactions of the Entomological Society of London (July, 1920) is a paper by Dr. G. D. Hale Carpenter on the forms and Acræine models of the Nymphaline butterfly, *Pseudacraea eurytus Hobleyi*, on the islands of Lake Victoria. Contained therein are some observations bearing upon the explanation of the theory of mimicry by natural selection. The object of the author is to show that in the presence of greater numbers of models the mimics are found to be true to type, but that when they outnumber the models many transitional and other varieties are preserved. The paper is a confirmation and extension of the author's earlier article published in March, 1914. The destruction of butterflies, so far as selective action is concerned, is held to be mainly the work of young birds which have to learn what to eat and what to avoid. Thus in 1914, when the models were extremely abundant, any member of a combination would have been more likely to be the distasteful Acræine. The young birds would therefore leave that combination alone, while varieties of the Pseudacræa not conforming to the model would be destroyed. As the birds grew older, and in localities where the models had become scarcer, one must suppose that the birds had forgotten what the latter tasted like, so that no one form of Pseudacræa had much more chance of surviving than any other. This explanation presupposes that the bird fauna stays on an individual island and does not fly from one to another. Dr. Carpenter has already brought forward some evidence which suggests that this is actually what does occur.

MESSRS. A. S. KENNARD AND B. B. WOODWARD have published in the Proceedings of the Malacological Society for September some "Nomenclatorial Notes relating to British Non-marine Mollusca." After discussing the names of various species of Testacella and Helix, they point out that the genotype of Ancylus is *Patella lacustris*, Linn., and that *Ancylus fluviatilis*, which belongs to a different genus, must be called Ancylastrum. This is a most unfortunate conclusion, because it is the latter species that has given the name to the well-known Ancylus Lake and Ancylus Clay of the late Glacial period in North-West Europe. Scarcely less regrettable is the authors' desire "to once again point out" that the name Bulinus is not available for "the Egyptian shells [*sic*] which play the part of host to Bilharzia," or, indeed, for any mollusc. They may be right, but we do not agree that because O. F. Müller adopted Adanson's pre-Linnean name Bulinus for four species, one of which was that imperfectly described by Adanson, his action "of course involves the acceptance of [Adanson's] shell as the type of the genus." The authors are so severe on Dr. Annandale for thinking that the name Bulinus (or Bullinus) ought to be preserved because of its wide currency, that one is astonished to find them, almost with the same penful, writing of Bilharzia, which they must know to be a synonym of Schistosoma. It is doubtless their misfortune rather than their fault that pages which blame the eccentric Fitzinger for neglect in proof-reading should themselves exemplify that form of carelessness.

FROM Buenos Aires we have recently received a copy of *El Hornero*, a journal of Argentine ornithology published by a recently established society, La Sociedad ornitológica del Plata, constituted for the encouragement of the study of the birds of the southern portion of South America. The journal derives its name *Hornero* from the Spanish word denoting one of the most characteristic birds of Argentina, known to Englishmen as the oven-bird and to science as *Furnarius rufus*, and an illustration of the birds and their curious massive nest built up of clay adorns the cover of each issue. The present number contains a carefully prepared list of the different species of penguins found along the coasts of Argentina drawn up by Señor R. Dabbene, the editor of the journal, and a list of 254 species of birds found in the neighbouring Republic of Uruguay from the pen of Señor J. Tremoleras, of Montevideo. Mr. A. G. Bennett, of Port Stanley, in the Falkland Islands, contributes some notes on the habits and distribution of the marine birds of that distant outpost of the British Empire, illustrated by reproductions of photographs taken by himself. The parasitic Mallophaga of the Argentine are treated of at considerable length by Dr. F. Lahille, who has himself described 31 out of the 159 species known to exist in the Argentine; and, finally, Prof. Lucas Kraglievich has an article on the fossil birds of the Republic, in which he discusses the relationship of Phororhacus with the recently described Diatryma of the Eocene beds of the United States. There are a number of shorter articles and notes, with an ample bibliography of recent publications dealing with South American ornithology, and the general get-up and editing of the journal reflect great credit on the Sociedad ornitológica del Plata and the editor, Señor Dabbene.

MR. W. H. TALIAFERRO records (*Journ. Exper. Zool.*, vol. xxxi., No. 1, July, 1920) the results of observations on the reactions to light in *Planaria maculata*, planned with the object of ascertaining how far, in this Turbellarian, the function of the eyes in the reactions to light can be correlated with the histology of these organs. Hesse (1897), who worked with certain Triclads which were negative to light, and hence moved away from the source of stimulation, maintained that this reaction was due to the fact that the sensory cells or rhabdomes were shaded by the pigment-cup which partially enclosed them, whereas when the worm turned in any other direction the pigment-cup did not shade all the rhabdomes. When certain of the rhabdomes were illuminated, as in the latter case, the animal turned so as to bring the sensory region of the eye again into the shadow of the pigment-cup. Hesse therefore maintained that the localisation of the photic stimulus is the specific function of the pigment-cup, which enables the animal to direct its course away from the source of light. Mr. Taliaferro has carried out experiments on normal Planaria and on others from which one of the eyes, or a portion thereof, has been very carefully removed. He shows that the rhabdomes in the eye are arranged in two localised sensory regions. Illumination of one set is followed by the animal's turning towards the side containing the eye, while illumination of the remaining rhabdomes is followed by the animal's turning in the opposite direction. The observed reactions can be explained without assuming (with Hesse) that the pigment-cup acts as a localiser of photic stimuli. Light must strike a given rhabdome parallel to the long axis of the latter in order to cause stimulation; thus the position of the long axis of the rhabdome results in a localisation of photic stimulation. Light entering the pigment-cup from any given direction illuminates the rhabdomes in a definite area, and a large proportion of these have their long axes directed parallel to the stimulating rays of light.

WE have received from Prof. H. F. Osborn reprints of some interesting brief notes on vertebrate fossils in the American Museum of Natural History, New York. A good drawing is published of a newly mounted skeleton of Moropus, the strange odd-toed hoofed mammal from the Miocene of Nebraska, in which the large hoofs are sharply pointed and deeply cleft as in some edentates (Proc. Nat. Acad. Sci., vol. v., pp. 250–52, 1919). Prof. Osborn concludes that this must have been a forest animal, and that the peculiar feet were used, not for digging, "but largely for the pulling down of the branches of trees." A drawing of a restored and mounted skeleton of a long-jawed mastodon (Megabelodon) from the Pliocene of Texas shows well the comparatively short limbs of the earlier elephant-like mammals (Proc. Nat. Acad. Sci., vol. v., pp. 265–66, 1919). Beginning apparently in northern Africa, these long-jawed mastodons reached Europe in Lower Miocene times, and appeared in America (Texas) in the Upper Miocene, attaining a gigantic size in the Middle Pliocene. The monograph of the Titanotheres is progressing, and Prof. Osborn describes some new fragments of jaws from the Eocene of Colorado (Bull. Amer. Mus. Nat. Hist., vol. xli., art. xv., 1919). The Jurassic Dinosaurs are also being actively studied, and some valuable notes on the original specimen of the gigantic sauropod, Camarasaurus, from Colorado, are published by Prof. Osborn and Mr. C. C. Mook (Proc. Amer. Philos. Soc., vol. lviii., pp. 386–96, 1919). The authors agree with Dr. W. J. Holland that the axis of the skull in the sauropods inclines downwards from the vertebral axis as an adaptation for browsing, and they give some striking restored sketches of the head of Camarasaurus as they think it appeared in life.

THE Memoirs of the Geological Survey of India (vol. xlvii., part 1) contain an extremely interesting account of the mines and mineral resources of Yunnan by Mr. J. Coggin Brown. Yunnan is the most southwesterly of the provinces of China, and is of importance from the British point of view because it forms the eastern boundary of Burma and Assam; it has been but little visited by Europeans, and Mr. Coggin Brown's explorations thus afford authentic information upon an extensive area which has hitherto been most imperfectly studied. The more important mineral products which he has described comprise coal, iron, copper, lead, silver, zinc, tin, arsenic, gold and salt. In addition to Tertiary lignite, coal of Mesozoic, Triassic and Carboniferous age is known, and the author is of the opinion that the province contains considerable quantities of coal, some of which, at any rate, is of good quality. He does not think there is much probability that coal can be exported in competition with other coalfields of the Far East, but holds that it will find its chief demand in supplying the local railways and local domestic and metallurgical requirements. Iron ores occur in many places, and the production of cast-iron, castings, wrought iron and steel is sufficient for all local requirements, which are, of course, by no means extensive. The native methods of iron-smelting are well described, and it is interesting to find that the Chinese have developed charcoal blast-furnaces 25 ft. in height and 7 ft. across the boshes. The author does not think that there is much room in Yunnan for the development of iron-smelting upon modern European lines, but that the native smelters will gradually learn to improve their own methods. It is stated that copper has been smelted in Yunnan for at least a thousand years, but although copper ores are widely distributed the industry appears to be a declining one. The same seems to be true of lead and silver, but the production of tin, on the other hand, is in a flourishing condition.

SOME interesting facts showing the limits of the continental United States which have been compiled by the United States Geological Survey are published in *Science* of September 24. The gross area of the United States is 3,026,789 square miles, of which 2,973,774 square miles are land and the remainder, 53,015 square miles, water; this is exclusive of the area occupied by the Great Lakes and that within the three-mile limit on the Atlantic and Pacific seaboards and in the Gulf of Mexico. The most southerly point of the mainland is Cape Sable, Florida, which is in latitude 25° 7′ N. and longitude 81° 5′ W.; this point is really forty-nine miles further south than the southernmost point of Texas, which often appears in maps to be the most southerly part of the land territory of the United States. The most easterly point is West Quoddy Head, near Eastport, Maine, in longitude 66° 57′ W. and latitude 44° 49′ N.; and the most westerly Cape Alva, Washington State, in longitude 124° 45′ W. and latitude 48° 10′ N. A small detached land area of northern Minnesota provides the most northerly point, in longitude 95° 9′ W. and latitude 49° 23′ N. The distance from the most southerly point of Texas due north to the forty-ninth parallel, the boundary line between the United States and Canada, is 1598 miles. From West Quoddy Head due west to the Pacific Ocean is 2807 miles, while the shortest distance from the Atlantic to the Pacific across the United States is 1152 miles, measured from the neighbourhood of Charlestown, South Carolina, to San Diego, California. The Canadian boundary line from the Atlantic to the Pacific is 3898 miles in length; the Mexican, from the Gulf of Mexico to the Pacific, 1744 miles. The Atlantic coast-line measures 5560 miles, the Pacific 2730 miles, while that washed by the Gulf of Mexico is 3640 miles in length.

BLUE HILL Meteorological Observatory has issued its observations and investigations for the year 1919 as vol. lxxxiii., part 4, of the Annals of the Astronomical Observatory of Harvard College, U.S.A. The work has been done under the direction of Prof.

Alexander McAdie. Consecutive observations have now been published for thirty-four years. Atmospheric pressure, air temperature, vapour pressure, relative humidity, cloudiness, wind direction and velocity, and precipitation are given twice daily, at 8 a.m. and 8 p.m., throughout the twelve months, and the means and totals are entered for each month with the differences from the normals for the thirty-four years, 1886 to 1919. Wind frequency is given for each month and for the year for each 45° of the compass, and the mean and highest wind velocity. The duration of sunshine and the percentage of the possible amount are also included. Phenomena showing the advance of the season for each of the thirty-four years are given, such as thawing of ponds, last snowfall and last frost in spring, first blossom and first ripe fruit, first snowfall in autumn, and ponds frozen. There are numerous constants and averages for the thirty-four years, such as days with snow, hail, thunderstorms, and fog. Rainfall and snowfall and mean temperatures for each month of the thirty-four years are entered in tables. In the introduction a slip has been made in transposing the references to tables ix. to xi. A detailed description is given by Prof. McAdie of "a quick method of measuring cloud heights and velocities," which will doubtless be useful at aerographic stations.

BATAVIA Observatory has issued a volume of 140 pages, giving in detail the meteorological and magnetical observations for 1915, and also the meteorological results for the several months for the fifty years 1866 to 1915 and the means for the whole period. The work is published by the Government of East India, under the supervision of Dr. W. van Bemmelen, the director. For half a century hourly observations of many of the elements have been uninterrupted. A change has been made in the position of the barometer during 1915 which reduces the daily range of temperature of the attached thermometer from 5° C. to only a few tenths of a degree—an important factor when searching for the diurnal range of atmospheric pressure. For wind velocity the factor 3 has been used as formerly for the reductions, but it is found that the true factor decreases with the increasing velocities of wind. The results for fifty years probably give in many cases means which will vary little by any increase in the length of the period, but the fifty years may contain cycles the means for which may differ considerably among themselves. Rainfall results are given for fifty-two years, and breaking these into two periods of twenty-six years, the monthly averages are very different. Roughly speaking, the rainfall for the latter twenty-six years, 1890–1915, has increased in the southern winter months and decreased in the southern summer months. Magnetical observations are given only for 1915; there are curves showing the monthly deviations of the magnetic components from the mean yearly values.

THE Report of the Committee on the Standardisation of the Elements of Optical Instruments just issued by the Research Department contains much information of prime importance to instrument-makers. It fixes standard focal lengths and diameters for telescope objectives, angles of prisms for binoculars, and diameters of tubing and of screws and pitches of the latter. It strongly advocates interchangeability amongst the products of the different manufacturers, and points out that two years ago the screws nominally of the same size turned out by one optical firm only in the country were interchangeable amongst each other. That firm has in a most public-spirited way offered to supply the chasers and gauges necessary to secure interchangeability. The adoption by the Committee of the inch as the unit of length will not permit of the principle of interchangeability being extended to instruments of Continental manufacture.

IN the September issue of the Journal of the Franklin Institute Dr. F. E. Pernot has written an interesting and important paper on submarine-cable signalling. Dr. Pernot gives the results of experiments carried out by the members of the Signal Corps Research Laboratory of the U.S. Bureau of Standards. Several successful attempts were made to increase the carrying capacity of a submarine cable by superposing an alternating current on the existing system of direct-current signals. It is pointed out that currents of several frequencies can be used simultaneously, as each message can be separated by a suitable tuning device. The author is to be congratulated on having determined the physical constants of a submarine cable at various frequencies, both by calculation and by experiment. It is shown that the design of suitable apparatus becomes a straightforward problem. Actual trials of these methods with cables as long as 700 km. were made, the results being in all cases completely satisfactory. With longer cables difficulties were experienced, but the experiments indicated that it was possible to superpose at least one alternating current on the existing duplex system of an Atlantic cable. From the theoretical point of view it is interesting to note that the high-frequency resistance of a submarine cable is greater than that computed by Kelvin's formula. The effects of the steel armouring and the uncertainty in the position of the return currents would probably account for this. It was found that 5 microvolts at the receiving end gave good signals with the powerful amplifiers which are now available.

"THE Gases Dissolved in Water" formed the subject of the Streatfeild memorial lecture delivered by Mr. J. H. Coste at the Finsbury Technical College on October 14. In a brief historical sketch reference was made to the work of Henry, Dalton, and Bunsen on the estimation of gases dissolved in water, and to that of Dittmar in connection with the *Challenger* Expedition. Curves were shown to illustrate the results of Adeney's work on the rate of aeration of air-free water, and reference was made to the investigations of Tornøe, Winkler, Roscoe, and Dittmar on the variation with temperature of the volumes of gases dissolved in water, results being given for distilled water and sea-water. The absorption coefficients determined by Bohr and Bock were given, and a curve depicting the manner in which solubility of oxygen in water falls with rise of temperature was shown. A method of collecting samples from any depth was illustrated, and Winkler's method for estimating the volume of dissolved air in water explained. The lecturer referred to the utility of this work in such diverse fields as public health and oceanography, and indicated the importance of dissolved air to subaqueous plant and animal life. The function of submerged green plants in absorbing carbon dioxide and liberating oxygen was explained, and it was stated that large quantities of oxygen in excess of saturation were found after a period of plant activity in bright light. One function of this dissolved oxygen is to maintain a healthy condition in water by oxidising submerged refuse—a process largely dependent upon the presence of living organisms. Reference was also made to geological changes due to dissolved carbon dioxide, to hardness produced by the same gas, and to the corrosive action of water containing dissolved air as exemplified by the oxidation of ironwork in hot-water radiators, and by the corrosion observed in all steam-raising systems owing to the oxygen dissolved in the feed-water. At the close of his lecture Mr. Coste referred in eloquent terms to the work done at Finsbury College during the past thirty-five years, and deplored the fact that the closing of the college was contemplated.

Engineering for October 8 gives some interesting particulars regarding fabricated ships constructed in the United States. It will be remembered that these ships were so arranged as to permit the separate parts to be manufactured by a large number of firms and then assembled at the shipyard. The fabricated freighter has now been afloat long enough to experience sufficiently varied conditions to reveal its seaworthiness. It is a known fact that steamers of this kind have been able to forge ahead in the teeth of storms that have driven larger boats of the usual build to leeward. Replacements in cases of breakdown or injury have been made very promptly. Two steamers, one of which was a fabricated vessel, collided, and each smashed a hawse-pipe; the fabricated vessel was repaired from stock in a few hours, whilst repairs to the other ship took six weeks. Reports made by masters and chief engineers reveal the soundness of the hulls and their unusual tightness and freedom from leakages in the cargo-bilges, etc. Up to April 1 of the current year 120 fabricated craft had been launched from the twenty-eight ways of the Newark Bay shipyard, the keel of the first having been laid in December, 1917—a feat which constitutes a record. It is proposed to carry on this yard, and the Submarine Boat Corporation has taken it over from the Government. The programme provides for extensive developments of both the yard and its neighbourhood, with the idea of making that point a highly equipped port of entry and departure, with dry docks and other repair conveniences.

WE learn that the X-ray and electro-medical business of the High Tension Co. has been purchased by X Rays, Ltd. Arrangements have also been made whereby Mr. Mortimer A. Codd, the author of a well-known book on the subject of high-tension apparatus, becomes the director of research for X Rays, Ltd. The direct association of an X-ray research laboratory with a manufacturing firm has yielded such astonishing results in America that one may look with confidence to the similar plan which has been initiated in this country.

WE are informed that the head offices of Siemens Brothers and Co., Ltd., and of Siemens Brothers Dynamo Works, Ltd., will be removed shortly from Palace Place Mansions, Kensington, London, W.8, to Caxton House, Westminster, London, S.W.1.

Our Astronomical Column.

THE NOVA IN CYGNUS.—This object has continued to decline in brilliancy at a fairly steady rate. Mr. Denning writes that since the end of August the star has lost light at a rate equivalent to one-tenth of a magnitude daily. The nova has exhibited features differing in several respects from those of the bright novæ of 1901 (Perseid) and 1918 (Aquilid), which showed remarkable fluctuations in their declining stages and presented phenomena analogous to those of ordinary variable stars. It seems, in fact, as though the new stars of 1901 and 1918, after their great outburst and quick decline, were subject to a series of minor outbursts affecting them at short and fairly regular intervals.

No such disturbances have apparently been observed in the case of Nova Cygni. At Bristol, during the fifty-five nights from August 20 to October 13 inclusive, the star was observable on forty-seven nights, and it has now become a rather faint telescopic object, its magnitude on October 7 being only $8\frac{1}{4}$.

It is remarkable that since 1848 twelve new stars have been discovered which were visible to the naked eye, although during the preceding 150 years not one nova was recorded.

CONNECTION OF PLANETARY NEBULÆ WITH HELIUM STARS.—*Astr. Nach.*, No. 5065, has an article by Herr H. Ludendorff on this subject. Herr Ludendorff alludes to the puzzling fact that the planetary nebulæ show a high average velocity in the line of sight, while the helium and Wolf-Rayet stars, with which they have spectroscopic affinity, have a conspicuously low one. It was at first thought that the number of nebulæ on Keeler's list, which was twelve, might be insufficient to deduce a trustworthy mean. But the publication of a much larger list of ninety-six nebulæ by Campbell and Moore has increased the mean radial velocity from 25 to 30 km./sec. It becomes very difficult to make any plausible scheme of cosmogony into which these nebulæ will fit. The low radial velocity of the helium stars is generally explained by their large mass on the assumption that the law of equipartition of energy applies to stellar velocities. There is, however, evidence of considerable mass in the case of the planetary nebulæ also. Campbell noted spectroscopic evidence of rotation in several cases. Combining these with van Maanen's parallaxes, Herr Ludendorff finds values for the masses of four planetaries as 14, 19, 162, and 28, that of the sun being unity. In view of this difficulty, he re-examines the evidence that spectroscopic binary systems give of the masses of the B stars, and states that it appears that those with the largest mass have also the largest radial velocity, and that the same rule appears to hold for the Wolf-Rayet stars.

While this result may help to bridge the gulf between the planetaries and kindred types of stars, it only removes one difficulty to create another. It remains to give a reasonable explanation of the increase of velocity with mass, which is quite opposed to preconceived ideas.

Our Conceptions of the Processes of Heredity.*

By MISS E. R. SAUNDERS, F.L.S.

II.

THE behaviour of the sex-chromosomes as here outlined suffices to account for the occurrence of sex-linked inheritance, but the relations found to hold between one sex-linked character and another need further explanation. If a cross is made involving two sex-linked characters, the F_1 females when tested by a double recessive male are found to produce the expected four classes of gametes, but not in equal proportions, or in the same proportions in the case of different pairs of sex-linked characters. Partial linkage (coupling) occurs of the kind which has already been described for the stock and the sweet pea. The parental combinations predominate, the recombinations ("cross-overs") comprise the smaller categories. The strength of the linkage varies, however, for different characters, but is found to be constant for any given pair. Since the sex-linked factors are by hypothesis carried in the sex-chromosomes, a clean separation of homologous members at meiosis should result in the characters which were associated in the parents remaining strictly in the same combination in each succeeding generation. The fact that this is not the case has led Morgan to conclude that an interchange of chromosome material must take place at this phase among a proportion of the gametes, and that the percentage of these "cross-overs" will depend on the distance apart of the loci of the factors concerned. This phenomenon of linkage may also be exhibited by pairs of characters which show *no* sex-linkage in their inheritance. The factors involved in these latter cases must presumably, therefore, be disposed in one of the chromosomes which is not the sex-chromosome.

To this brief sketch of the main points of Morgan's chromosome theory must be added mention of the extremely interesting relation which lends strong support to his view, and the significance of which seems scarcely to admit of question, viz. that in *Drosophila ampelophila* there are four pairs of chromosomes, and that the linkage relations of the hundred and more characters investigated indicate that they form four distinct groups. It is scarcely possible to suppose that the one fact is not directly connected with the other. The interesting discovery of Bridges (*Journ. Exper. Zool.*, vol. xv., 1913) that the appearance of certain unexpected categories among Drosophila offspring, where females of a particular strain were used, coincided with the presence in these females of an additional chromosome adds another link in the chain of evidence. On examination it was found that in these females the X chromosome pair occasionally failed to separate at the reduction division, and, consequently, that the two XX chromosomes sometimes both remained in the egg, and sometimes both passed out into the polar body. Hence there arose from fertilisation of the XX eggs some individuals containing *three* sex-chromosomes, with the resulting upset of the expectation in regard to sex-limitation of characters which was observed.

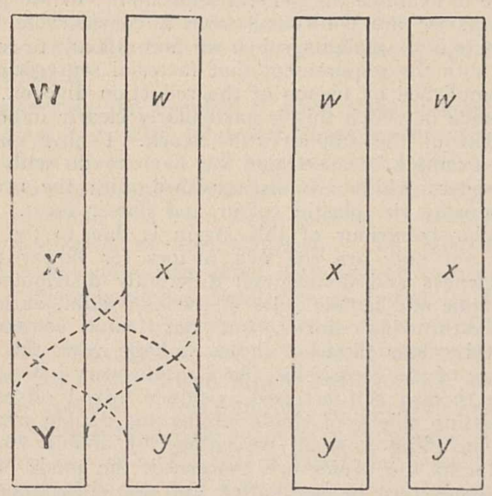
It, however, remains a curious anomaly that in the cross-bred Drosophila male no corresponding crossing-over of linked characters, whether associated with the sex-character or not, has yet been observed. His gametes carry only the same factorial combinations which he received from his parents. For this contrast in the behaviour between the sexes there is at present no explanation. The reverse condition has been described by Tanaka (Journ. Coll. Agr., Sapporo, Japan, 1913–14) in the silkworm. Here interchange takes place in the male, but not in the female.

It must, then, be acknowledged that Morgan's interpretation of the cytological evidence has much in its favour. The striking parallel between the behaviour of the chromosomes and the distributional relations of Mendelian allelomorphs is obvious. The existence in *Drosophila ampelophila* of four pairs of chromosomes and of four sets of linked characters can scarcely be mere coincidence. The employment of the smaller physical unit in accounting for the reshuffling of characters in their transmission commends itself in principle. The necessity for postulating the occurrence of some orderly irregularity in the hereditary process in order to explain the phenomenon of partial linkage is, it will be seen, inherent alike in both theories. When, however, we come to examine the general applicability of Morgan's theory, we are confronted with a considerable body of facts among plants which we find difficult to reconcile with the requirement that factorial segregation is accomplished by means of the reduction division. An instance in which this is particularly clearly indicated is that of the sulphur-white stock. I have chosen this example because here we have to do with two characters which are distinguished with the utmost sharpness, viz. plastid colour and flower form. The peculiar behaviour of this strain is due to the fact that not only are the two factors for flower form (singleness and doubleness) differently distributed to the male and female sides of the individual, as in all double-throwing stocks, but the factor controlling plastid colour likewise shows linkage with the sex-nature of the germ-cells. As a result every individual, even though self-fertilised, yields a mixed offspring, consisting chiefly of single whites and double creams, but including a small percentage of double whites. So far as the ovules are concerned, the mode of inheritance can be accounted for on either theory. According to the reduplication hypothesis, the factors XY, producing singleness, and W, giving white plastids, are partially coupled so as to give the gametic ratio on the female side 7 WXY : 1 WX*y* : 1 *wx*Y : 7 *wxy* (or possibly 15 : 1 : 1 : 15).[1] On the chromosome scheme the factorial group WXY must be assumed to be disposed in one member of the bivalent chromosome formed at meiosis, the corresponding recessive allelomorphs *wxy* in the other. If the three factors be supposed to be arranged in the chromosome in alphabetical order, and if, on separation, a break take place between the loci of the two factors for flower form (as shown), so as to give "cross-overs" of Y and *y* in about 12 per cent. of the gametes, the occurrence of such "cross-overs" would fulfil the required conditions. But the case of the pollen presents a distinct difficulty on this latter view. The sulphur-white stock is distinguished from both the Drosophila and the Abraxas type by the fact that none of the male germs carry either of the dominant characters. In place of the XX—XY form of sex-linked inheritance in the former type and the WZ—ZZ in the latter, we should need to regard this form as constituting a new class, which we might represent as DR—RR, thus indicating that both members of the bivalent chromo-

* From the opening address of the President of Section K (Botany) delivered at the Cardiff meeting of the British Association on August 24. Continued from p. 227.

1 The letters X and Y are used here to denote particular factors, not, as in Morgan's scheme, the entire sex-chromosome.

some on the male side appear to be inert and able to carry only the recessive characters, and hence are represented as RR, in contrast with the DR pair of the female side. By this formula we can indicate the behaviour of the several double-throwing strains. It is, besides, becoming clear, I think, from recent results that there is no "crossing-over" of these factors on the male side in the F_1 cross-breds. But the real difficulty is to explain why these factors are confined to the female side in the ever-sporting individual. This may result from aberrant behaviour or from loss of chromosomes at some point in pollen development. On this point I hope that evidence will shortly be available. Failing such evidence, the presumption is that the elimination of XY (and in one strain of W) must have taken place *prior to*, and not *at*, the moment of the maturation division. Morgan's proposal to fit the pollen into his scheme for Drosophila by having recourse to hypothetical lethal factors does not appeal to the observer, who finds the pollen all uniformly good and every ovule set. Other examples suggesting premeiotic segregation can be quoted, notably cases among variegated plants and plants showing bud sports, where somatic segregation appears to be of regular occurrence.



Ovules Pollen

It has been argued from time to time that any scheme representing the mechanism of heredity which leaves out of account the cytoplasm must prove inadequate. This general statement has been expressed in more definite form by Loeb ("The Organism as a Whole," 1916), who holds that the egg cytoplasm is to be looked upon as determining the broad outlines—in fact, as standing for the embryo "in the rough," upon which are impressed in the course of development the characteristics controlled by the factors segregated in the chromosomes. The arguments in favour of the view that the cytoplasm, apart from its general functions in connection with growth and nutrition, is the seat of a particular hereditary process are mainly derived from observation upon embryonic characters in certain animals, chiefly Echinoderms, where the inheritance appears to be purely maternal. It has been shown, however, that such female prepotency is no indication that inheritance of the determining factors takes place through the cytoplasm. Other causes may lead to this result. It has been observed, for example, that hybrid sea-urchin larvæ, which at one season of the year were maternal in type, at another were all paternal in character, showing that the result was due to some effect of the environment. Again, where the hybrid plutei showed purely maternal characters it was discovered by Baltzer (*Archiv für Zellforschung*, vol. v., 1910) that in the earliest mitoses of the cross-fertilised eggs a certain number of chromosomes fail to reach the poles, and are, consequently, left out of the daughter nuclei. The chromosomes thus lost probably represent those contributed by the male gamete, for in both parents certain individual chromosomes can be identified owing to differences in shape and size. After this process of elimination, those characteristic of the male parent could not be traced, whereas the one pair distinctive of the female parent was still recognisable. In the reciprocal cross where the first mitosis follows a normal course the embryos are intermediate in regard to the character of the skeleton, thus affording proof of the influence of the male parent. Another type of case is found in the silkworm. Here a certain rate-character determining the time of hatching out of the eggs has been shown to exhibit normal Mendelian inheritance, the appearance that it is transmissible by the female through the cytoplasm alone being delusive. The eggs are always laid in the spring. According as they hatch out immediately so that a second brood is obtained in the year or do not hatch out for twelve months, the female parent laying the eggs is described as bivoltin or univoltin. Now the length of interval before hatching is obviously an egg-character, and therefore maternal in origin. Consequently, when a cross is made between a univoltin female and a bivoltin male the eggs laid are not cross-bred in respect of this character, any more than the seed formed as a result of a cross is cross-bred in respect of its seed-coat, which is a maternal structure. The silkworm mother being univoltin, the eggs will not hatch out until the following spring. The F_1 mother will, in turn, lay eggs which again take twelve months to hatch, since the long-period factor is the dominant. It is not until the eggs of the F_2 generation are laid that we see the expression of the character introduced by the bivoltin father. For some of the egg batches hatch at once, others not for twelve months, showing that of the F_2 females some were univoltin and some bivoltin, and hence that the egg-character in any generation depends upon both the maternal and the paternal antecedents of the female producing the eggs.

Consequently, in the case of an egg-character the effects of inheritance must be looked for in the generation succeeding that in which the somatic characteristics of the zygote become revealed. We find, in fact, that in almost all instances where the evidence is suggestive of purely cytoplasmic inheritance, fuller investigation has shown that the explanation is to be found in one of the causes here indicated. The case of some plants where it has been established that reciprocal hybrids are dissimilar still, however, remains to be cleared up. We know nothing as yet of the cytology of these cases, and it is not improbable that the interpretation may be found in some aberrant behaviour of the chromosomes. An instance in a plant type where a definite connection appears traceable between chromosome behaviour and somatic appearance has been recently emphasised by Gates (*New Phytologist*, vol. xix., 1920), who attributes the peculiarity of the *lata* mutation in Œnothera (which has arisen as a modification at different times from each of three distinct species) to an irregularity in meiosis in the germ mother-cells whereby one daughter-cell receives an extra duplicate chromosome which is lacking in the sister-cell. The cell with the extra chromosome fertilised by a normal germ produces a *lata* individual. On the chromosome view every normal fertilised egg contains a double set of chromosomes, each carrying a complete set of the factor elements. Hence, if some of the one set become eliminated, we can still imagine that a normal, though undersized, individual might develop. The converse relation, where increased size goes with multiplication of chromosomes, was discovered by Gregory (Proc. Roy. Soc., B, vol. lxxxvii., 1914) in a Primula, and occurs also in *Œnothera gigas*, a mutant derived from *Œ. Lamarckiana*. It is interesting in this connection to recall the results obtained by Nemec (*Jahrb. f. wiss. Bot.*, xxxix., 1904, "Das Problem der Begruchtungsvorgänge," 1910) as the result of subjecting the root-tips of various plants to the narcotising action of chloral hydrate. Under this treatment cells undergoing division at the time were able to form the daughter nuclei, but the production of a new cell-wall was inhibited. The cells thus became binucleate. If on recovery these cells were to fuse before proceeding to divide afresh a genuine tetraploid condition would result. So few cases of natural tetraploidy have thus far been observed that we have as yet no clue to the cause which leads to this condition.

The conclusions to which we are led by the considerations which have here been put forward are, in the main, that we have no warrant in the evidence so far available for attributing special hereditary processes to the cytoplasm as distinct from the nucleus. On the other hand, there is a very large body of facts pointing to a direct connection between phenotypic appearance and chromosomal behaviour. In animals the evidence that the chromosomes constitute the distributional mechanism may be looked upon as almost tantamount to proof; in plants the observations on Drosera, Primula, Œnothera, and Sphærocarpus are in harmony with this view. When we come, however, to the question of linkage and general applicability of the conception of "crossing-over" as adopted by Morgan and his school, we are on less certain ground. In Drosophila itself, the case which the scheme was framed to fit, the entire absence of "crossing-over" in the male remains unaccounted for, while the evidence from certain plant types appears to be definitely at variance with one of its fundamental premises. If segregation at the recognised reduction division is definitely established for animal types, then we must conclude that the sorting-out process may follow a different course in the plant.

The question as to what is the precise nature of the differences for which the Mendelian factors stand is constantly before the mind of the breeder, but we are only now on the threshold of investigation in this direction, and it is doubtful whether we can as yet give a certain answer in any single instance. Still less are we able to say what the actual elements or units which undergo segregation may be. In the case of such allelomorphic pairs as purple and red sap colour or white or cream plastid colour, it may be that the difference is *wholly qualitative*, consisting merely in the formation or non-formation of some one chemical substance. But the majority of characteristics are not of this hard-and-fast type. Between some the distinction appears to be one of *range*—to be quantitative rather than, or as well as, qualitative in nature, and range must mean, presumably, either cumulative effect or a force or rate difference. It may well be, for example, that with some change in physiological equilibrium accompanying growth and development, factorial action may be enhanced or accelerated, or, on the other hand, retarded or even inhibited altogether, and a regional grading result in consequence. Range in a character is not confined to, though a common characteristic of, individuals of cross-bred origin. It may be a specific feature, both constant and definite in nature. For example, a change as development proceeds from a glabrous or nearly glabrous to a hairy condition is not an unusual occurrence in plants. In the stock such a gradational assumption of hairiness is apparent no less in the homozygous form containing a certain weak allelomorph controlling surface character, when present with the factors for sap colour, than in those heterozygous for this or some other essential component. We see a similar transition in several members of the Scrophulariaceæ, *e.g.* in various species of Digitalis, in *Antirrhinum majus, A. orontium, Anarrhinum pedatum,* Pentstemon, and Nemesia. In perennials an annual recurrence of this change of phase may be seen, as in various species of Viola and in *Spiraea ulmaria*. In some, perhaps in all, of these cases the allelomorphs may stand for certain states of physiological equilibrium, or such states may be an accompanying feature of factorial action. A change of phase may mean an altered balance, a difference of rhythm in interdependent physiological processes. In the case, for instance, of a certain sub-glabrous strain of stock in which the presence of a single characteristically branched hair or hair-tuft over the water-gland terminating the midrib in a leaf otherwise glabrous is an hereditary character, it is scarcely conceivable that there is a localisation in this region of a special hair-forming substance. It seems more probable that some physiological condition intimately connected with the condition of water-content at some critical period is a causal factor in hair production, and that this condition is set up over the whole leaf in the type, but in the particular strain in question is maintained only at the point which receives the largest and most direct supply. In this same strain a leaf may now and again be found lacking this hydathode trichome in an otherwise continuous hair-forming series, an occurrence which may well result from a slight fluctuation in physiological equilibrium such as is inherent in all vital processes—a fluctuation which, when the genetic indicator is set so near to the zero point, may well send it off the scale altogether. If, as is not improbable in this and similar cases, we are concerned with a complex chain of physiological processes, investigation of the nature of the differences for which the allelomorphs stand may present a more difficult problem than where the production of a particular chemical compound appears to be involved. In such a physiological conception we have probably the explanation of the non-appearance of the recessive character in certain dominant cross-breds.

Up to this point we have treated of the organism from the aspect of its being a wholly self-controlled, independent system. As regards some characteristics, this may be regarded as substantially the case—that is to say, the soma reflects under all observed conditions the genetic constitution expressed in the Mendelian formula. Correspondence is precise between genotypic potentiality and phenotypic reality, and we have so far solved our problem that we can predict certainly and accurately the appearance of offspring, knowing the constitution of the parents. In such cases we may say that the efficiency of the genetic machine works out at 100 per cent., the influence of external environment at 0. Our equation somatic appearance = factorial constitution requires no correction for effect of conditions of temperature, humidity, illumination, and the like. But most somatic characters show some degree of variability. Phenotypic appearance is the outcome primarily of genotypic constitution, but upon this are superposed fluctuations, slight or more pronounced, arising as the result of reaction to environmental conditions. In the extreme case the genetic machinery may, so to speak, be put out of action; genotypic potentiality no longer becomes actual. We say that the character is not inherited. We meet with such an example in *Ranunculus aquatilis*. According to Mer (Bull. Soc. Bot. de France, i., 27, 1880), the terrestrial form of this plant has no hairs on the ends of the leaf-segments, but in the aquatic individual the segments end in needle-shaped hairs—that is to say, hairs of a definite form are produced in a definite region. Again, Massart (Bull. Jard. Bot. Bruxelles, i., 2, 1902) finds that in *Polygonum amphibium* the shoot produces characteristic multicellular hairs when exposed to the air, but if submerged it ceases to form them on the new growth. Every individual, however bred, behaves in the same manner, and must therefore have the same genetic constitution. In an atmospheric environment genotypic expression is achieved; in water it becomes physiologically impossible. A limitation to genotypic expression may in like manner be brought about by the *internal* environment, for the relation of the soma to the germ elements may be looked upon in this light. Thus in the case of a long-pollened and round-pollened sweet pea, Bateson and Punnett (Report to the Evolution Committee, Roy. Soc., ii., 1905) found that the F_1 pollen-grains are all long, yet half of them carry the factor for roundness. If we take the chromosome view, and if it be presumed that the factor for roundness is not segregated until the reduction division, the cytoplasm of the pollen mother-cells may be supposed to act as a foreign medium owing to a mixture of qualities having been impressed upon it through the presence of the two opposite allelomorphs before the moment of segregation. We should, consequently, infer that the round-pollen shape is produced only when the round-factor-bearing chromosome is surrounded by the cytoplasm of an individual which does not contain the long factor. If, further, we regard the result in this case as indicative of the normal interrelation of nucleus and cytoplasm in the hereditary process, we shall be led to the view that, whatever the earlier condition of mutual equilibrium or interchange between these two essential cell constituents may be, an ultimate stage is reached in which the *rôle* of determining agent must be assigned to the nucleus.

In conclusion, I would appeal for more organised co-operation in the experimental study of genetics. It is a not uncommon attitude to look upon the subject of genetics as a science apart. But the complex nature of the problems confronting us requires that the attacking force should be a composite one, representing all arms. Only the outworks of the fortress can fall to the vanguard of breeders. Their part done, they wait ready to hand over to the cytologists, with whom it lies to consolidate the position and render our foothold secure. This accomplished, the way is cleared for the main assault. To push this home we urgently need reinforcements. It is to the physiologists and to the chemists that we look to crown the victory. By their co-operation alone can we hope to win inside the citadel and fathom the meaning of those activities which take shape daily before our eyes as we stand without and observe, but the secret of which is withheld from our gaze.

The Air Conference, 1920.

THIS Conference, consisting of representatives of aviation in all its many branches, lasted three days, and was organised by the Air Ministry in order to bring together persons interested in the subject in conditions under which urgent problems could be freely discussed with the knowledge that resolutions of the conference arrived at after such discussion would be welcomed by the Ministry as assisting the Secretary for Air in his endeavour to promote in every way the national interests depending on aeronautics.

At the luncheon at which he presided on the first day of the conference, Mr. Churchill, Secretary of State for War and Air, made this abundantly clear. The future of military aviation, he pointed out, depended on the widespread development of civil aviation. "We," he continued—"I am speaking for the Government—intend to help civil aviation by every means in our power. You know our resources are limited, but I hope the day is coming when it will be possible for us to increase to some extent the resources which are available for the development of civil aviation. I do not think three years should be too much to reconstruct the Air Service, so that fathers of every grade in our national life shall be glad to send their sons into it with the feeling that they are giving them a good start in life, with the possibility of a fine career."

In the main (he added), civil aviation must fly by itself, and the function of the Government would be to facilitate its action—to liberate, stimulate, and encourage its action. The Air Estimates had shortly to be considered. He excluded no solution which would be likely to help us through the two or three difficult years ahead of us. No one could have the slightest doubt about the ultimate future. To suppose that the world, having got into the air, was ever going to get out of it, was as absurd as to suppose that the world, having taken to steamships, was going back to schooners and sailing ships. They were gathered there to drive away pessimism and to assert their view that a great and bright future was opening for British aviation.

The conference was held, by the courtesy of the Lord Mayor, in the council chamber of the Guildhall on October 12, 13, and 14, and the room was well filled during all the sessions. The Lord Mayor himself welcomed the members, and in a few well-chosen words expressed his sense of the importance of the occasion. He then gave place to Lord Montagu of Beaulieu, whose interest in aviation is known to all. On the second day Lord Weir of Eastwood, President of the Air Council during a most critical part of the war, presided; while on the third day the chairmen were, in the morning, Lord Beatty and, in the afternoon, Lord Londonderry, Under-Secretary of State for Air, who had been detained in Ireland and was unable, in consequence, to be present at the opening sessions.

The business details were admirably arranged. A paper was read by some recognised authority on the subject under discussion, one or two invited speakers followed, and then the discussion was open to all who cared to contribute.

The conference was fortunate in that three out of the six papers were read by the members of the Air Council responsible for the subjects considered, while other members of the Council took part in the discussion. The audience thus learnt at first hand official views on these matters.

The conference was widely representative; invitations had been sent not only to airmen, to designers and builders of aircraft of all kinds, and to the representatives of aeronautical organisations, but also to the Air Attachés of foreign Powers, to members of learned societies, to representatives of various Government Departments, and to the secretaries of the Transport Workers' Federation and of the United Vehicle Workers.

Turning now to the details of the meeting, the first day was devoted to civil aviation and air services and to the operation of civil aircraft in relation to the constructor.

Major-Gen. Sir Frederick H. Sykes, Controller-General of Civil Aviation, was the author of the first paper. He dealt in detail with the growth and present position of air-mail goods and passenger services (*a*) in the United Kingdom, (*b*) between London and the Continent, (*c*) in foreign countries, and (*d*) in the British Dominions and Colonies. Under (*b*) he gave a most valuable series of statistical tables, showing the amount and type of the general traffic, the number of arrivals in and departures from the United Kingdom, the number of letters carried, customs returns, and the number of accidents. Details as to the last were very striking; the dangers of air traffic are quite small, and it was stated during one of the discussions that all the accidents for some time, so far as could be known, had originated in the failure of the engine or of one of the engine accessories.

A large map brought clearly before the eyes of all the routes actual and projected, and information was given with regard to the proposed services from Paris to Prague, Warsaw, and the Balkan States, and from London to Copenhagen, Hamburg, and Scandinavia. The importance of Egypt to the Imperial routes to Africa and the East was very clearly shown. This point was stressed later by Sir Hugh Trenchard in his paper.

The second part of Sir F. Sykes's paper dealt with the factors contributing to successful air services, and the author concluded a most valuable contribution with suggestions for the future development of those services. Referring to the recommendations of Lord Weir's Advisory Committee on Civil Aviation, he said that the more experience he obtained and the more he considered the case in regard to the scheme of subsidies which Lord Weir's Committee recommended, the more clear he was that those recommendations were sound. He appreciated the argument in favour of allowing industry to stand on its own feet, but he was strongly of opinion that civil aviation must not be allowed to die for lack of direct assistance, the need for which would only be temporary, that was to say, during the period —three to five years—during which old material was being used up, and while new and really suitable types were being evolved. Without this small stimulus it would be very difficult for transport concerns to show enterprise and vigour, even if they could live during the next year or two.

The conference was greatly indebted to Mr. White Smith, the able and energetic chairman of the Society of British Aircraft Constructors, for his paper in the afternoon. After discussing the present lack of financial success in operating air services and its main causes, and emphasising the need for improved trustworthiness, while pointing out the high standard already attained, Mr. Smith proceeded to give a series of most important statistics as to the costs of operating commercial air services, showing the capital expenditure involved in the use of various types of aircraft, the operating costs, and the necessity of improved design as shown by the operating costs.

The tables which accompanied the paper will, no doubt, be published in full, and, while they may need correction in some details—Mr. Handley Page in the course of the discussion did criticise some of the figures relating to one of his machines—they form a most valuable mine of information and must prove of immense service. The economic advantage of the large high-powered machine is very clearly brought out.

The second day was devoted to research. Between the morning and afternoon sessions on that day a most interesting visit was paid to the Croydon Aerodrome to see the arrangements for the departure and arrival of aircraft to and from the Continent and to learn something of the working of an air-port. A large number of the most modern types of machine were on view, and many members had their first flight.

Lord Weir was in the chair, as was specially fitting, for during his tenure of office as President of the Air Council he appointed a Committee on Education and Research, and thus led up to the scheme connected with the Zaharoff professorship which is now being developed at the Imperial College.

Air Vice-Marshal E. L. Ellington's paper gave a full account of the present position of aircraft research and contemplated developments—questions which, as Director-General of Supply and Research, he was specially qualified to discuss. He dealt in the case of aircraft heavier than air with trustworthiness, controllability, performance, safety and comfort, and cheapness. Particulars were also given as to airships and kite-balloons.

Capt. Barnwell, in the afternoon, dealt very fully with the technical aspects of Service and civil aviation. In the course of the discussion reference was made to the important work carried out during the war by the scientific staffs of the Royal Aircraft Establishment and the National Physical Laboratory, and the fear was expressed lest the reductions which had taken place at Farnborough were on such a scale as to impair the efficiency of the research work. It was also pointed out by several speakers that, in addition to a research staff in the scientific establishment, it is essential that builders of aircraft should be in a position to retain the services of a staff of skilled designers, whose work is necessary before the results of research can be made use of in improved machines.

During the afternoon session two resolutions were moved and carried *nem. con.* The first, moved by Major-Gen. Sir R. Ruck, was to the effect "That the Air Conference of 1920 desires to record its emphatic opinion that the rapid development of civil aerial transport is vital to the interests of the Empire, not only as a means of developing its communications, but also as an essential element in its defence, and the conference endorses the recommendations of Lord Weir's Advisory Committee on Civil Aviation and urges their adoption by the Government"; while the second, moved by Prof. Bairstow, urged that sufficient means for researches, both in the Government establishments and elsewhere, should be provided, and that steps should be taken to enable constructors to retain the services of a number of skilled designers.

On the first day a resolution had been carried urging that certain mails should be conveyed by air.

The work of the third day was no less interesting and important. In the morning Air-Marshal Sir H. M. Trenchard, Chief of the Air Staff, spoke on the aspects of Service aviation, the problem of war in the air. He discussed at some length the prospects of young officers in the Force, pointing out that all cannot be taken on permanently, and suggesting that in some cases four years in the Force might take the place of the university. In conclusion, he said that the power of aircraft to cover great distances at high speed, their instant readiness for action, their independence of physical communications, their indifference to obstacles, and the inability of an enemy unprovided with an Air Service to counter their attack, combined to encourage their use more often than the occasion warranted. The power to go to war at will was apt, in fact, to result in a thoughtless application of that power.

In the afternoon session Sir Trevor Dawson dealt with the future of airships. He thought there would be no difficulty in producing ships to travel at eighty miles an hour, thus giving an average speed, allowing for the wind, of sixty miles, and expressed the view that there would be no difficulty in running a regular trans-oceanic service once the trustworthiness and saving of time had been demonstrated. In his opinion, the time to the Cape might thus be reduced from eighteen days to five, and that to India from sixteen days to four or five.

Sir James Stevenson, Civil Member of the Air Council, stated towards the end of the discussion on behalf of the Ministry, and he thought he might say on behalf of the Government, that if a commercial syndicate would offer to take their airships and develop them as a national undertaking, it would be an easy matter to get the Government to agree to give them not only airships, but also aerodromes and the other assets.

A further resolution was passed asking the Government to reconsider the report of the Civil Aerial Transport Committee and the recommendations it contained with the view of adopting such as might now apply.

The conference, which was remarkable in many ways, closed with the usual votes of thanks, and in replying, Lord Londonderry, chairman at the concluding session, expressed the appreciation of the members for the help afforded by the Press.

There is no doubt that aviation, particularly civil aviation, will benefit from the discussions which have taken place, and still more from the fuller consideration which can be given to the papers when published in full. The hope was expressed by many that the conference may become an annual event, and thus afford a regular opportunity for the ventilation of questions of great public interest.

R. T. G.

Annual Report of the Meteorological Committee.[1]

THE Report of the Meteorological Committee for the year ending on March 31 last marks the end of a definite stage in the development of the British State Meteorological Service. During the year under review four notable developments occurred: (1) The Office became attached to the Air Ministry instead of being in direct connection with the Treasury; (2) the work of the British Rainfall Organization was incorporated with that of the Office; (3) the co-ordination of the Services of the Navy, Army, and Air Force, which developed during the war, was begun; and (4) inter-Dominion and international co-operation in meteorology, which had largely been in abeyance during the war save for military purposes, began to take a more definite shape. One might add as a fifth important occurrence that the period of service of Sir Napier Shaw as Director of the Office came to an end at the close of the year, though he consented to remain in office until the appointment of his successor was carried through.

An appendix to the report gives the recommendations of the Sub-Committee of the Research Committee of the Cabinet which was appointed to lay down principles on which the State Meteorological Services should be reorganised. It is satisfactory that the wisdom of having one State organisation has been realised, and that while the constitution of the Committee provides for adequate representation of public Departments, the Royal Society and the Royal Society of Edinburgh are also represented. The constitution of the Committee provides that the Controller-General of Civil Aviation shall act as its chairman, but on the representation of the Royal Society it was agreed that a vice-chairman should be elected from amongst the representatives of scientific societies. The Director of the Office, who under the old *régime* was chairman of the Committee, ceases to be a member, but "will act generally as adviser to the Committee on all meteorological and geophysical subjects," and is made responsible for bringing before the Committee "all matters of importance relating to the application, progress, and development of the science of meteorology in which the Meteorological Service might share."

The British Rainfall Organization had a separate existence for sixty years, but it had for some time been evident that incorporation with the growing State Service was desirable, and indeed necessary. On the retirement of Dr. H. R. Mill from active duty as Director of the Organization, the transfer was carried through. Mr. Carle de S. Salter, who was associated with Dr. Mill, has been appointed superintendent of the rainfall work of the Committee, so that the continuity of the work and of the relations with voluntary observers is assured.

The overlapping of the various Meteorological Services which developed during the war was perhaps more apparent than real, but there cannot be two opinions as to the need for co-ordination under a central authority. The Navy, the Army, and the Air Force each had quite distinct and separate needs which were met by separate establishments, but the only serious overlapping which occurred arose from the creation of separate headquarters in London, provided with a staff for forecasting, and each collecting similar information. This overlapping has now, fortunately, disappeared, and a start has been made with the establishment of local civil distributive stations to take the place of war-time stations for supplying to aircraft, shipping, and the general public information derived from detailed study of the weather in a form suitable for practical use. One interesting development in this connection is the provision of an effective local organisation for Scotland, with headquarters in Edinburgh and a local advisory committee.

The effect of the war in bringing to light the value of meteorological information is well gauged by the increase in the *personnel* of the Office. In 1914 the staff of the Office comprised about 20 professional and 60 clerical and technical assistants, while on March 31, 1920, the establishment was 97 professional staff and 278 clerical and technical staff.

The inter-Dominion and international arrangements are still far from being stabilised, but one of the most important developments was a Conference of Dominion meteorologists, which concluded with the following resolution: "That this conference of representative meteorologists of the British Empire assembled together for the first time agree to continue as an association for the exchange of their views from time to time by correspondence upon scientific matters concerning the achievements, requirements, and organisation of their Services, and hereby elect Sir Napier Shaw their first president, and invite the members to submit rules for the guidance and acceptance of the

[1] Fifteenth Annual Report of the Meteorological Committee to the Lords Commissioners of His Majesty's Treasury for the Year ended March 31, 1920. Pp 88. (Cmd. 948.) (London: H.M. Stationery Office, 1920.) Price 9*d.* net.

association." This conference had been preceded by the international meeting in Brussels of representatives of the scientific academies of the Allies, at which meteorology was amongst the subjects considered. A Geodetic and Geophysical Union was set up, one of its branches being meteorology with Sir Napier Shaw as chairman and Dr. Marvin (of the U.S. Weather Bureau) as secretary. A meeting in Paris followed, summoned by the French Government, at which a new international meteorological committee was appointed, with Sir Napier Shaw as president, in continuation of the old committee. A further complication arises out of the convention relating to aerial navigation, which formed part of the work of the Peace Conference, and by Annexe G regulates "the collection and dissemination of statistical, current, and special meteorological information."

What shape international co-operation may ultimately take is sufficiently obscure, but it is satisfactory to know that Sir Napier Shaw, who has been responsible for so great a development in the past, is to continue to act as president of the new International Committee.

E. M. W.

Proposed British Institute for Geodetic Training and Research.[1]

By DR. E. H. GRIFFITHS, F.R.S., and MAJOR E. O. HENRICI.

GOOD maps are necessary for the development of a country, for such purposes as defining property boundaries, limits of mining and other concessions, and so on, as well as for such engineering purposes as railway, road, and canal schemes, hydro-electric schemes, water-supply, irrigation, etc. The importance of good charts, as well as of trustworthy information as to tides and currents, scarcely needs emphasising. An incorrect or out-of-date chart will cause losses due to delays to shipping, even if it does not lead to more direct loss. Anything that will assist in the production of up-to-date and accurate charts is of great and direct benefit to the shipping industry, and through it to the nation. Even when such work has once been completed there is no finality, as both maps and charts require periodical revision at more or less frequent intervals, according to circumstances.

The economical and speedy production of such maps and charts necessitates a thorough knowledge of the principles on which all survey work is based and of the best means of applying such principles under varying conditions. Apart from revision work, there is still a great deal of survey work waiting to be carried out, enormous areas still exist in the Empire which are surveyed very inadequately or not at all.

Very large sums have been misapplied in the past owing to a lack of appreciation of the principles which should underlie all survey work. The Egyptian Survey of 1878–88 cost some 360,000*l.*, and produced incomplete maps of some 2000 square miles. Almost the whole of the work had to be repeated in 1892–1907, when, owing to the adoption of proper methods, and in spite of many difficulties, some 13,000 square miles were satisfactorily mapped at a cost of less than 450,000*l.*

The methods to be adopted depend upon circumstances, the nature of the country, and the objects of the survey. The difficulties to be overcome vary in different parts of the world. The experiences of the various surveyors have been published in their records and reports, but these are not in an easily accessible form, nor is there any general index or summary to be found. The originals are circulated to a limited number of persons and institutions, and buried in libraries, even if their existence is not forgotten. When a new difficulty arises in any survey it has to be tackled *de novo*, though it is quite likely that similar circumstances have arisen before. In such a case it is probable that the surveyor in question does not know of it; and, even if the reports are accessible to him (which they frequently are not), the actual information he wants is most effectually buried. This leads to much waste of effort, as there is no central body to which he can refer.

As regards existing departments and institutions, the Dominion, Indian, and Colonial Surveys are all independent, and, broadly speaking, train their own staff. There are, however, good survey schools in some of the Dominions. The Ordnance Survey produces its well-known maps, which are revised periodically, and they are so complete that no extensive survey work is required by outsiders in this country. This accounts for the lack of attention paid to the subject outside Government Departments, but the result has been that the development of the science of surveying has largely stagnated in this country, the centre of the Empire.

There is, therefore, a distinct need for a school and institution in which students can be trained in the principles of survey work, and where the subject is studied as a whole. This school would also serve as a central information bureau, enabling the scattered surveyors of the Empire to keep in touch with developments, and to which they could apply for information and assistance.

It might seem at first sight that this could and should be undertaken by a Government Department, but this is scarcely possible for various reasons. There is no central authority which deals with the Government Surveys of the Empire, though a link is kept between the Colonial (as distinct from the Dominion) Surveys by the Colonial Survey Committee. The various Surveys and Departments naturally have to consider their own immediate needs first; they are usually short of funds, and consequently not in a position to carry out the work now being discussed. Even if a central authority were formed for this purpose, it could deal only with Government Surveys, and could not train surveyors and engineers for private work.

There seems little doubt that most of the Government Surveys would welcome a school from which they could recruit their staff and an institution to which they could apply for information, and which could keep them in touch with the activities and progress in other parts of the world.

The existence of such an establishment would also encourage the production of improved designs of instruments and the production of new time-saving devices; there have been many such improvements of late years, but mostly from abroad, *e.g.* invar tapes and wires for base measurement (France) and an improved levelling instrument (Germany). There are also many developments in view which require working out, *e.g.* the use of wireless time-signals for the determination of longitude in the field, survey from aircraft, etc. At present makers have little

[1] From an address on "The Urgent Need for the Creation within the Empire of a Central Institution for Training and Research in the Sciences of Surveying, Hydrography, and Geodesy," delivered to a joint meeting of Sections A and E at the Cardiff meeting of the British Association on August 27.

inducement to bring out new and improved patterns of instruments; their largest customers are engineers, who, as a rule, have had a very elementary training as surveyors, and are shy of adopting any new instrument or method.

The above remarks apply particularly to land surveying, but are largely true also of hydrographic work. India and Canada have their own Hydrographic Services, but apart from these the Hydrographic Department of the Admiralty has to deal with all the seas and coasts of the Empire, and also with such others as are not dealt with by their own Governments. The task is great, and the resources available are all too small for the work. Even in home waters there is much to be done, if only due to the changes continually taking place in all estuaries. Apart from the shifting of sandbanks, etc., much of the earlier work is not up to the standard of modern requirements.

There is no school where hydrographic surveyors can receive instruction in the principles and theory of their work, and no staff available for studying methods and instruments and bringing them up to date. The hydrographic staff of the Admiralty is recruited from volunteers amongst the younger officers of the executive branch of the Royal Navy who have passed in navigation. They learn their surveying in the surveying ships while work is in progress, and the staff of trained surveyors is at present so limited that it can give little instruction to the beginners. Many officers after serving in a surveying ship for two or more years return to ordinary duties afloat, or specialise in other branches where their knowledge of survey work is of great benefit to them. The remainder are advanced in rank *pari passu* with the officers of H.M. Fleet. The existence of a school where the theoretical side of the question could be studied would be of great benefit to all.

The principles involved in survey are the same whether applied by land or by sea, and the instruments largely the same. One establishment could usefully study and give instruction in both sides of survey work.

Survey cannot be carried out over large tracts of country without consideration of the science generally known as geodesy, which is really only survey as applied to the earth as a whole. The problems involved in this require not only world-wide data, but also high mathematical skill. Problems interconnected with these are those concerning the tides and terrestrial magnetism, both of great importance to navigation. These, again, are connected with the study of the earth's structure in its wider sense, and so with seismology and geology. These problems may all be summed up in the word "geophysics."

While a knowledge of geophysics is not necessary for every surveyor, no survey authority can function satisfactorily without it. At the same time few such authorities have the staff available for its proper study. A central institution which could be referred to for information would add greatly to the efficiency of the survey authorities.

The need for a British geodetic institute is admitted by all who are acquainted with the nature and importance of the pressing Imperial and scientific problems which depend on the great surveys. The study of such problems has hitherto been left, in characteristic British fashion, to the initiative of enthusiastic individuals or neglected altogether. Take, for example, the case of the tides—so vital a matter to our sailors. While the late Sir George Darwin still lived it could at least be said that one master-mind was devoted, with some approach to continuity, to the study of the great problems which must be attacked and solved if tidal prediction is to advance beyond its present elementary and scrappy state, but since his lamented death in 1912 the subject has lacked attention.

At the request of the British Association, Prof. H. Lamb recently reviewed the whole situation with regard to tides, and in a masterly report indicated the number and importance of the problems awaiting solution. Problems comparable in insistence are connected with the land surveys of our Empire, and a similar review of the general situation, also initiated by the British Association under the stimulus of war, directed attention to the pressing need for some determined effort to attack them. The report opened with this cogent sentence: "There is no institution, association, or department whose business it is to deal with the higher geodesy." Consideration of the report by a special committee, afterwards enlarged, developed in the direction of urging the establishment of a geophysical institute. The need for such an institute has been formally recognised as urgent by the Conjoint Board of Scientific Societies (formed during the war for the study of urgent questions), which appointed a small executive committee (which included the president and secretary of the Royal Society) to press for the immediate establishment of such an institute.

We think it would be difficult to find in any scientific matter greater unanimity amongst all the authorities concerned therein. We trust that sufficient evidence has been given as to both the national importance of the subject and the urgency of the need for action. We await the advent of the *vivus benefactor*, for, as already indicated, there is a consensus of opinion that such an institution should be established within a university by private benefactions, although assistance might, as a consequence, be forthcoming from national funds. The wide ramifications of survey, geodesy, and geodynamics into mathematical, physical, and engineering sciences call for their study in a university rather than in a departmental atmosphere.

The Imperial College as a University of Science and Technology.[1]

THE real issue is whether a useful and worthy type of university can be erected on the comparatively narrow basis of a limited group of studies. In both primary and secondary education there has been a growing tendency to evolve several distinct types of school. Is it only university cloth that must always be cut to the same pattern? If we consider the enormous complexity of modern civilisation and the degree and extent to which it is based upon science, we must think that, in the region of university education, the time has come for a further differentiation of functions, and that the first step in this development should be the creation of a new type of university based upon pure and applied science, not to supersede, but to supplement, the existing type. The normal type of university, embracing a great number of faculties, would still remain, and ought to be, the predominant and prevalent type.

Science, pure and applied, from its nature, is worthy to rank in educational and cultural values with other

[1] Synopsis of a paper on "The Proposed University of Science and Technology: Can a Useful and Worthy University be Based on Pure and Applied Science?" read before the Old Students' Association of the Royal College of Science on October 12 by J. W. Williamson.

university studies. It is qualified not less by its extent to form a foundation neither flimsy nor narrow for a university superstructure. During the past half-century science has developed not only intensively, but also so extensively as to cover vast fields of knowledge previously undreamt of. The result has been the creation of new sciences, differentiated by their own specialised literature, methods, instruments, practitioners, and societies. The step from a faculty of science in a university to a university of science and technology is in line with the steps that have given us to-day separate professors of inorganic chemistry, organic chemistry, physical chemistry, and metallurgy in place of the one-time professor of chemistry whose ambit included all these subjects.

The Imperial College was styled "Imperial" with deliberate intention from the first. From its charter it is clear that it is set to perform real university work of the highest order in science and technology. There is, moreover, a special need which the Imperial College is peculiarly marked out to fill, but which it cannot do adequately unless it has the status of a university with the power to confer degrees. A large and increasing number of students from the overseas Dominions, after completing their courses in the Dominion universities and technical colleges, go to Europe or America to take up what is essentially post-graduate scientific work, especially in its application to industry. The courses of the Imperial College completely satisfy their needs in this direction, better probably than those of any university in the United Kingdom, but the college in its present status cannot give to such overseas graduates who go through the full post-graduate courses anything more than the college diploma. On the other hand, Zurich and some American and German cities have institutes of technology granting degrees. It has already been pointed out that in the industrial and professional worlds the university degree is recognised as a hall-mark and has a commercial value. The consequence is that there is a growing tendency among these overseas graduates and scientific students to go to America instead of to England, so that they may have a veritable and recognised technological degree, and not a mere diploma, to show for the work they do; and the Imperial College is thus being starved of a type of student it was deliberately charged at its foundation to receive and train. The loss, and even the danger, to the Empire of such a tendency are obvious.

Such a university of science and technology would be the keystone of the arch of our technical colleges and polytechnics; it would influence and enlarge the conceptions of technical and scientific education throughout the country and the Empire; and it must be of great benefit to the modern industrial research movement by raising the status of technological science, by pouring out a stream of the most highly trained technologists and research workers, and by being the natural head and crown of the national recognition, so long and disastrously delayed, of the vital importance of scientific research, especially in its application to industry.

There is nothing intentionally or inherently injurious to the University of London or to any other university in the proposal to give a university status to the Imperial College. To propound as a sort of unalterable principle that for Greater London, with a population as large as that of Canada and twice as large as that of Switzerland, there must be one, and only one, university savours rather of an academic dogma than of a balanced educational perspective. The Imperial College and the University of London should be set free to work out each its own future independently of the other. They have divergent aims and interests, and it would be an injurious mistake to force them into an unworkable *mésalliance*.

Agriculture in Egypt and Cyprus.

AGRICULTURAL operations in Egypt are entirely dependent upon the Nile, and all extensions in the direction of taking fresh land into cultivation depend upon the way in which more profitable use can be made of the waters of the Nile and of the fertilising mud that it carries with it. The construction of the Aswan reservoir has rendered it possible to retain much of the flood-water, but even now a large amount is wasted that would aid in the expansion of the cultivated area if it could be conserved. Mr. G. C. Dudgeon (Bull. Imp. Inst., vol. xvii., No. 3) sets forth a statistical estimate of the possible and available water-supply, together with the theoretical annual consumption of water for the chief crops. It is suggested that if certain proposed schemes of reclamation were carried out, the whole water requirements of Egypt would be met by less than 60 per cent. of the mean annual discharge of the Nile.

Under the auspices of the Egyptian Ministry of Agriculture, special attention is being given to the various problems of crop and animal husbandry with the view of improving the agriculture of the country (*Agricultural Journal of Egypt*, vol. ix., 1919). The war emphasised the local needs, and revealed deficiencies in many directions, especially in labour, animals, and manures. Motor-tractor ploughing is now advocated, and the adoption of machine-threshing would result in better quality grain and flour, as the present native system introduces a large percentage of mud into the product which cannot be removed by any known mechanical means. As cattle manure is being used more and more as fuel, increased production is now dependent chiefly upon the use of chemical fertilisers, and there are possibilities that if cheap sulphuric acid could be produced, an appreciable supply of sulphate of ammonia and superphosphate could be turned out. Attempts are being made to improve the chief crops, and experiments with various rust-resisting Australian wheats show that some of these offer distinct possibilities for Egyptian agriculture, and are worthy of further trial.

The most important crop is cotton, so much so that the tendency is to increase the area devoted to it at the expense of that utilised for food production, and it is now necessary to import a larger proportion of food than in earlier years. The area under cotton increased steadily to a maximum in 1914 at a greater rate than the total cultivated area, but for the last twenty-three years the average yield per *feddan* has steadily decreased. This, curiously enough, is attributed chiefly to the improvement in the water-supply. The increased water-supply has not been accompanied by sufficiently increased drainage; the soils become saturated and the subsoil-water remains at a high level—a condition of things that is most unsuitable for the satisfactory growth of the cotton plant. Further, the additional supply of water has rendered possible the extension of cotton-growing to new lands which are less fertile than those which have been longer under cultivation, and the lower yields obtained have reduced the general averages. The varieties grown also influence the yield, as many recently introduced ones, possessing other very desirable qualities, give smaller crops than the older kinds.

Since its comparatively recent introduction into Egypt the pink boll-worm, *Pectinophora* (*Gelechia*) *gossypiella*, has so rapidly increased that it has for some years been the chief insect pest of cotton. Much scientific work is being done on its life-history and on its effect on the cotton crop with the view of attacking the pest in the most effective manner, as it may now be classed on a par with the Phylloxera of vines for destructiveness. Field experiments indicate that the effect of Gelechia attack may be rendered less harmful by reducing the water-supply in July and stopping it altogether after the first week in August, as by this means the yield of cotton is increased and the crop ripens earlier.

During the last sixteen years the farmers of Cyprus have exhibited an enlightened and receptive attitude towards modern agricultural methods, with the result that considerable improvements have taken place in the agriculture of the island. These changes are set forth by Mr. W. Bevan in the Bulletin of the Imperial Institute (vol. xvii., No. 3, pp. 302–58), and the resources and possibilities of the island are briefly summarised. About 1,200,000 acres are under cultivation, but another 770,000 acres are either under forest or could be cultivated. The average rainfall is about 20 in. per annum, and the climate, especially in the plains, shows considerable extremes of temperature. Agriculture is the main industry, but methods and appliances are behind the times, though improvements are being effected through the activities of the Agricultural Department. Irrigation is essential, and if a satisfactory solution of the water problem could be reached, large fertile areas which now have to remain fallow could be brought under cultivation for growing cotton and other similar crops and for extending vegetable and fruit culture. A considerable amount of stock-raising is carried on, sheep-rearing being an important industry. Cheese and butter are made from sheep's and goat's milk, largely for home consumption, though some is exported to Egypt. Poultry-farming could be made very profitable, as the climate and food-supply are suitable, but ignorance of proper management at present hinders the industry from prospering.

The chief cereals grown are wheat, barley, and oats, though maize and rye have been introduced during the last few years. Fruit-growing is of much importance, and the export trade in this respect is considerable, some amount of wine and spirits also being produced and sent abroad. Market-gardening is receiving much attention, as there is a good demand in Egypt for fresh vegetables which are raised round the "ports" of Cyprus.

Heredity and Eugenics.

DR. R. RUGGLES GATES contributes to the latest number of the *Eugenics Review* a valuable essay on heredity and eugenics. "Probably in no other species of animal or plant does the number of differences between individuals approach the number to be observed in man." "It has now become a commonplace of observation that the *differences* between organisms, as well as their resemblances, are often inherited." Heredity includes both the entailment of parental variations and the possibility of new variations. A very interesting survey is taken of the inheritance of both physical and mental characters in man. Eugenic action should include, if only there were sufficient knowledge, (1) positive selection for desirable qualities, which are frequently dominant; (2) negative selection against undesirable recessive qualities which appear in collateral or ancestral lines, and may therefore be carried in the family germ-plasm; (3) isolation of individuals having undesirable dominant qualities; and (4) an effort to foster matings between individuals showing the same desirable recessive quality. Another interesting feature of Dr. Ruggles Gates's paper is the discussion of the question whether there are any details of structure so small or of such a nature as to be beyond the reach of hereditary entailment. Some good examples are given of the continuance of very minute structural idiosyncrasies. As regards the inbreeding and outbreeding of human races, the author concludes that intermixture of unrelated races is from every point of view undesirable. "The more advanced race is diluted and degraded by such intermixture." "The blend is only a blend when considered *en masse*." On the other hand, interbreeding of related races or strains gives increased vigour.

University and Educational Intelligence.

ABERDEEN.—The Lord Rector, Lord Cowdray, will deliver his address in the Mitchell Hall on October 23.

Dr. J. B. Orr, director of the Rowett Research Institute, has been appointed research lecturer in the physiology of nutrition for the ensuing academical year, and Mr. R. H. A. Plimmer, chief biochemist, re-appointed research lecturer in applied biochemistry.

CAMBRIDGE.—Mr. S. M. Wadham, Christ's College, has been appointed senior demonstrator in botany, and Mr. R. E. Holthum, St. John's College, junior demonstrator.

LONDON.—In response to a request made by many of those who attended Dr. Jeffery's public lecture on Einstein's theory of relativity, a course of eight lectures on the same subject by Dr. Jeffery has been arranged at University College. The course will begin on Monday, October 25, at 6 p.m.

A course of ten public lectures on "The Development of Philosophy from Descartes to Leibniz" is being given at King's College by Prof. H. Wildon Carr on Tuesdays at 5.30 p.m. The course commenced on October 12.

OXFORD.—The new academical year has begun with a very large number of fresh entries. The colleges are almost inconveniently full, and most of the scientific departments are overcrowded. The activities of the teaching staff of both University and colleges are being taxed to the utmost. A contributing cause of the present pressure upon the resources of accommodation and teaching is the influx of women students, who are now to be seen in the academic costume lately devised for their use.

On October 14 a new departure was taken by the admission of nearly sixty women to degrees; these included the conferring of the degree of M.A. by decree on the Principals of the women's colleges and halls and of the Society of Oxford Home-Students.

A letter has been addressed by some members of the University to the professors of the arts and sciences and to members of the universities and learned societies in Germany and Austria, expressing a "desire to dispel the embitterment of animosities that under the impulse of loyal patriotism may have passed between us," and suggesting that a reconciliation may surely be looked for in the fields of arts and learning.

MR. J. R. C. GORDON has been appointed professor of materia medica and therapeutics at the Anderson College of Medicine, Glasgow.

THE new session of the Aristotelian Society will be inaugurated on Monday, November 8, at 8 o'clock, when the president, Dean Inge, will give an address on "Is the Time Series Reversible?" The meeting will be held in the Conference Hall of the University of London Club, 21 Gower Street, W.C.1.

FREE public lectures on physic will be delivered by Sir Robert Armstrong-Jones at Gresham College, Basinghall Street, E.C.2, at 6 p.m., on November 8, 10, 11, and 12. The subjects of the lectures will be "The Air We Breathe," "The Houses We Live In," "The Clothes We Wear," and "The Food We Eat."

THE *British Medical Journal* for October 16 states that the University of Heidelberg has received 500,000 marks from Herr F. Behringer, of Bielenfeld, for the erection of an institute for the study of the chemical constitution of albumin. Until the institute is completed the researches will be carried on in the physiological institute under the direction of Prof. Kossel.

WE learn from *School Life* for August 15 last that Mr. August Heckscher, of New York City, has given 500,000 dollars to Cornell University to maintain professorships of research and to provide facilities for scientific work. The persons selected for such positions will be relieved of routine teaching and administrative details in order that they may be free to devote themselves to scientific investigation and to the training of future investigators.

ON October 18 the report of the Higher Education Sub-Committee on London University was adopted at a special meeting of the Education Committee of the London County Council. Mr. H. C. Gooch said that, having obtained an assurance from the President of the Board of Education that acceptance of the Bloomsbury site for the headquarters of the University would not close the door against grants from Treasury sources towards the building and equipment of the new premises, the Sub-Committee felt justified in recommending the Education Committee to ask the Council to make a conditional building grant. He moved: "That, subject to satisfactory arrangements being made between the Government and the Council of King's College for the reinstatement of King's College on the proposed Bloomsbury site, and in the event of the University of London accepting the site in Bloomsbury referred to in Mr. H. A. L. Fisher's letter dated April 7, 1920, and provided that adequate grants are made by the Government for the erection of administrative buildings on the new site, the Council is prepared to consider an application for a building grant for this purpose subject to the condition that the Council's contribution shall not exceed one-third of the contribution made by the Government in respect of expenditure not exceeding 1,000,000*l*., and that the Council be recommended accordingly." The resolution was adopted by eighteen votes against five.

THE Y.M.C.A. Universities Committee, of which Dr. D. H. S. Cranage is chairman and the Rev. Basil A. Yeaxlee secretary, has issued an admirable educational handbook for the guidance of secretaries and for providing suggestions for the building up of local educational programmes for the various branches of the Y.M.C.A. according to their respective needs. There has been established with this object an education department at the headquarters of the association, 13 Russell Square, W.C.1, from which further advice and guidance can be obtained. It is proposed to establish throughout the kingdom divisional areas connected with the local branches of the Y.M.C.A., each with its educational committee representative not only of the members, but also of the local educational activities, whether official or voluntary. The movement is chiefly concerned with the supply of adult education, the emphasis upon which should lie largely with non-vocational subjects such as religion, history, sociology, science, literature, the arts, and physical education, the technical and vocational studies being offered only when other educational agencies fail to provide them. It is earnestly advocated that one of the greatest needs of our country to-day is a democracy with the power to think and to form judgments, people who have the country's welfare at heart and are prepared to take their place as citizens, understanding clearly the implications and duties of citizenship. Having this purpose in view, the National Council has asked the universities and other bodies co-operating with the association in its war-time educational work to continue to send representatives to form the Y.M.C.A. Universities Committee, and the response has been cordial and complete, a body being formed comprised of eighty-five members representative of all the universities and the university colleges of Great Britain and other voluntary agencies. Well-defined lecture and tutorial courses upon a variety of subjects are arranged, including philosophy, history and geography, literature, art, religion and morals, economics, music and the drama, and suggestions for correspondence groups, for the formation of libraries, and for summer and week-end schools are offered.

FROM the *Pioneer Mail* for August 13 last we learn that an extraordinary meeting of the Senate of Allahabad University was held on August 7, at which Sir Harcourt Butler, Chancellor of the University, presided. In opening the debate, the Chancellor said that the policy in the United Provinces for higher education was the development of a number of universities of the unitary, residential, and teaching type. The first step in this direction was the establishment of an institution on these lines at Lucknow, and a Bill had been prepared and published which aimed at putting into force the recommendations of the Lucknow University Conference. The second step was that the line between university and school teaching should in future be drawn at the intermediate stage. This involved the re-organisation of secondary education. To this end it was proposed to establish a Board which would supersede the existing School-leaving Certificate Board, and be entrusted with the task of providing the preparation for university work now given in the intermediate classes of the college, and of developing a system of high secondary education. The third step to be accomplished was the re-organisation of Allahabad University. It should be divided into two parts, one, internal, being a self-contained unitary, residential, and teaching university, and the other, external, consisting of affiliated outlying colleges. In conclusion, it was pointed out that primary, secondary, and technical education would not be in any way retarded by lack of finances should the schemes for university reform be adopted. A discussion followed, and the Senate passed a resolution, moved by Dr. Sapru, approving the general scheme for establishing a university at Lucknow, but reserving its opinion as to details. Motions were also passed by which the draft Bill for the establishment of a Board for High School and Intermediate Education, and the report of the committee on the re-organisation of Allahabad University, should be referred to a Select Committee.

IN Bulletin No. 50, 1919, of the United States Bureau of Education an account is given of the condition of science teaching in the schools of

Memphis, Tennessee. The bulletin is divided into four sections, dealing with the elementary schools, the central high school, the vocational high school, and the high school for coloured children. In the elementary grades no science or Nature-study enters into the curriculum. At the central high school instruction is divided into eight groups, according to the principal subject taken: Latin, history, science, modern languages, commerce, technical training, home economics, and a course in which any subjects may be taken. In five of these groups no science studies are essential; in one, one science subject is necessary, in another two are required, and in the remaining one five are compulsory. However, in six of the groups either four or five sciences are voluntary, and another offers three "elective" sciences, but in the commercial group no science studies are undertaken. The number of students actually taking scientific subjects amounts to only 28·7 per cent. of the total number of pupils on the books, and measures are suggested for ensuring that a greater number obtain some training in science. Part of the scheme suggested is that general science should be taught in the upper classes of the elementary schools. The number of teachers employed in teaching science, and in many cases their qualifications, appear to be quite inadequate to the task before them. At the vocational high school shop-work is prominent, but it is surprising to note that there are no laboratories equipped for work in science, and no teachers apparently who are competent to teach such subjects. In the high school for coloured children the condition of scientific studies is even worse; it is impossible to do anything but text-book and recitation work, and even this is done only with great difficulty on account of the constant over-crowding of the room. The whole school is reported as unclean and insanitary and in a pitiable condition.

A COPY of the regulations and syllabus of the British School of Malting and Brewing for the year 1920–21 has been received. The school is a department of Birmingham University, and deals with all branches of applied biochemistry, especially as applied to fermentation industries, to agriculture, and to sanitation. Four courses of instruction are provided—a degree course, a diploma course, a part-time series of lectures for brewers and maltsters leading to a certificate, and special short courses on malting and brewing. The lectures for the degree are recommended to students desirous of qualifying as chemists or bacteriologists in industries in which biochemistry plays an important part. A fourth year's work in the department of brewing qualifies a graduate for the diploma in that science. The diploma course is intended for students leaving school who desire training in the principles of malting, brewing, and other fermentation industries. The first two years are devoted to general scientific training as a preparation for the technical work of the third year, which consists largely of acquiring a practical knowledge of brewing and of the methods used by brewers in the judgment and valuation of barley, malt and other requisites of the trade. The part-time course for brewers and maltsters is open to all, but to qualify for the University certificate the candidate must have had two years' practical experience in brewing or malting. The ground covered is similar to that dealt with in preparation for the diploma, but the laboratory work does not go so far into the scientific side of the operations. The short courses provided are intended for those who find themselves unable to attend any of the above classes; such students share all advantages equally with diploma students. A time-table and syllabus of each course are given in the booklet. It is interesting to note that the director of the school, Prof. A. R. Ling, has been given wide powers for aiding competent research workers concerned with fermentation industries by finding accommodation in his laboratories and in other ways. Applications for such assistance should be made direct to the director of the school.

Societies and Academies.

MANCHESTER.

Literary and Philosophical Society, October 5.—Sir Henry A. Miers, president, in the chair.—Dr. A. E. **Oxley**: Recent researches in magnetism. After dealing briefly with the nature of ferro-magnetism, para-magnetism, and diamagnetism, the author considered the characteristic variations of these properties over a range of temperature varying from that of liquid air to 300° C. Practically all substances show a change of magnetic property when crystallisation takes place, and in the case of certain diamagnetic substances definite hysteresis loops with respect to temperature have been obtained. These loops are similar to those shown by nickel-steels which are ferromagnetic. The experimental results were interpreted in terms of the electron theory of magnetism, and finally extended, through Tyndall's work on the deportment of crystals in a magnetic field, to interpret the nature of crystal structure and the spatial distribution of electrons within the atom. The atomic configuration so deduced is similar to that of the cubical atom developed by Lewis and Langmuir, and distinct from that of the Bohr theory, which fails to account for the magnetic properties. It is considered, however, that these theories may be brought into line in the near future by a due recognition of the possible differences between radiating and non-radiating matter.

PARIS.

Academy of Sciences, September 27.—M. Léon Guignard in the chair.—A. **Appell**: A partial differential equation of the theory of hypergeometric functions.—F. E. **Fournier**: Concerning the apparent displacement of some stars in the total eclipse of the sun of May 29, 1919.—M. **Lugeon** and N. **Oulianoff**: The geology of the Croix-de-Fer massif. The sedimentary zone separating the massif of Mont Blanc from that of the Aiguilles-Rouges has been usually considered as a simple synclinal, but E. Paréjas has recently proved the existence of two synclinals. A study of the region between the Arve and the Trient has now shown that the structure is still more complex, a detailed description of which is given.—C. **Sauvageau**: The indigenous marine algæ capable of furnishing gelose.—V. **Burson**: A solar prominence with great radial velocities. Photographs taken on September 8 showed a prominence visible on the photograph of the lower layer—a phenomenon of great rarity. This was followed up by a series of photographs, and certain parts were shown to have a radial velocity greater than 132 km. per second.—H. **Deslandres**: Remarks on the preceding communication of V. Burson.—J. **Welsch**: Position of the springs on the concave bank of rivers in permeable limestone strata.—R. **Cerighelli**: The gaseous exchanges of the root with the atmosphere. The respiration of plant-roots placed in a confined atmosphere takes place similarly to that occurring with other plant organs; the ratio of carbon dioxide evolved to oxygen absorbed varies between 0·7 and 1·0, according to the species. These results are for detached roots; the modifications caused by contact with a very moist atmosphere and by leaving the plant attached to the roots under experiment are also described. —E. **Rousseaux** and M. **Sirot**: The nitrogenous materials and phosphoric acid during the ripening and germination of wheat.—A. J. **Urbain** and P. **Marty**: The influence of the subterranean work of the mole on the flora of the pasturages of Cantal. The effect of the work of the mole is to drain the soil, to favour the germination and growth of the seeds, and to introduce new plants, often useful.—P. **Wintrebert**: The relations between the aneural ectodermic irritability and the nervous and muscular working in the embryos of Amphibians.—A. **Krempf**: The tentacular apparatus of *Coeloplana gonoctena*.

SYDNEY.

Linnean Society of New South Wales, August 25.—Mr. J. J. Fletcher, president, in the chair.—T. G. **Sloane**: A list of the species of Australian Carabidæ which range beyond Australia and its dependent islands. Forty-four Australian species are recorded from localities outside Australia and its dependent islands as follows:—Africa 1, Amboyna 1, Aru Islands 1, Asia 6, south-east Asia 4, Borneo 1, Burma 1, Celebes 3, Ceylon 5, Egypt 1, India 2, Java 8, Lord Howe Island 2, Malay Archipelago 6, New Caledonia 12, New Guinea 10, New Zealand 3, Siam 1, Sumatra 1, and Sumbawa 3.—T. **Steel**: Dental encrustations and the so-called "gold-plating" of sheep's teeth. For many years past there have appeared from time to time in newspapers and magazines published all over the world statements as to the occurrence of a metallic encrustation on the teeth of sheep. Popularly this encrustation, being frequently of a yellow tint, has been attributed to gold, supposed to have been derived from particles of that metal scattered about the pastures. Complete analyses are given of the encrustation from sheep, ox, man, and a number of other animals, and it is shown to consist of a phosphatic salivary deposit or calculus, and to be common to the teeth of all mammals and of several other animals. —Marjorie I. **Collins**: The structure of the resin-secreting glands in some Australian plants. An account of certain types of glandular hair and of the development of the glands observed during an investigation of the resinous secretion of the bud in seven Australian genera of the natural orders Sapindaceæ, Leguminoseæ (sub-order Mimoseæ), Compositæ, Goodeniaceæ, and Myoporineæ.—Prof. W. N. **Benson**, W. S. **Dun**, and W. R. **Browne**: The geology and petrology of the Great Serpentine Belt of New South Wales. Part ix. The geology, palæontology, and petrography of the Currabubula district, with notes on adjacent regions. (1) More than ninety species are recognised, comprising corals, bryozoa, brachiopods, pelecypods, gastropods, scaphopods, cephalopods, and trilobites, of which five forms previously reported have now been for the first time critically examined, seven are new records for the State, and fifteen species and three varieties are described as new. One new genus of corals is also proposed—a simple turbinate form with a corallum of the Lithostrotion type. (2) A comparison of the Burindi fauna with the Lower Carboniferous faunal succession in the British Isles shows that, on the evidence of thirty-one British species of brachiopods in the Burindi series, it should be placed at the very base of the Viséan series or on the Tournaisian-Viséan boundary. This accords remarkably well with De Koninck's conclusions put forward forty years ago.

Books Received.

An Introduction to the Study of Terra Sigillata: Treated from a Chronological Standpoint. By F. Oswald and T. D. Pryce. Pp. xii+286+lxxxv plates. (London: Longmans, Green and Co.) 42s. net.

Feeblemindedness in Children of School-Age. By Dr. C. P. Lapage. Second edition. Pp. xv+309+ plates. (Manchester: University Press; London: Longmans, Green and Co.) 10s. 6d. net.

A Book about Plants and Trees. By R. and S. G. Gurney. Pp. xvi+103. (London: C. Arthur Pearson, Ltd.) 1s. 6d. net.

Studies in Contemporary Metaphysics. By R. F. A. Hoernlé. Pp. ix+314. (London: Kegan Paul and Co., Ltd.) 16s. net.

Type Ammonites. By S. S. Buckman. Part xxiii. Pp. 19–24+13 plates. (London: W. Wesley and Son.)

Easy Lessons in Einstein. By Dr. E. E. Slosson. Pp. vii+128. (London: G. Routledge and Sons, Ltd.; New York: Harcourt, Brace and Howe.) 5s. net.

Psycho-analysis: Its History, Theory, and Practice. By A. Tridon. Pp. xi+272. (London: Kegan Paul and Co., Ltd.) 10s. 6d. net.

A Naturalist on Lake Victoria. With an Account of Sleeping Sickness and the Tse-tse Fly. By Dr. G. D. Hale Carpenter. Pp. xxiv+333. (London: T. Fisher Unwin, Ltd.) 28s. net.

Memoirs of the Geological Survey. Special Reports on the Mineral Resources of Great Britain. Vol. xiii. Iron Ores (continued). Pre-Carboniferous and Carboniferous Bedded Ores of England and Wales. By Sir A. Strahan and others. Pp. iv+123. (London: E. Stanford, Ltd.; Southampton: Ordnance Survey Office.) 7s. 6d. net.

Smithsonian Institution. United States National Museum. Bulletin 110. Osteology of the Carnivorous Dinosauria in the United States National Museum, with Special Reference to the Genera Antrodemus (Allosaurus) and Ceratosaurus. By C. W. Gilmore. Pp. xi+159+36 plates. (Washington: Government Printing Office.)

The Practice of Railway Surveying and Permanent Way Work. By Prof. S. Wright Perrott and F. E. G. Badger. Pp. viii+303. (London: E. Arnold.) 30s. net.

Reinforced Concrete Design. By Dr. O. Faber. Vol. ii., Practice. Pp. xii+246. (London: E. Arnold.) 18s. net.

Fisheries—England and Wales. Ministry of Agriculture and Fisheries. Fishery Investigations. Series iii., Hydrography. Vol. i., The English Channel. Part v., The Section from Plymouth to Brest. Pp. 19. (London: H.M. Stationery Office.) 2s. net.

Department of Scientific and Industrial Research. British Association for the Advancement of Science. Third Report on Colloid Chemistry and its General and Industrial Applications. Pp. 154. (London: H.M. Stationery Office.) 2s. 6d. net.

Milk Testing. By C. W. Walker-Tisdale. Second edition. Pp. 90. (London: J. North, 98 Fetter Lane.) 3s. 6d. net.

Moby-Dick or the Whale. By H. Melville. (The World's Classics.) Pp. xii+675. (London: Oxford University Press.) 2s. 6d. net.

Opera Hactenus Inedita Rogeri Baconi. Fasc. v. Secretum Secretorum cum Glossis et Notulis. Tractatus Brevis et Utilis ad Declarandum Quedam Obscure Dicta Fratris Rogeri. Nunc Primum Edidit Robert Steele. Accedunt Versio Anglicana ex Arabico Edita per A. S. Fulton. Versio Vetusta Anglo-

Normanica Nunc Primum Edita. Pp. lxiv+317. (Oxonii: E. Typographeo Clarendoniano.) 28s. net.

Rudiments of Electrical Engineering. By P. Kemp. Pp. viii+255. (London: Macmillan and Co., Ltd.) 6s.

The Ila-Speaking Peoples of Northern Rhodesia. By the Rev. E. W. Smith and Capt. A. M. Dale. Vol. i., pp. xxvii+423; vol. ii., pp. xiv+433. (London: Macmillan and Co., Ltd.) Two vols., 50s. net.

The Early History of Surgery in Great Britain: Its Organisation and Development. By Dr. G. Parker. (Medical History Manuals.) Pp. ix+204. (London: A. and C. Black, Ltd.) 7s. 6d. net.

Elementary Dynamics: A Text-book for Engineers. By J. W. Landon. Pp. viii+246. (Cambridge: At the University Press.) 10s. 6d. net.

Memoirs of the Geological Survey. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for 1919. Pp. 70. (London: E. Stanford, Ltd.) 2s. 6d. net.

Companions: Feathered, Furred, and Scaled. By C. H. Donald. Pp. ix+159. (London: John Lane; New York: The John Lane Co.) 7s. net.

Essentials of Physiology. By Prof. F. A. Bainbridge and Prof. J. A. Menzies. Fourth edition. Pp. viii+497. (London: Longmans, Green and Co.) 14s. net.

Diary of Societies.

THURSDAY, OCTOBER 21.

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

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—Squad.-Ldr. R. M. Hill: A Comparison of the Flying Qualities of Single- and Twin-engined Aeroplanes.—C. Baker: Night Flying.

INSTITUTION OF MINING AND METALLURGY (at Geological Society), Special General Meeting, at 5.30; at 5.45.—J. Morrow Campbell: The Origin of Primary Ore Deposits.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Dr. A. R. Abelson: A Psychological Study of the Delinquent Child.

FRIDAY, OCTOBER 22.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. A. Keith: Demonstration on the Contents of the Museum.

ROYAL SOCIETY OF MEDICINE (Study of Disease in Children Section), at 5.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Capt. H. Riall Sankey: Presidential Address.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—F. Martin-Duncan: Birds and Beasts from many Lands.

JUNIOR INSTITUTION OF ENGINEERS (at Caxton Hall), at 8.—A. H. Fitt: Impulse Turbines.

ROYAL SOCIETY OF TROPICAL MEDICINE (at 11 Chandos Street, W.1), at 8.30.—Prof. W. Yorke: The Present Position of Trypanosomiasis Research.

MONDAY, OCTOBER 25.

FARADAY SOCIETY AND PHYSICAL SOCIETY OF LONDON (at Institution of Mechanical Engineers), at 2.30.—Joint Discussion on The Physics and Chemistry of Colloids and their Bearing on Industrial Questions. Prof. The Svedberg: A Short Survey of the Physics and Chemistry of Colloids.——Discussion on Emulsions and Emulsification. Opener: Prof. F. G. Donnan.—W. Clayton: Emulsion Problems in Margarine Manufacture.—S. S. Bhatnagar: Reversal of Phases in Emulsions and Precipitation of Suspensoids by Electrolysis: an Analogy.——Discussion on Physical Properties of Elastic Gels. Openers: E Hatschek and Prof. H. R. Procter.—S. C. Bradford: The Reversible Sol-gel Transformation.—Dr. J. O. W. Barratt: The Structure of Gels.——Discussion on Glass and Pyrosols. Opener: Sir Herbert Jackson.——Discussion on Non-Aqueous Systems. (a) *Nitrocellulose.* Opener: Sir Robert Robertson.—F. Sproxton: Non-Aqueous Colloid Systems with Special Reference to Nitrocellulose.—Dr. G. Barr and L. L. Bircumshaw: The Viscosity of Some Cellulose Acetate Solutions. (b) *Rubber.* Opener: B. D. Porritt: The Action of Light on Rubber.——Discussion on Precipitation in Disperse Systems. Openers: Dr. R. C. Tolman and Dr. R. S. Willows.—J. N. Mukherjee: The Origin of the Charge of a Colloidal Particle and its Neutralisation by Electrolytes.—W. Clayton: Coagulation of Inorganic Suspensions by Emulsions.——Discussion on Cataphoresis and Electro-endosmose. Opener: Prof. A. W. Porter.—Dr. W. Ormandy: Some Practical Applications of Electro-endosmose and Cataphoresis.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. S. G. Shattock: Demonstration of Pathological Specimens in the Museum.

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—W. H. Dolamore: The Importance of Clinical Observation in Dental Surgery (Presidential Address).

MEDICAL SOCIETY OF LONDON, at 8.30.—Prof. J. B. Leathes and others: Discussion on The Determination of Degree of Renal Function.

TUESDAY, OCTOBER 26.

SOCIOLOGICAL SOCIETY (at 65 Belgrave Road), at 5.15.—H. Carter and R. Unwin: Impressions of the New Germany.

ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5.30.—Dr. F. Parkes Weber: The Differentiation of the Secondary Forms of Polycythæmia Rubra.—Dr. Paterson: Notes on a Case of Transient Polycythæmia in a Child.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Rev. R. A. Lorrain: The Wild Head-hunting Tribes of Lakherland: their Manners and Customs.

WEDNESDAY, OCTOBER 27.

INSTITUTE OF AERONAUTICAL ENGINEERS (at Royal College of Science), at 7.45.—Col. N. T. Belaiew: The Structure of Steel.

THURSDAY, OCTOBER 28.

CHEMICAL SOCIETY (at Institution of Mechanical Engineers), at 8.—Dr. M. O. Forster: The Emil Fischer Memorial Lecture.

ABERNETHIAN SOCIETY (at St. Bartholomew's Hospital), at 8.30.—Sir St. Clair Thomson: Recollections of Joseph Lister by one of his House-surgeons.

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30.—Sir Thomas Horder: The Treatment of Sub-acute Nephritis by Decapsulation; with an Account of Four Cases.—W. Bonney: A New Operation for Nephroptosis.

FRIDAY, OCTOBER 29.

ROYAL GEOGRAPHICAL SOCIETY (at the Æolian Hall), at 5.—T. A. Barns: In the Land of the Okapi and the Gorilla.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. A. Keith: Demonstration on the Contents of the Museum.

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

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—H. W. Bennett: Winchester: The Cathedral, the School, and the Hospital of St. Cross.

CHEMICAL INDUSTRY CLUB (at 2 Whitehall Court), at 8.—Annual Meeting.

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8.30.—Dr. A. K. Chalmers: The Function of the Isolation Hospital in a General Scheme of Hospital Provision.

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