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CONTENTS.

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Trusts and National Progress.

THE nineteenth century was known as the 'steel' age. Attempts to find a word to describe the present age have not succeeded. 'Chemical,' 'wireless,' and 'flying' are adjectives which prejudge the issue of the fierce rivalry between chemists, physicists, biologists, psychologists, engineers to leave an impress on their day and generation. Pending a decision, it is safe to suggest that the present age is an age of 'surprises.' The War itself was a surprise—its outbreak to Great Britain, its result to our enemies; and many of the surprises which have followed that event with bewildering profusion are attributable to the War. We shall find a good example in the history of the 'trustification' of industry. Had anybody predicted before the War that the present year of grace would see the promotion of a great chemical combine—the Imperial Chemical Industries, Ltd.—with a nominal capital of £65,000,000, he would have been advised to consult a mental specialist. In the years preceding the War, the United States, under special legislation, was ruthlessly suppressing its powerful trusts as inimical to the public welfare. Is it possible that the stone which the American builder rejected should become the corner-stone of the British economic temple?

There were a few trusts in Great Britain before the War, together with their by-product in the form of millionaires—a few only, and these, unable to establish a monopoly, provoked no strong public opposition. To tell the truth, these trusts showed no disposition to grind unduly the faces of the poor. An occasional newspaper war regarding the price of soap or sewing-cotton served its immediate purpose of increasing the circulation of the newspaper, and may incidentally have reminded the manufacturer that there is a limit to the exploitation of the consumer. But the public at large showed no great interest in such questions, or indeed in kindred questions vitally affecting the public safety. As to the chemical industries, how many foresaw the importance these industries would assume in the prosecution of the War? It was known that the 'heavy chemical' industries were prosperous, but the dye industry, based on the discovery of an English chemist, had virtually acknowledged defeat. Some eighty per cent. of the dyes used in Great Britain before the War were imported from abroad, mainly from Germany.

"Trusts," says a well-known encyclopædia in the opening words of its article on this subject, "are large business organisations which aim at

restricting or eliminating competition." In relation to the conditions, national and international, obtaining to-day, this definition is obviously partial and strabismal. Possibly it is the work of one of those economists whose predictions, as a speaker said at the British Association meeting last year, are generally falsified by events. We are asked to imagine an idyllic scene in which two competing manufacturers producing the same article, one to sell at 2*d*. per lb. and the other at 2½*d*. per lb., decide to 'combine' and sell their total product at 2½*d*. per lb. The position which the coal industry, the chemical industry, and other great British industries are facing to-day is more complex. "Amalgamations," says Sir Alfred Mond, the evangelist of the new economic gospel, "mean progress, economy, strength, prosperity." They are the bulwarks of defence for which the whole community has been patiently waiting, "offensive weapons against those enemies at home and abroad who are attacking insistently and insidiously the fortress of the national fortunes."

In cold truth we are entering on an economic war which will lead to the extinction of the less strong and efficient nations. This war will be fought out by large-scale and highly organised units; and the form of organisation ensuring the maximum of financial strength and stability, the minimum of duplication of plant and service, the concentration of the best brains available on the real problems of industry, the most effective methods of promoting scientific research and the application of scientific discoveries, will win the day. Already the amateur company director is beginning to spell out the writing on the wall, and scientific workers are at long last seeing their value appreciated by the industrialist. The question whether, in making our plans for this economic war, we are pursuing the best policy, tactical and strategical, is of direct and vital interest to every citizen.

This question has innumerable aspects, and some of these cannot appropriately be discussed in detail in a scientific journal. Political influences are obviously of the highest importance—not in the narrow sense of the form of government, Tory or Labour, which may happen to be in power at any particular moment. Direct and indirect government aid to scientific research, diplomatic and consular services, factory and patent legislation, monetary system, trade union regulation, health and unemployment insurance, and a hundred other influences are at work, promoting or hindering the progress of industry. Our educational organisation is a powerful influence both in raising the general average of intelligence and in selecting and training those 'captains of industry' whose silent moves on the chequer boards of manufacture and commerce may lead to disaster or victory. Industrial psychology is a new and important science, and 'the human factor' in industry will have to receive increasing attention. But labour difficulties have not caused serious trouble in the *scientific* industries—a good sign and omen.

The loss of the dye industry before the War, to which reference has been made, affords a good illustration of the working of some of these influences. It is a twice-told tale reflecting no great credit on our Victorian forbears. Dr. Herbert Levinstein says:

"If after the Franco-Prussian war *laissez-faire* had not been the policy of the State, a very different position would have resulted in this country. If the State had provided duty-free spirit on terms comparable to those enjoyed abroad; protection for inventions, and prohibition of import of dyes manufactured abroad; information concerning foreign products, and, above all, an assurance of a benevolent interest in the industry; do you think that Perkin and Nicholson would have left?"

The official apology of the British Dyestuffs Corporation harps on the same string and strikes a new note in pointing to the lack of systematic research and of facilities for training organic chemists. Our ancient universities, content in producing educated men of a particular type, adopted an attitude of indifference, or even of scorn, to the public demand for scientific education. The Government, dimly recognising the public need, did a useful service in establishing the Royal College of Science. But Hofmann, one of the most distinguished professors of that college, inspirer of those researches of Perkin which laid the foundation of the dye industry, was attracted back to Berlin, after the death of the Prince Consort; his companions followed him, and took with them much of the expert knowledge of aniline dyes. Ambassador Walter Page, in one of those illuminating letters written during the War to President Woodrow Wilson, which have raised our respect and affection for the United States, referred to some things which the Allies would do in "the war after the War." The Germans, he wrote, had used commercial and financial methods in England, and in Russia in particular, which were unmoral if not immoral—methods which might have been taken out of the book of a decade or so about the Standard Oil Company.

"They 'dumped,' and killed competition by starving out competitors. They conducted systems

of commercial espionage, etc. etc. etc. The English were slow to detect these things, and sluggish to move against them. They will be neither slow to see nor sluggish to act for some time after the War. They will try, too, to prevent dependence on Germany for dyestuffs and other monopolised articles."

This prediction has been verified. Forming part of a great combine of the chemical industries, the British dye industry, a key industry as the War has shown, will be able to play a worthy part in "the war after the War."

Adequate finance is not, however, the only advantage which the new trust will offer to the dye industry. Of special interest, fully recognised by the promoters of the trust, is the question whether it will be possible to improve methods and results in scientific research. The record of the constituent companies in this respect is creditable enough, and the work they accomplished during the War earned the gratitude of the nation. But combination must tend towards greater economy and greater efficiency. Industrial research, as Dr. Levinstein has pointed out, can only be successfully conducted by great organisations. The expense of a scientific staff is too great to be borne by the average manufacturing concern of moderate size.

"There is nothing so unprofitable," he says, "as employing a number of chemists who either have not the knack of discovering things for you, or who discover things for you that you have not got sufficient technical ability to work on a large scale, or for which you have not sufficient discernment to find a market."

The inventive chemist is generally a pure research chemist without knowledge of or interest in large-scale production. Are we not disposed to overlook the high and difficult character of the scientific, technical, and engineering work which transmutes the laboratory product into an article of commerce? For example, the combination of nitrogen and hydrogen under high pressure in the presence of a catalyst to produce ammonia was a reaction of academic interest until Haber pointed out to the Badische Company that the cost aspect would be altered if the ammonia could be separated from the compressed gases without the pressure being released. Even so, the working out of the process was a colossal undertaking, so complicated that Dr. Levinstein suggests that no firm in Great Britain could at the time have adopted the idea. We have good reason to know and to remember how the process enabled Germany to prolong the War by rendering that country independent of supplies of Chile saltpetre; and we have good reason also to be grateful for the enterprise of Messrs. Brunner, Mond and Co., who have overcome the technical difficulties and established at Billingham the synthetic nitrogen industry—an industry which will literally change the face of the earth, making the desert places smile and rejoice. The modern chemist can call spirits from the vasty deep.

"Why, so can I; or so can any man:
But will they come, when you do call for them?"

What is the chemist's reply to this searching Shakespearian question? He selects a very inert element in the air and turns it into manna to feed the multitude. In some instances, science is able to supersede natural processes. The synthesis of indigo by the Germans, one of the greatest triumphs of industrial chemistry, the result of prolonged and expensive scientific research, has thrown thousands of acres out of cultivation. Artificial silk has caused the silkworm 'to go out of business.' The men of science who work these miracles derive no stimulus from the lash of competition. By pooling our resources, spiritual and material, we may hope to obtain the best results and to compete on even terms with other highly organised nations.

We come, finally, to an aspect of the question on which Sir Alfred Mond rightly lays stress—the question of national psychology. We are suffering, he says, from the people who are always sitting round with the 'No' complex; people who dedicate their intellects to the congenial task of creating difficulties and objections to every proposed development; people who themselves achieve nothing except to hold up the march of progress of nations and industries. The only real advantage which America has over us, he suggests, is that the Americans welcome new ideas and are always ready to give them a trial. "You want more people with the 'Yes' complex," he says. "There is no room for the 'No' people: they must get out of the way or it will be a serious thing for this country." We have the men, the money, the material. "I am not in the least impressed," Sir Alfred Mond says, "with the technical superiority of any other people in the world." There are no abler chemists or engineers to be found; and our working men are "extraordinarily adaptable, highly skilled, and well trained." No miracle is required, no new dispensation from Heaven, to keep Great Britain in the forefront of industrial nations—only common sense, energy, and the spirit of research.

T. LL. H.

The Greek Conception of Theoretical Geometry.

The Thirteen Books of Euclid's Elements. Translated from the Text of Heiberg, with Introduction and Commentary, by Sir Thomas L. Heath. Second edition, revised with additions. Vol. 1: Introduction and Books I., II. Pp. xii+432. Vol. 2: Books III.-IX. Pp. vi+436. Vol. 3: Books X.-XIII. and Appendix. Pp. vi+546. (Cambridge: At the University Press, 1926.) 70*s.* net.

THE preface to the first edition of Sir Thomas Heath's translation of Euclid's "Elements" begins with the following quotation from De Morgan: "There never has been, and until we see it we never shall believe that there can be, a system of geometry worthy of the name, which has any material departures (we do not speak of *corrections* or *extensions* or *developments*) from the plan laid down by Euclid." In 1908, when that edition appeared, the movement in favour of a text-book for schools that discarded Euclid's order and proofs was in full vigour, and, in reference to that movement, Sir Thomas Heath contented himself with saying: "It is, perhaps, too early yet to prophesy what will be the ultimate outcome of the new order of things; but it would at least seem possible that history will repeat itself and that, when chaos has again come into geometrical teaching, there will be a return to Euclid more or less complete for the purpose of standardising it once more."

The possibility suggested in 1908 may be asserted in 1927 as a probability, if not indeed a certainty. Among the many text-books that have appeared in recent years—and some of these have many excellent features—there is none that could possibly have induced De Morgan to change one word of the sentence quoted above. The revolt inaugurated by Ramus in the sixteenth century against the Euclidean system and in favour of the admission of many theorems as 'obvious' has its counterpart in recent times, and there are many signs that the inadequacy of the new system is being felt as decidedly now as in the earlier period. But whether there is to be a return to Euclid, more or less complete, or a continuance of the wider liberty prevailing at present, it is very desirable, indeed essential, that all who have charge of the teaching of geometry should make a real study of the development of the science, especially in its early stages, and its reduction to an ordered system in the writings of Euclid. Probably few, if any, desire a return to Euclid *simpliciter*, but, whatever be the attitude to Euclid's "Elements" as a text-book, it is quite impossible to form an adequate appreciation of the influence of mathematics on modern thought without a careful study of the Greek geometry; for such a study there is no better basis than these volumes of Sir Thomas Heath.

It is a tribute to the excellence of the first edition that, while numerous changes have been made in the second, chiefly due to the new knowledge gained in recent researches, these changes are comparatively small; but the revision has been very thorough, and many passages have been rewritten. The paging, however, has been preserved, so that the page-reference to any proposition is the same for both editions. Two new excursuses are appended to the first volume. The first of these is on "Pythagoras and the Pythagoreans," and discusses at greater length certain views that had been dealt with in the notes to Euclid I. 47; the second bears the title "Popular Names for Euclidean Propositions," the names being: *Pons Asinorum*, *Elefuga*, *The Theorem of the Bride*, *The Bride's Chair*, *Dulcarnon*, *Francisci Tunica*, *Goose's Foot* (*Pes anseris*), and *Peacock's Tail* (*Cauda pavonis*). Those to whom any of these names is unknown may be amused by trying to find a proposition that fits it.

Euclid was not the first to write a treatise on geometry, and doubtless many theorems were known and applied before any proof of them was systematically attempted. Unfortunately, the character of the early proofs is to a very considerable extent a matter of guess-work. The very excellence of Euclid's "Elements" swept away such earlier treatises as existed, and such information as we have of them must be extracted from later commentators; even these are chiefly known through Proclus, whose commentary on the first book of Euclid is thus of fundamental importance in the history of mathematics. If the text of Proclus is trustworthy, it is hard to believe that he was an able geometer, but he was a well-trained philosopher, and, we may assume, was familiar with the philosophical principles that lay at the basis of theoretical geometry. Be that as it may, it is on Proclus more than any other single writer that we are dependent for our knowledge of the conditions under which Euclid worked.

In the introductory chapters of vol. 1, Sir Thomas Heath gives a most illuminating discussion of the bearing on Euclid's system of the philosophical conceptions of the period antecedent to the composition of the treatise. Accurate scholarship,

wide knowledge, and, of equal importance, calm and restrained judgment, mark the treatment of a subject that has been too often the occasion for rash assertions. A study of these chapters throws a strong light on the difficulties that are involved in the passage from 'practical geometry' to geometry as a science, and proves the practical sagacity as well as the mathematical ability of the writer of the "Elements." Euclid was no mere redactor; it may be, and probably is, the case that now and again he had not the courage to discard older statements, but it demanded genius of a high order to reduce the loose and vague generalities of earlier treatises to a system that is at once comprehensive and logically compact.

It is impossible to discuss these volumes in detail, but it may be said that to almost every proposition interesting notes are appended that, in their totality, form an excellent introduction to the history of geometry; the numerous references, if followed up, would form a fascinating study and do much to make the geometry lessons more interesting to pupil and teacher alike. The inclusion of Euclid's arithmetical books is specially welcome, and one may express the hope that the tenth and thirteenth books may now become something more than names to all who are interested in geometry; nowhere is Euclid's genius better seen than in these books. But the most ardent adherent of Euclid would scarcely object to the simplification that is introduced by modern symbolism in an elementary treatment of the constructions in Book XIII.

It is almost impossible to praise too highly the selection from the overwhelming material with which Sir Thomas Heath had to deal or the luminous exposition of many difficult topics; his mastery of English is nowhere better shown than in the translation of the text, where the flavour of the original is never lost, and yet due respect is paid to the English idiom. The only *caveat* I would make is that, at times, there is a tendency to read too much into the Greek texts. For example, I find it impossible to assent to the statement (vol. 1, p. 220) that Playfair's postulate "is distinctly stated in Proclus' note to Eucl. I. 31." It is one thing to *prove* that, with Euclid's postulate, there is only one parallel through a given point to a given straight line (and this seems to me to be at most what Proclus does); it is quite a different thing to reverse the process, and this is the essence of Playfair's procedure. Playfair, of course, does not claim the credit of the axiom; he says that the axiom "has been assumed by others, particularly by Ludlam." Who are the others? I do not know, but Playfair's discussion seems to show that he at least did not see it in Proclus. There are other cases in which I think too much is read into the older treatises, but, after all, these considerations are largely matter of opinion, and the debt which mathematicians owe to Sir Thomas Heath is too great to justify more than a passing reference.

GEORGE A. GIBSON.

Festschrift Carl Schröter.

Veröffentlichungen des Geobotanischen Institutes Rübel in Zürich, Heft 3. Festschrift Carl Schröter. Gewidmet von seinen Freunden, Schülern und Kollegen. Im Auftrag des Schröter-Jubiläum-Komitee redigiert von H. Brockmann-Jerosch. Pp. viii + 811 + 28 Tafeln. (Zürich: Rascher und Co., 1925.) 30 francs.

ON December 19, 1925, Carl Schröter, still "Professor der Botanik an der Eidgenössischen Technischen Hochschule in Zürich," celebrated his seventieth birthday. A *Festschrift* of 811 pages, containing an account of Schröter's life and work by Rübel, a former student and present colleague, and forty-nine original articles by botanists of some thirteen nationalities, was published in honour of the occasion.

The influence of Carl Schröter has been great, not only on the institution in which he was first a student and afterwards professor for forty-two years, but also on the development of Swiss botany in general. Since 1882 his chief interest has been ecological plant geography, a study to which he was attracted by a perusal of Christ's "Pflanzenleben der Schweiz," and Kerner's "Pflanzenleben." His influence on the subject to which he has devoted his life can be compared with that of Schimper and Warming. He has been an indefatigable investigator, a mere list of his publications occupying some thirteen pages of the *Festschrift*. His published researches, independent or in collaboration, include many important studies on the vegetation of Swiss grasslands, moorlands, and lakes, while his extensive knowledge of alpine plants is summed up in his well-known "Pflanzenleben der Alpen," now in its second edition.

Schröter's influence, however, has been due even more to his personality as a man and a teacher than to his writings. Above all, he is intensely human. Tansley, in his article in the *Festschrift*, refers to "the distinguished and beloved founder of the Zürich school, who has contributed so much by example and personality to international under-

standing and co-operation." The secret of his success in this respect may be summed up in the words of Rübel, "Für ihn liegt der Zweck des Lebens im Geben." In the lecture room, laboratory, and not least in the field, Schröter always gave of his best to his students, and in return received from them unswerving loyalty and devotion. Thanks to Schröter's inspiring leadership, the Zürich school of plant geography (or that branch of it known as plant sociology) is now one of the most active centres in the world for the study of natural vegetation.

Schröter's keen love of Nature led him to take a most active part in the Nature Reserve movement. He was one of the founders of the magnificent Swiss National Park, on which he contributed an article to NATURE (vol. 112, p. 478, 1923), and he selected it in April of last year as the subject of his Hooker lecture to the Linnean Society of London. His reverence for Nature was brought home to me some years ago as he and I stood together near the Kleine Scheidegg. Glancing from the Jungfrau and the Mönch, bathed in sunshine, to the modern hotels in the foreground, Schröter exclaimed with intense feeling, "It is a desecration."

In the pursuit of his ecological studies Schröter has travelled widely. From the first he made field excursions a special feature of his botanical teaching. Zürich students are fortunate in having the Alps, "The Playground of Europe," at their very doors. But sometimes more distant excursions, for example, to Corsica or Algeria, are organised. In this respect British botanical schools have hitherto been less enterprising than the Swiss and some American schools. Schröter himself has visited many parts of Europe, the Sahara, the Canary Islands, the United States, and in 1898–99 travelled round the world. Even now, in his seventy-first year, he is absent on a year's journey to South Africa, India, and the Far East.

It is impossible within the limits of a review to do more than indicate something of the scope of a few of the articles contributed to the *Festschrift* by botanists of many lands. The articles are grouped into eight sections according to subjects.

In the first section are fifteen papers dealing with Alpine and Arctic vegetation. Rübel (Zürich) shows that many of the plants of high Alpine meadows hibernate under deep snow in a green condition. Evergreen meadows are not confined to the lowlands. Du Rietz' (Upsala) work on the altitudinal ranges of plants of northern Lapland appears to suggest that edaphically indifferent common species may be important as indicators of climate. Rikli (Zürich) resolves the Alpine-Arctic flora into elements derived from various distributional centres, and discusses probable routes of migration. Flahault (Montpellier) gives a general account of wind and snow as ecological factors. He instances cases of young conifers buried under winter snow being killed, not by cold, but by asphyxiation brought about by overlying layers of snow and ice.

The second section (nine papers) is devoted to extra-Alpine vegetation. Tanfiljef (Odessa) describes the natural alluvial meadows (Auen) of Russia. Much of the grassland of western Europe is at best only semi-natural, but true natural meadows occur in river valleys in east Europe and Siberia. The treelessness of the valley meadows of northern Russia is attributed to the prolonged waterlogging of the soil, and to the velocity of the ice-covered rivers, when the melting snow floods the valleys in springtime. Morton (Vienna) discusses the flora of caves from the physiological viewpoint. Blue-green and green algæ in particular are extremely tolerant of shade, some retaining their chlorophyll after years of cultivation in darkness. "The Structure of Woodlands" by Salisbury (London) deals with the stratification of woodland vegetation in relation to gradients of atmospheric and soil conditions. Four types of undergrowth species are distinguished, according to the time of development and duration of the assimilating organs. MacDougal (Arizona) describes the rapid changes in vegetation of an area adjacent to the Gulf of California, consequent on draining and increasing salinity. Podpěra (Brünn), in a paper on the origin of present-day European forests, groups Eurasian forests into Tertiary forests, Relict forests, the Eurasian Taiga and the dwarf forests of high mountains and Tundra. Miocene aridity and Pleistocene glaciation have profoundly modified the original Tertiary forests. Tansley (Cambridge) analyses the vegetation of the English Chalk. He emphasises the important point, ignored in the early days of ecology, that vegetation cannot be understood unless it is investigated from the developmental point of view as well as from that of habitat factors.

The third section of the book contains four papers by Pavillard (Montpellier), Chodat (Geneva), and others, on phyto-plankton.

The fourth part has five papers on phyto-palæontology and historical plant geography. Neuweiler (Zürich), from evidence afforded by fossil woods, concludes that from Palæolithic to Roman times the Swiss forests north of the Alps contained 82·3 per cent. of deciduous trees, and

only 17·7 per cent. of conifers. He criticises, quite justly, statistics based on the modern pollen analyses of peat. Herzog (Munich) finds, in a study of the geographical relations of the mosses of south Brazil, strong support for the hypothesis of Wegener and others, that the continents of Africa and South America were formerly continuous.

Section 5, on systematic botany and genetics, contains one short paper by de Vries (Holland) on the quest for the origin of species, and five other papers.

Under the heading "Soziologische Begriffe" (Section 6) are four papers, two of which deal with the struggle for existence amongst plants. Cajander (Helsingfors) adduces convincing evidence that the limits of natural distributional ranges of species. The sharpness of the boundaries of particular plant communities, as well as the definite structure of these communities, are largely determined, in the last resort, not by climate or soil, but by the mutual struggle for existence. Yapp (Birmingham) analyses the probable inter-relationships of plants in vegetation, and introduces the new concept of 'priority' as distinct from competition. Priority amongst plants is the passive interception of supplies of a necessity by an organism which is more favourably situated than another.

Section 7 on anatomy and physiology contains one paper by Jaccard (Zürich) on the weeping ash, and the final part (Section 8), five papers on economic botany.

From this brief résumé it will be seen that most of the papers have a direct or indirect bearing on the comprehensive subject of plant geography. Many reach a high level of importance, and not a few are concerned more with general principles than with details. The volume distinctly enriches the literature of plant geography. It has been well edited by Brockmann-Jerosch on behalf of the Schröter-Jubiläum-Komitee, and is well printed and illustrated. The *Festschrift* forms a sincere and fitting tribute to a singularly winning personality.

R. H. YAPP.

The New Wireless Technique.

The Theory and Practice of Radio Frequency Measurements: a Handbook for the Laboratory and a Textbook for Advanced Students. By E. B. Moullin. (Griffin's Scientific Textbooks.) Pp. xi+278. (London: Charles Griffin and Co., Ltd., 1926.) 25*s.* net.

IT is difficult for a wireless worker of to-day, who has been trained along modern lines, to realise how much precision has been introduced into his subject by the development of the thermionic valve. Important radio measurements were made in pre-War days, but in every case strong signals had to be used. The difficulties were largely due to the relative insensitivity of the instruments available for the measurement of high-frequency currents and potentials. But this, of course, did not prevent the pioneers of those days from making the very best use of the instruments at their disposal, and more than twenty years ago Duddell and Taylor, in a classical series of experiments, laid the foundations of the subject of signal measurement by studying the falling-off of signal intensity with increase of distance from a radio transmitter. In these experiments the high-frequency currents produced in a receiving antenna were measured directly with a Duddell thermogalvanometer. Although audible signals were detectable at much greater distances, quantitative observations were possible only up to a distance of 80 miles. In signal strength measurements over long distances, subjective methods involving audibility comparisons had to be used which were not very trustworthy.

The development of the thermionic valve has changed all this. It has supplied us with transmitters of electric waves which are remarkably constant in amplitude and frequency. It has made possible the building of stable amplifiers by means of which small oscillatory currents and potentials may be magnified to sufficient volume to affect our alternating current measuring instruments. Finally, in the tube itself we have a high-frequency voltmeter of precision.

The absence of a comprehensive account of the methods and devices now at the disposal of the wireless engineer and research worker has been felt for some years, and we are grateful to Mr. Moullin for undertaking the task of writing one. His work cannot have been easy. The setting-up of a wireless set, to receive signals, is easy, as every schoolboy knows, but once the word 'measurement' is introduced in connexion with high-frequency phenomena, difficulties begin to appear. None of these difficulties has been shirked by Mr. Moullin. Throughout his volume the physical principles are clearly interpreted, and every page bears witness to his wide experience in dealing with students' difficulties. As an example of this we may quote the practical details and advice he gives concerning the use of low-power valve generators for laboratory experiments. The instructions he gives for designing, setting-up, and adjusting for maximum output a valve generator

to meet given requirements could scarcely have been improved.

The older books on wireless telegraphy have dealt with measurements of high-frequency resistance, capacity, and inductance, but Mr. Moullin has much to say that is new. In the sections on the measurement of frequency and of signal intensity all the newer methods are given, including an account of Mr. Dye's very important work on the multi-vibrateur. In view of the importance of the use of quartz crystals as frequency controllers in a wireless spectrum already crowded, it is unfortunate that the work of the same author on this subject was published too late to be included.

There is no doubt that Mr. Moullin's book will be widely read by wireless engineers, but we must very reluctantly point out that the price of the volume is too high for it to be used as a text-book in university classes and thus assist in missionary work among the younger generation of physicists. E. V. A.

Our Bookshelf.

Handbuch der biologischen Arbeitsmethoden. Herausgegeben von Prof. Dr. Emil Abderhalden. Lieferung 204. Abt. 9: *Methoden zur Erforschung der Leistungen des tierischen Organismus*, Teil 1, Hälfte 2, Heft 2. Spezielle Methoden: *Tierhaltung und Tierzüchtung.* Pp. 215+484. (Berlin und Wien: Urban und Schwarzenberg, 1926.) 12·30 gold marks.

NOTICES of successive fascicules of this comprehensive work edited by Prof. Abderhalden have frequently appeared in our columns. The present instalment is concerned with the biology of insects and the technique of breeding and rearing those animals for purposes of scientific observation. Several groups have already been dealt with in Lieferung 182, and in the part before us most of the larger orders are considered.

Dr. C. Börner discusses the Homoptera with special reference to the aphides. His contribution includes a useful list of numerous members of the latter group in different parts of the world, with their known primary and secondary hosts. This is followed by a section dealing with the transmission of mosaic and other plant diseases through the agency of various Homoptera. The Lepidoptera are dealt with by Dr. E. Fischer, whose account is divided into two parts. The first is concerned with methods of collecting, and is followed by a larger section on the technique of rearing, including pairing, counteracting disease, and conducting experiments under varying conditions of heat and cold.

Dr. F. Heikertinger contributes the chapters on Neuroptera, Trichoptera, Mecoptera, Coleoptera, and Diptera. The accounts of the last two orders mentioned are in considerable detail, each family being considered separately. The concluding part is on Hymenoptera, by Dr. J. Fahringer. This is more curtailed than the preceding sections, and we think might have been expanded to advantage considering the specialisation of technique often required, especially with regard to the parasitic members of the order. A. D. I.

Chemistry and Recent Progress in Medicine. By Prof. Julius Stieglitz. (The Johns Hopkins University School of Medicine, The Charles E. Dohme Memorial Lectureship, Second Course, 1924.) Pp. viii+62. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1926.) 7*s.* net.

THE subject matter of this little volume is indicated by its title and does not follow any very novel path. The work referred to is mainly trans-Atlantic and its presentation suffers somewhat from the fact that more than a year has elapsed between the delivery of the lectures and their publication. About one-third of the book is devoted to the subject of oxidation, in which the author develops the theory that oxidation is a loss of one or more electrons, and reduction, correspondingly, their gain, by atoms or ions of the molecules taking part in the reaction; in this connexion reference is made to glutathione.

Among other applications of chemical or physico-chemical principles to medical problems to which reference is made, are the conditions necessary for the deposition of calcium phosphate in bone and the study of blood as a physico-chemical system. In the earlier part of the book the author reviews the progress made in preparing synthetic drugs for therapeutic purposes and in isolating the active principles of the internal secretory glands of the body. Among the substances mentioned were noticed ethylene as an anæsthetic, certain of the arsenical derivatives and dyes used clinically, the secretions of the pancreas, pituitary gland, and ovary, and the isolation of purified principles from antibacterial sera.

Heredity. By Prof. A. Franklin Shull. (McGraw-Hill Publications in the Zoological Sciences.) Pp. xi+287. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 15*s.* net.

THE author, who is professor of zoology in the University of Michigan, states in his preface that this volume represents a course of lectures delivered for several years to large classes of students who were admitted "without prerequisite." Doubtless for this reason the presentation of the subject matter is more or less popular, and in consequence somewhat dogmatic and superficial. Besides the phenomena of heredity proper, it deals with such topics as problems of population, immigration, and eugenics. Though by no means a poor book, it is rather mediocre and lacking in distinction. Probably it is better adapted to the audience for which it was planned than to an English one, but if it should help to stimulate interest in such matters it will have served a good purpose.

Letters to the Editor.

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

Wireless Communication and Terrestrial Magnetism.

DR. CHREE'S letter in NATURE of Jan. 15 alludes to the names which might be associated with that upper portion of the atmosphere the aid of which is so often invoked to account for many of the facts of wireless telegraphy. May I explain why I happened to choose the name "Heaviside layer" some sixteen years ago?

In the spring of 1902 I was writing from time to time on wireless telegraphy in the pages of the *Electrician*, and one day Mr. Tremlett Carter, the editor, showed me a letter from Mr. Oliver Heaviside which, while discussing other things, asked if the recent success of Mr. Marconi in telegraphing from Cornwall to Newfoundland might not be due to the presence of a permanently conducting upper layer in the atmosphere. I believe this letter was shown to various friends of the editor, but I think it was not published. The substance of the suggestion was repeated by Heaviside in his article in the new edition of the "Encyclopædia Britannica" which appeared in America and in England in 1902. The suggestion was gradually approved during the years that followed; and about 1910 I used the convenient name 'Heaviside layer' in a paper, to indicate the portion of the atmosphere that functions so usefully for the purposes of wireless telegraphy.

The existence of a conducting stratum in the atmosphere, and the probable connexion of the stratum with the aurora, must have been surmised by every observer of electric discharge in rarefied gases even before the date of Cavendish; and as Dr. Chree points out, Balfour Stewart suggested that a conducting layer might have to do with certain variations of the magnetic elements. Schuster, I believe, first gave definiteness and substance to this suggestion. Later, G. F. Fitzgerald calculated the period of electric oscillation of the earth supposed surrounded by a sharply defined conducting layer in the upper atmosphere, thus for the first time introducing the conception of a relationship between electric waves and an upper layer. But, so far as I know, there is as yet no evidence that the auroral layer is the same as the Balfour Stewart or Schuster layer, or that this is the same as the Fitzgerald layer, or that any of them are the same as the physically present layer called for convenience the Heaviside layer. Therefore it seems to me that to call the wireless layer by the name of Cavendish or Balfour Stewart or Schuster, or even Fitzgerald, would assume too much. Why not let well alone until there is proof that the Heaviside layer is the same thing as one or other of the hypothetical layers?

May I take this opportunity of referring to another matter. I wish to urge that full advantage should be taken of the solar eclipse next June for learning more about the Heaviside layer. The map given in Dr. Lockyer's excellent article in NATURE of Jan. 15, leads one to suggest that a wireless transmitting station near London and another in the north of Scotland should be devoted to transmitting signals continually throughout the eclipse period, so that receiving stations scattered about Great Britain might observe the intensity of signals which have crossed the path of the moon's shadow. Galvanometric measurements of a continuous stream of waves from the transmitters would be the ideal type of observation; but aural observations of the intensity of a code signal, if the time of each observation were accurately registered, would also be valuable.

In the latter case the method devised by the British Association Committee for use in 1914 may be recalled. Each transmitting station—one in Russia, one in France, and one in Ireland—was assigned a sequence of Morse letters for continuous transmission, the sequence of letters being such that no succession was ever repeated. A chronographic record of the transmitted sequence was to be made at each transmitting station, and observers had no other task than to write down the letters heard, heavily when the signals were strong, lightly when they were weak.

It was hoped that analysis and comparison of the records would show the effect of the shadow cone on waves passing through it; but the War came, and the organisation which had been built up for making observations throughout Europe immediately collapsed. Would it be possible, on the occasion now approaching, to arrange similar wide-spread European observations of signals proceeding from a special station in the north of Scotland? Indeed, if short waves were used, observations at a number of selected distant points of the globe would probably yield highly interesting results.

W. H. ECCLES.

142 St. James' Court,
Buckingham Gate, S.W.1, Jan. 17.

The Beginning of Agriculture.

MAY I be allowed to make a few remarks on some of the points to which reference is made in Prof. Elliot Smith's letter on "The Beginning of Agriculture" in NATURE of Jan. 15, p. 81?

The observation that "The statement that barley was the staple article of diet in Egypt from the earliest pre-dynastic period has passed without any notice whatever during the last fifteen years," would scarcely be made by any one acquainted with ancient cereals. That barley was an important cereal in Egypt in pre-dynastic and dynastic times is quite certain, for samples of this grain from these periods are well known. Its importance, however, was shared with Emmer wheat (*T. dicoccum*), and from the frequent 'finds' of the latter, often mixed with barley, I think it is probable that both were of equal importance for a long period, after which other races of wheat probably derived from Emmer took foremost place in the diet of ancient Egyptian and Babylonian populations.

The opinion expressed in the letter of Prof. Netolitzky that wheat was not eaten by the pre-dynastic people of Egypt, if based, as it appears to be, on the results of his examination of the material taken from the intestinal tracts of the Naga-ed-Dêr specimens, is of little value. The microscopic analysis of Prof. Netolitzky revealed the presence of barley husks in this material, and the discovery was confirmed by Frau Gherasim. Wheat husks were not found, and their absence Frau Gherasim asserts "definitely establishes the fact that pre-dynastic people did not eat wheat." Such a conclusion, based on the evidence given, is, to say the least, unwarranted. Two explanations may be given of the absence of wheat husks in the intestinal material examined, namely, (1) the human beings concerned had not recently eaten wheat; (2) in barley the husks (glumes) are closely adherent to the grains, and portions of them are consequently consumed with them, whereas in wheat the husks or glumes are free from the grains and must be removed

before the latter can be used as food. That the husks were removed from Emmer wheat before the grains were used in ancient Egypt is amply proved by the frequent discovery of dehusked grains and the separate empty husks.

In regard to the antiquity of Emmer in Egypt, the following samples have passed through my hands: (1) From an undisturbed site of Badarian people (3500 B.C. or 5500 B.C., Petrie), sent by Mr. Guy Brunton; (2) a sample sent by Miss Caton Thompson obtained from a settlement of the second prehistoric period, near Qau; (3) from straw-lined pits found in the Fayum area by Miss Caton Thompson and dated by Sir Flinders Petrie at least 10,000 B.C. With these Emmers, barley was also found, and in the excavations which revealed sample (3) were also found the naked grains of a race of wheat which cannot be determined with certainty.

During the last week I examined a sample of naked grains of wheat discovered by Prof. Langdon in a vase on the site of an old Sumerian house in Mesopotamia and estimated by him to date from a period at least 3500 B.C. These, in my opinion, belong to a variety of Rivet wheat (*T. turgidum*), a race showing affinities with Emmer and doubtless derived from it. This is the first authentic sample of Rivet wheat which I have seen from ancient Babylonia or Egypt.

The present distribution of wild barley and wild Emmer suggests that even in the beginning of agriculture, primitive man would have the choice of both, and I doubt if ever there was a time when barley only or Emmer alone was the cultivated cereal. All the trustworthy evidence we possess shows that both barley and wheat were grown by the earliest agriculturists of whom we have any definite knowledge, and it appears to me likely that by the time agriculture had become sufficiently advanced to provide for even a comparatively small population, the merits of both these cereals would have been well established.

Into the question whether civilisation originated in Egypt or Babylonia I am not competent to enter, but I may point out that unless climatic conditions have undergone considerable changes in these regions, it may safely be concluded that Emmer wheat and possibly barley were taken there from Syria and Palestine, where they occur in a wild state.

The origin of the all-important bread wheat (*T. vulgare*), which has almost entirely supplanted Emmer and barley as human food, remains obscure; so far as trustworthy evidence goes, it was unknown to the ancient Egyptians and appears to have been a discovery of agriculturists accustomed to a cooler and more northerly climate.

In conclusion, I should like to take the opportunity to urge that small samples, or as much as can be spared, of all ancient cereals, as well as other crops and their associated weeds, discovered by archæologists, should be sent to one central museum—Kew, the British Museum, or the University, Reading, where we have a collection of some 2000 species, races, and varieties of wheat grown annually—where they would be easily accessible for study by experts and their nature more accurately determined than is possible at present, scattered as they are in large and small museums throughout Europe. In the past the naming of ancient cereals, and the wheats in particular, has been appallingly inaccurate, and it is not an exaggeration to say that three-fourths of the published statements about their botanical nature are worthless and misleading, many of them having been made by persons who have had no knowledge of more than one race of wheat, and only recognised wheat grains as distinct from those of barley or oat.

JOHN PERCIVAL.

The University, Reading.

PROF. ELLIOT SMITH has done good service in publishing Prof. Netolitzky's letter in NATURE of Jan. 15, for many must have been puzzled by the discrepancy between the statements made in 1911, and have not had the advantage of the private information with which Elliot Smith very kindly provided me. Frau Hedwig Gherasim's paper has definitely established that barley, and not wheat, was the food eaten at their last meals by the pre-dynastic people of Naga-ed-Dêr, the contents of whose stomachs had been sent to her for examination. To say, however, that this discovery "definitely establishes the fact that the pre-dynastic people did not eat wheat," is more than the facts available warrant.

That barley was used, and presumably cultivated, by the pre-dynastic folk of Naga-ed-Dêr at an early period is quite clear, though precisely how early must remain undetermined until there appears the full report of the excavation of Cemetery 7000, with details of the grave contents. As this was explored in 1901 this publication is long overdue. It has generally been thought that wild barley, *Hordeum spontaneum*, did not grow in Egypt, and no actual occurrence of this plant has been reported. I am indebted, however, to my friend Dr. O. Stapf for the information that during the closing decade of the nineteenth century it was reported from two sites in Tripoli. It is probable, therefore, that at an earlier date it grew also in the north of Egypt. I should be glad, however, to learn the evidence on which Elliot Smith bases his statement that barley is found wild in the regions to the south and east of Egypt.

We can well believe, therefore, that wild barley was brought under cultivation by people living on the banks of the Nile or at the edge of the Delta. Whether they were the only people thus to cultivate wild barley, still more the first to do so, must remain for the present a matter of uncertainty.

Evidence of the occurrence of wheat before the time of King Sahure has been accumulating of late years. In the tomb of Zer, the third king of the first dynasty, Petrie found a carving in wood of an ear, which was at the time described as of 'bearded barley.' It is now accepted by all grain experts as being an excellent representation of an ear of Emmer (*T. dicoccum*). But wheat was known, too, in pre-dynastic times. It is true that the grain found by Legrain and Lampre with a contracted burial between Kawamil and Silsileh, and claimed by them to be Emmer, has been declared by Schultz to be barley, but in the winter of 1912–13 Prof. Peet found at Abydos a range of large pots which had been used for drying grain, and he pronounced them to be undoubtedly of pre-dynastic date. In these were small caked masses of carbonised grain. Some of these grains were examined by Prof. Harvey Gibson, who found them to be wheat (*T. vulgare*). Near by a similar series of pots were found, but containing no grain; these, however, held sherds of decorated pottery belonging to the Middle Pre-dynastic Period.

One may, perhaps, question the identification of this grain as *T. vulgare*. All the grains from Dynastic Egypt so far found have been Emmer, or members of the *dicoccum* group. So far as we know, *T. vulgare* first made its appearance in Egypt in Roman times. It is by no means easy for one who is not a grain specialist to distinguish between *T. vulgare* and *T. dicoccum* in the carbonised state, but Prof. Harvey Gibson is too good a botanist to have mistaken barley for wheat. It is very desirable, however, that this carbonised sample should be submitted to grain experts for determination.

It would appear, then, that during the Middle Predynastic Period, wheat of some kind, almost certainly *T. dicoccum*, was cultivated at Abydos. Yet no one

has claimed wheat as native to Egypt. The distribution of wild Emmer, *T. dicoccoides*, is fairly well established; it ranges from Mount Hermon in Syria to the mountains of Moab. A single plant was found by Strauss in the Zagros mountains between Bagdad and Kermanshah. It would seem, therefore, that wheat and the practice of cultivating it must have been introduced from Asia. May not the cultivation of barley have been similarly introduced, for wild barley has a wider distribution in Asia than in Africa?

I have not yet seen Prof. Breasted's new book, but the passage quoted by Elliot Smith is rather surprising. The tablets he refers to are evidently the Nippur tablets and the Weld-Blundell prism. When publishing the latter, Langdon deduced from it that the date of the first dynasty of Ur was about 4000 B.C., though at the last moment in the preface he reduced this by fifty-six years. If from the same source Prof. Breasted deduces that the date of this dynasty is about 2900 B.C., it is clear that these tablets do not determine the maximum age of the earliest written documents with precision. The difference of more than a thousand years is not negligible.

It is quite likely that the second layer at Susa is contemporary with the first dynasty of Ur. The lowest layer, which contained the painted pottery, was succeeded by another layer containing a different type of ware, and this again by a sterile layer, 1 to 2 metres in thickness, before the layer known as Susa II. was deposited. How long it would take for such a thickness of soil to accumulate on an unoccupied hillock it is impossible to compute, but it is clear that the people of Susa I., who were cultivators of grain, lived very long before the first dynasty of Ur.

One sentence in Elliot Smith's letter has somewhat surprised me: "We know that people lived in Egypt at this time, many centuries before the metal copper was known." It is usually conceded that copper objects occur, rarely it is true, in the very earliest predynastic graves; moreover, Brunton has told us that in graves of the Badarian culture, which are earlier still, he found beads made of narrow copper ribbon and a stout copper pin or borer.

I should like to explain that the reason why the facts adduced by Elliot Smith relating to the early use of barley were not mentioned in recent discussions at meetings of the British Association and at the Royal Anthropological Institute was not that they were unknown to many of those present, but that both discussions were confined to the early cultivation of wheat in Egypt, and the question of barley did not arise. I trust, however, that these few lines, giving items of information apparently not very well known, may help to remove some of the widespread misunderstanding of which Elliot Smith quite rightly complains. I hope to deal with the question more fully at the Royal Anthropological Institute next week.

HAROLD J. E. PEAKE.

Westbrook House,
Newbury, Jan. 17.

Biological Fact and Theory.

ON returning from a holiday, my attention has been directed to an attack upon my book "The Physiology of the Continuity of Life," which appeared in NATURE on Dec. 25.

Fortunately an author is not expected to defend himself from criticism, just or unjust, but there is one point in the article which requires attention. The reviewer quotes the statement, "The F_2 shows all gradations from bar-eye to normal eye," and calls upon me to withdraw it. The words occurred as one of the following sentences:

"There are many examples of failure to show the clear-cut differentiation expected in the F_2 generation. Morgan cites the case of the cross between the normal and bar-eyed *Drosophila*. The F_1 generation is intermediate. The F_2 generation shows all gradations from bar-eye to normal eye. Here the segregation does not seem to be complete."

Morgan's words in his "Physical Basis of Heredity," page 31, are: "A mutant eye shape of *Drosophila*, called 'bar' (Fig. 7, *a*), has an intermediate hybrid type (Fig. 7, *b*). The F_2 group may be represented (Fig. 8) in the following scheme:

"Fig. 8.—Relation of bar-eye to normal eye, as shown by the F_2 classes.

In this case the hybrid, intermediate type overlaps the bar type, so that in F_2 these two latter types give a nearly continuous class. At the other end of the F_2 series the round-eyed normal (or wild) type can be distinguished without difficulty from either of the other classes."

I think that my interpretation is justified.

D. NOËL PATON.

University of Glasgow,
Jan. 7.

PROF. PATON'S letter is another instance of what I complained of in my review—failure to grasp the fundamentals of genetics before proceeding to attack and criticise its conclusions.

What are the facts about bar-eye as revealed by Prof. Paton's quotation from Morgan? They are: (1) That bar is a partial dominant; (2) that the variability of the heterozygote is greater than that of either homozygote; (3) that the heterozygote's eye-type overlaps that of the dominant; (4) but that it does *not* overlap that of the recessive (wild-type or round eye).

Three further important points not quoted by Prof. Paton are as follows: (5) In F_2 the frequency curve for facet-number (eye-size) is definitely trimodal. There is a discontinuity between the round-eye mode and the rest; but the "nearly continuous class" comprising bar and heterozygote types shows two well-defined modes. (6) The overlap only occurs in the females. This, however, does not mean that the males show segregation, the females not, but is of course due to the fact that no heterozygous males can exist, since Bar is sex-linked (the frequency curve for males alone is therefore bimodal, while that for females alone remains trimodal). (7) We can therefore, as regards overlap, consider only females. But if *any* female from the "nearly continuous class" be taken and crossed with a wild-type (round-eyed) male, one of two results will invariably be seen in the female offspring: either (*a*) they will all be of heterozygous type, with a unimodal frequency curve; or (*b*) they will be half round-eyed and half of heterozygous type, *with no overlap*. Further (*c*), if enough individuals be tested, the ratio of those giving result (*a*) to those giving result (*b*) will approximate 1 : 2.

This can only be explained if the female parents are either of constitution BB or Bb, and that therefore segregation did occur in the germ cells of F_1, as well as in their own germ cells.

Even apart from these additional points, however, the quotation from Morgan definitely shows that segregation exists. For F_1 was all of the heterozygous type, not overlapping with the recessive round eye; and yet in F_2 this recessive wild-type eye was recovered pure, and without overlap!

It should, however, be strongly emphasised that this question of phenotypic overlap has of itself nothing to do with the question of segregation; and this is the graver error into which Prof. Paton appears to have fallen. Segregation—I also quote from

Morgan ("Mechanism of Mendelian Heredity," p. 1) —consists in this, that "the units contributed by each parent separate in the germ-cells of the offspring without having had any influence on each other." The *expression* of any unit in phenotypic characters will of course (again an elementary fact) vary with (*a*) environmental factors; (*b*) the presence or absence of other genetic factors affecting the same character (*i.e.* multiple or modifying factors). The overlap of the heterozygote type with that of one homozygote (which was of course complete in Mendel's original experiments) has *no bearing* on the question of segregation; nor indeed does its overlap with both homozygotes. In such cases, as Mendel showed sixty years ago, breeding tests must be used to discover the constitution of the organisms. For example, in Mendel's tall × dwarf cross there is considerable height-variation of the tall F_2 class (due to environment); but breeding-tests to F_3 (or back-crosses as in my point (7)) show at once that all the tall individuals are either pure talls (TT) or heterozygotes (Tt); some TT's will be taller, others shorter, than the average Tt, and vice versa. The same procedure will prove segregation even when the heterozygote phenotypically overlaps both homozygotes.

I must apologise for going into such elementary facts in the columns of NATURE; but I can only repeat what I said in my review, that the course of biological progress is impeded when distinguished men in positions of authority attack whole disciplines of biology without having understood their data and principles sufficiently well to avoid elementary mistakes.

It may, in conclusion, be mentioned (what again Prof. Paton appears not to be aware of) that in the last few years Zeleny and his pupils have shown, by using purified inbred stock under well-standardised environmental conditions, that the high variability of bar-eye and its heterozygote depends partly on temperature during a 'critical period' of development, partly on specific modifying genes. The pure stock under standard conditions loses the large phenotypic variability described by Morgan, just as a chemical substance ceases to behave irregularly when purified and when experimental procedure is improved.

In this purified stock at 25° C., the mean facet-number (which is directly proportional to eye-size) for females of the classes in question is as follows (Morgan, 1925, "Bibliographica Genetica," vol. 2, 31-32):

Homozygous bar (pure stock or extracted in F_2)	68
Homozygous round-eye (pure wild-type or extracted)	779
Heterozygous bar (F_1 or F_2)	358

It is obvious to my mind that Mendelian theory is far from complete. We know, *e.g.*, very little about the way genes act during development to influence phenotypic characters, and still less about the causes of mutation. But progress will be achieved by building on the ample foundation already obtained by tens of thousands of breeding-tests, not by going elsewhere to erect a superstructure without adequate foundations.

J. S. HUXLEY.

King's College,
Strand, W.C.2.

IN NATURE of Dec. 25, there appears a long review of Prof. Noël Paton's book, "The Physiology of the Continuity of Life," by Prof. Julian Huxley, who criticises the book severely because its author attacks from the point of view of the physiologist the whole edifice of the theory of genes or factors in heredity. I do not propose to intervene in order to support Prof. Paton, who is perfectly capable of defending himself, but Prof. Huxley has seen fit to attack the work of Tornier and to blame the author, and incidentally myself, for holding that it has any bearing on the question of heredity. It was I who gave to Prof. Huxley the references to Tornier's work, and I hold that this work is the most important, and indeed the only work on the causes of mutations which has yet appeared, and that it is worth all the factorial analyses put together. As this work is little known to readers of NATURE, may I briefly summarise its principal features?

Tornier investigated the conditions under which 'fancy races' of goldfish were bred in China, which is the original home of the species. He found that there was nothing recondite in the methods of these breeders; the fish were exposed to insanitary conditions and deposited spawn in these circumstances. The greater part of the eggs died. What survived gave rise to fish of varying degrees of abnormality, and *when these fish were bred these abnormalities were transmitted in some degree to their offspring.* By selection, a reasonably 'pure' 'fancy' could be produced in a few generations.

Tornier analysed the physiological causes of the development of these abnormalities, and showed that they could be reduced to a weakening of the developmental energy of the germ at a critical period of development, and that this weakening was transmitted to posterity and produced in each generation the same results. He imitated as nearly as possible the Chinese breeders' methods with the eggs of Amphibia and got similar abnormalities. He does not give details of experiments on breeding, but he expressly states that all these abnormalities are inherited. Anyone who asserts that Tornier's experiments have no bearing on the inheritability of mutations is, in my opinion, wilfully blind.

As to the inheritance of acquired characters, which is the other great factor in inheritance, Prof. Huxley refers to Dr. Noble's communication to NATURE of Aug. 7 on the subject of Kammerer's Alytes as if that closed the controversy. He does not refer to my answer to Dr. Noble. Since I wrote this, however, new light has been shed on this painful matter. The American journal *Science* has published verbatim the last pathetic letter which Kammerer wrote. In this letter, addressed to the University of Moscow, he explains the reason for his intended suicide. He gave full permission to Dr. Noble to examine his specimen of Alytes, believing that it would prove conclusive. He was greatly shocked at Dr. Noble's conclusion that it had been 'doctored' with Indian ink. He examined it himself and confirmed Dr. Noble's finding, and sadly acknowledged that the evidential value of this particular specimen had been destroyed. But he found also *that many others of his specimens on which Dr. Noble had not reported had been similarly treated*, and that all the fruit of his pre-War work, which would require twenty years to repeat, was gone. He did not feel the energy to begin all over again and so ended his life.

Dr. Przibram and the colleagues who knew Kammerer best, continue to have full confidence in him and are getting up a fund to perpetuate his memory. Perhaps Dr. Noble could throw light on the source from which he obtained the information that he would find the specimen of Alytes treated with Indian ink, as that might help us to discover the miscreant who, to damage Kammerer's credit, destroyed his life-work behind his back.

In conclusion, I should like to say to Prof. Huxley that the game of the mutationist opposition to

Lamarckism is up. Evidence in favour of Lamarckism is pouring in from all quarters. I direct his attention to the recent work of Metalnikoff in the Institut Pasteur, who, experimenting with the caterpillars of the genus Galleria, showed the inheritability of acquired immunity. This work was continued for nine generations under standardised conditions with adequate controls. E. W. MACBRIDE.

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South Kensington, S.W.7.

DURING the past twenty years I have made several contributions to the evidence in favour of the chromosome theory of heredity, the last in 1926. I am not nearly so sure as I was of the universal validity of that theory, and I hope that even in my callow youth I was never so dogmatic about it as is Prof. J. S. Huxley in his review of Prof. Noël Paton's book (NATURE, Dec. 25, p. 902). I feel that some protest should be made lest the constant repetition of certain dogmatic statements by Prof. Huxley and others of the same school should lead to a general belief that these statements represent proven facts accepted by all biologists who are familiar with this particular branch of knowledge.

When the mode of distribution of the chromosomes to the daughter cells during the production of the gametes is compared with the manner in which the Mendelian characters appear in breeding experiments, the coincidence seems at first sight to be overwhelmingly in favour of the chromosome theory, so much so that it appears to have blotted out every other point of view to many people. To me, however, it appears to give us no more than the right to assume that the appearance of certain characters or groups of characters may possibly be determined by certain chromosomes. Prof. Huxley has stated before, and states again in his review, that the "hereditary constitution of at least all higher organisms consists of a number of units (factors or genes), each of which may exist in a number of forms (allelomorphs); these genes exist in definite proportions, and are arranged in a definite order; the whole gene-complex is divided up amongst the separate chromosomes." He states these as proven facts which are thoroughly established, and not questioned except by those who are unaware of these claims, amongst whom he apparently places Prof. Paton.

Anyone who has dissected a chimpanzee must have been struck by the extraordinary similarity between its characters and those of man, similarities that extend to small branches of particular blood-vessels and nerves and to folds in the skin. If we believe in evolution of any kind we must believe that the bulk of our characters have come to us from remote pre-human ancestors through countless generations, all the individuals of which developed these characters in turn, and that the appearance of these characters depended upon their "hereditary constitution." I must point out, at the risk of being platitudinous, that it is only the capacity for developing a character under certain very limited conditions, and not the character, that is inherited.

Now to me it is difficult to imagine how all the characters in a complicated organism such as man can be conveyed by units or genes which are contained in individual chromosomes. The very mechanism that makes the theory fit so well with the appearance and disappearance of certain characters in successive generations in Mendelian experiments, is an obstacle when the fact is kept in mind that most characters are common to all individuals of the race. In the one case a given character appears in a certain proportion of the offspring and does not in the rest; in the other the character appears in all.

It may be claimed that what I describe as characters are not characters in the sense intended by Prof. Huxley. In what, then, are they different except in degree? To me it appears that the presence of a head, of ten fingers, extra digits, the colour of the eyes, the shape of the section of the hair, the colour of the skin, and such diseases as hæmophilia in man are all of them due to the hereditary constitution of the fertilised ovum and the action upon it of the environment. But it also appears to me that we cannot place all these characters in the same category as regards their mode of inheritance. Some might be due to units carried by individual chromosomes, others would of necessity appear to be conveyed by a potentiality in the cell elsewhere than in the chromosomes, when we consider how these are distributed during the production of the gametes.

My own belief is that the Mendelian mode of inheritance is confined to comparatively recent variations, and this belief is the more acceptable to me in that it provides for the ready elimination of the useless variations, as important a factor in evolution as the preservation of the useful.

I see that Prof. Huxley in his review limits himself to "at least all higher organisms" as regards his view of the chromosome theory, a limit I have not noticed that he has made previously. I quite appreciate why he has done this, but I think that it would have been wise to have pointed out that there is a number of organisms in which the distribution of the chromosomes is such that they could not possibly convey a Mendelian character (Dobell, *La Cellule*, t. 35, 1 fasc. 1924, and others.) This being the case, the function of the chromosomes in these organisms must be something entirely different from what it is in the higher organisms, to me an entirely unwarrantable assumption. CHARLES WALKER.

Television.

THE article headed "Television" which appeared in NATURE of Jan. 15, contains the following statement: "a difference of phase of only one degree is capable of spoiling definition." Were this statement true, my television system, depending as it does on synchronism, would certainly, as the writer states, be faced with a very serious barrier. It is, however, a misstatement of fact. Phase difference between receiver and transmitter has no effect whatever upon definition, the whole effect being a displacement of the image as a whole.

Later in the article a statement is made: "The recent claims to have transmitted 'outlines' by infra-red rays mark no advance toward television with diffusely reflected light." This is an erroneous statement. I have on no occasion made claims to have transmitted 'outlines' by infra-red rays. What I have actually demonstrated is the transmission of real images of living faces in complete darkness, using diffusely reflected infra-red rays.

An open invitation was extended to members of the Royal Institution to witness these results, and on Dec. 30, 1926, some forty members of the Institution were given demonstrations at our laboratories. Among those who have witnessed demonstrations I may mention Dr. Russell, Mr. R. W. Paul, and Mr. Creed, who are, I think, sufficiently well known in the scientific and engineering world. In these demonstrations one party remained in a totally dark room; the second party, in a different, were then shown the faces of any of the first party who cared to sit in front of the transmitting apparatus in the dark room.

My discourse at the exhibition of the Physical Society is criticised and the statement made that it was "not the way to convince a sympathetic audience of experts." I was requested by Dr. Rankine, the secretary of the Society, to deliver a lecture suitable for a public audience interested in scientific matters generally, but not experts on television. The lecture was therefore of a semi-popular type and in no way intended for an "audience of experts."

While the writer of the article in NATURE appears to be dissatisfied, judging by the reception which the lecture was given and the appreciative letters which I have received, I am assured that opinion was not shared by the bulk of the audience.

I am further criticised for withholding technical details. The writer of the article is surely aware that my inventions are the property of a limited company. The disclosures by me of technical details likely to assist competing interests would therefore be a grave breach of trust to the shareholders. I may further add that we have demonstrated the invention to Government experts, and have received a letter from the Government requesting us to withhold publication of technical details.

The writer states further that: "There are at least three pioneers in the field who appear to be on the verge of a complete solution of the television problem," and mentioned Belin, Jenkins, and Alexanderson. The results which, according to press reports, they have demonstrated should be mentioned. Belin and Jenkins have succeeded in transmitting crude shadowgraphs; and Alexanderson, within the last few weeks, apparently claims to have achieved the same feat. This is a long way from television, and does not justify the statement that they appear to be on the verge of a complete solution of the television problem.

JOHN L. BAIRD.

Television Limited, Motograph House,
Upper St. Martin's Lane, London, W.C.2,
Jan. 19.

THE further information given above by Mr. Baird is precisely the kind which physicists were waiting for. In the absence of a clear description in technical language, many misconceptions are bound to arise, and it would be well for Mr. Baird to consider the advisability of making such a communication at the earliest opportunity consistent with his other obligations.—EDITOR, NATURE.

The Auroral Green Line 5577.

MESSRS. McLennan, McLeod and McQuarrie have published in NATURE, vol. 118, page 441 (Sept. 25, 1926) the results of some recent experiments on the origin of the auroral green line 5577. During July and August last, while a guest of the Nela Park Research Laboratory, at the kind invitation of Dr. W. E. Forsythe, I had the opportunity of investigating spectroscopically the electrical discharge in mixtures of (1) helium with oxygen, and (2) argon with oxygen. The relative proportions of the two gases in each mixture were varied as well as the current through the gases. In the case of helium with oxygen, traces of this green line were found on some plates, but its intensity was usually very feeble. In one experiment, however, with argon and oxygen, the line 5577 appeared very strongly, about one-half the intensity of the argon line 5559, the iron arc spectrum being used for comparison (Fig. 1. I am indebted to Prof. Lloyd for the enlargement).

The discharge tube was made of pyrex tubing 8 mm. in internal diameter, and was fitted with tungsten electrodes which had been 'outgassed' before introducing the mixture of argon and oxygen (argon pressure = 40 mm., oxygen pressure = 8 mm.). The tube was of H-form, and the discharge was viewed along the bar of the H with a Hilger quartz spectrograph of the D type. The current used was 80 milliamp./cm.², and the potential 800 volts.

When the tube had run for one and a half hours, a second photograph was taken on which the line 5577

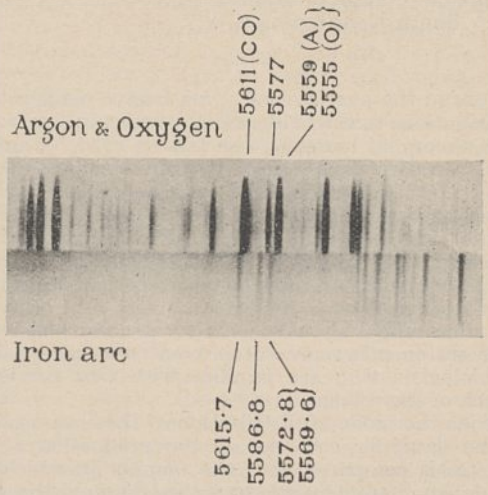

FIG. 1.

was entirely absent. The oxygen had combined with the tungsten, forming a bluish deposit of tungsten oxide on the glass near the electrodes. This result confirms the recent work of McLennan and his co-workers, and the absence of the line when the oxygen was removed is further evidence that the line is primarily due to the oxygen.

DAVID A. KEYS.

McGill University.
Montreal.

The Polishing of Surfaces.

MR. MACAULAY and Mr. Preston, in their letters in NATURE of Sept. 4, 1926, and Jan. 1, 1927, raise the interesting question of the mechanism by which the surface layer is produced in the process of polishing. This layer, so thoroughly studied by Beilby, resembles a supercooled liquid so nearly that it has been suggested that the surface layers are liquefied.

It does not seem necessary to suppose that actual liquefaction occurs. An amorphous layer indistinguishable from a supercooled liquid will be formed by any mechanism which rearranges the surface molecules at random. The polisher adheres to the surface, and especially with the high coefficient of friction mentioned by Mr. Preston, will tear away the surface particles of the glass when it is moved. Hardy found the surface of solids to be torn by the mere motion of a slider. Some of these particles will naturally be redeposited elsewhere at random, thus forming the amorphous layer. Some of the particles torn away must be of molecular dimensions for the final result to be a completely amorphous layer.

Surface tension in the ordinary sense does not enter into the problem, but since the flat, liquid-like surface is that of least potential energy possible in the circumstances, molecules are more likely to be deposited as part of such a surface, and less likely to be removed from it, than otherwise. The crystalline state, of still less potential energy, will not be formed, as sufficient time is not allowed in the redeposition of particles. This mechanism is actually more likely to

produce a completely amorphous layer than liquefaction, for the resolidification of a liquefied surface layer might result in the formation of small crystals.

In his article on 'Polish,' the late Lord Rayleigh concluded that the material is worn away 'almost molecularly.' Some redeposition seems necessary in order to account for the amorphous layer. Probably the polishing, as distinct from an abrading agent, tends to remove particles of molecular dimensions; and the yielding nature of the support frequently used assists the molecules or atoms adhering to the polisher to come frequently into close contact with the glass or metal, and thus promotes redeposition.

N. K. ADAM.

University of Sheffield,
Jan. 8.

Fine Structure of the Balmer Lines of Hydrogen.

USING two optical trains, (1) two crossed Lummer plates, the larger of resolving power 670,000, and (2) an echelon of resolving power 660,000, with a vacuum tube of the Wood form having a 1 cm. diameter capillary, cooled with liquid air, we have determined the wave-length differences between the two well-known components λ' and λ'' of H_α, H_β, and H_γ ($\lambda' < \lambda''$), and have sought to obtain still further resolution. The doublet separations are shown in the subjoined table together with those given by Houston (*Astrophys. Jour.*, 64, 2, 1926, pp. 81-92), which latter are, in our estimation, the most trustworthy thus far obtained.

Our values are somewhat higher, but this possibly is not to be wondered at, because of the different current densities employed, 250 against 25 milliamperes per sq. cm. A very trustworthy Lummer plate spectrogram, taken at 13 milliamperes per sq. cm., yields 0·1391 for H_α, which is in harmony with such a current change.

The search for other components revealed a third on the longer wave-length side of λ'. This component is not fully resolved but is clearly present. Moreover, λ'' is distinctly narrower than λ', and under the discharge conditions employed is somewhat more intense. λ' of $H\beta$ also shows an asymmetry of the same nature but about one-half as great. Hansen (*Ann. der Physik*, 78-6, 22, pp. 558-600, 1925) has noticed asymmetries in both these cases.

$\Delta\lambda$ IN TENTH-METRES.

Line.	Houston. (250 ma./sq. cm.)	Kent, Taylor, and Pearson. (25 ma./sq. cm.)	(13 ma./sq. cm.)
H_α	0·1358	0·1370	0·1391
$H\beta$	0·0782	0·0791	..
H_γ	0·0665	0·0669	..

Details will be published in the *Proceedings of the American Academy of Arts and Sciences*, or elsewhere.

NORTON A. KENT.
LUCIEN B. TAYLOR.
HAZEL PEARSON.

Boston University,
Boston, Mass., Nov. 19.

Ionisation Phenomena in Active Nitrogen.

IN some recent experiments with active nitrogen, it has been found that ionisation effects differ with the gases mixed with the nitrogen. When the active nitrogen alone was drawn past an ion trap into cylindrical condensers, the negative charges obtained were found to be proportional to the areas of the negative electrodes, indicating that the conductivity is due to photo-electrons emitted from the electrode and not to the production of free ions in the gas. The same observations were made when hydrogen and mercury were added to the active nitrogen before it entered the condenser. With iodine (ionisation potential 9·4 volts), however, a different ratio of currents was obtained, showing that ionisation is produced in the gas. This suggests that the phenomena associated with active nitrogen may be due to a metastable state of the nitrogen molecule with energy between 9·4 volts and 10·4 volts. The effect of various gases on the deviation of the after-glow was examined, the most important result being that it is not affected by helium when the helium is made ten times the density of nitrogen.

PH. A. CONSTANTINIDES.

Ryerson Laboratory,
University of Chicago,
Dec. 17.

IT may be remarked that I showed long ago that the ionisation associated with the decay of active nitrogen was dependent on the gases mixed with it (*Proc. Roy. Soc.*, vol. 86, pp. 60, 61, 184, 1911–12). In particular, sodium vapour greatly increased the effect obtained with nitrogen alone, and oxygen or nitric oxide greatly diminished it. Mercury had little effect, as in the experience of Mr. Constantinides. The views expressed by him scarcely seem adequate to cover all the above facts. But the subject is doubtless well worth pursuing, with the much greater theoretical illumination of the present time.

RAYLEIGH.

Jan. 5.

The Problem of Secretion.

THE summary of Bowen's recent discussion of the cytology of secretion in NATURE of Jan. 1, p. 30, fails to do justice (as Bowen himself has done in his papers) to the contribution of other workers to this difficult subject.

The earlier work of Golgi, D'Agata, Cajal, and Da Fano, and the investigations of Bowen's immediate predecessors and contemporaries, Nassonov, Brambell, Ludford, and Cramer, contribute so materially to the establishment of our present state of knowledge, that the impression conveyed by the summary in NATURE that this work is solely the achievement of Bowen is, we feel, unfair to the other investigators mentioned. As representing the institutes in which much of the work in Great Britain has been carried out, we think that this article should not be allowed to pass without comment.

JAS. P. HILL.
J. A. MURRAY.

Department of Histology and Embryology,
University College,
Imperial Cancer Research Fund,
Jan. 4.

MOST of the short notice referred to was prepared as paragraphs for "Research Items," which accordingly were intended to be simply a summary of the position of the problem as presented by the author. The paragraphs were afterwards arranged, with little modification, in the form of a short notice. This was offered as a brief statement, not for the specialist but for the more general reader, of the present position as set forth in one of the latest accounts of the subject; it was not intended to be a review of the literature of the problem. Such a review, which would need to be much more extensive, would, of course, take full cognisance of the previous investigations referred to in the above letter.—EDITOR, NATURE.

Popular Long-Range Weather Forecasts.

THE 50-day weather forecasts published in the *Daily Mail* have attained such popularity that an authoritative pronouncement from science as to whether they have or have not any real value has become desirable, and Capt. Cave is to be congratulated on opening an investigation on the subject.

The principles on which the curves are prepared are largely empirical, so that it is only by long-continued comparison of expectations with facts that their dependability can be estimated or improvement can be effected. Their preparation entails a large amount of labour and involves the maintenance of an office with technical assistance. They have never received the support of official meteorology, so that, without the public-spirited enterprise first of the *Field* and now of the *Daily Mail*, the work could not have been carried on. From the point of view of science, two consequences of this are unfortunate :

(1) The form in which they appear is popular rather than scientific.

(2) It has not been possible to publish full details of the methods used without disloyalty to those who have backed them.

Before trying to compare the expectation diagrams with facts, it is necessary to be quite clear as to what is aimed at in them. Since they are published for popular use and not for scientific study, the explanation given with them is not so complete as a scientist might wish. It is stated that—

(1) Nothing approaching infallibility is claimed.

(2) The diagrams indicate the expectation of rain; the higher the curve the greater the expectation.

(3) The curves are not intended as day-to-day forecasts, and their author is quite satisfied if the timing of his expectations is correct within 24 hours either way.

This was explained in some detail, but in popular form, in the *Daily Mail* of April 30, 1926.

For the benefit of more scientific readers their author would like to add :

(4) The datum line and the shaded and blacked areas are intended only as a guide to the eye and have no precise significance.

(5) While the curves primarily indicate degree of expectation, it is reasonable that they should also show some relation to rain amounts. At one time the investigations were based on rain or no-rain, 50 mm. being counted as exactly the same as 0·2 mm., but now (as from June 17, 1926) the factor of amounts has been introduced into the expectations, and their author aims at checking his results for each station by plotting the actual rain amounts to the vertical scale shown in the following table, which is roughly proportional to the logarithms of the amounts. It will be realised that this is an extremely searching test, and one which even 12-hour forecasts would not be able to stand.

Rain Amount.	Vertical Scale.
Nil	− 2 units
Up to 0·1 mm.	− 1 ,,
,, 1·0 ,,	0 ,,
,, 2·0 ,,	+ 1 ,,
,, 5·0 ,,	+ 2 ,,
,, 11·0 ,,	+ 3 ,,
,, 25·0 ,,	+ 4 ,,
,, 56·0 ,,	+ 5 ,,

(6) The diagrams for the British Isles as a whole show the extent to which rain is expected to be general over the British Isles.

It is to be regretted that Capt. Cave did not study the *Daily Mail* of April 30, 1926, or communicate with the author of the diagrams before making his tests, for it will be seen that neither his " weather numbers " nor his " forecast numbers " are appropriate. Both his criticism and his diagrams, therefore, being based on those numbers, fail to apply.

Further, since the complete set of curves is made for the 50 days independently every week, each one has a character of its own, and should be considered as a whole. To select the fourth to the tenth days out of each 50 for criticism is like criticising a 12-hour forecast by examining the weather for an interval of 103 minutes out of each day. For this reason, too, the comparison made in Capt. Cave's diagrams is not a fair one.

The *Daily Mail* curves are based on the combination of fifteen cycles which are selected for each of the four stations every week. Some of these cycles are well known, and no originality is claimed for them ; others have been developed for this special purpose, and have stood the test of time ; others again are still in the experimental stage. The method of selecting the cycles depends partly on permanent factors, which can be anticipated for any length of time ahead, and partly on temporary factors, which may change from time to time. While, therefore, some of the cycles usually remain the same from week to week, often changing conditions introduce new ones, causing more or less variations in the expectation curves. Such variations do not seem unscientific or in any way unreasonable. They must be admissible even in a 12-hour forecast—if a forecaster at 8 A.M. expects a heavy shower at 2 P.M. and at noon modifies his forecast and expects a moderate shower at 3 P.M. instead, we do not regard him as a fraud or his forecasts as worthless. Whether or not the diagrams under discussion are invalidated by the modification is a question of degree which can only be decided by a careful comparison of a series of complete diagrams over a long period.

For this purpose two sets of diagrams are here shown. Fig. 1 is a series of ten expectation curves as published in the *Daily Mail* for the British Isles as a whole, covering the period June 18–Oct. 7, 1926. This series is a fair average sample, and it shows the extent of the weekly variation in the

curves for the British Isles; at individual rain gauges obviously somewhat greater variation must be expected. As a convenient check on the results, a curve of facts has been added in which the ordinates are made proportional to the number of rain gauges, out of the 43 British reporting stations, which have recorded rain (0·2 mm. or more) during the 24 hours.

Fig. 2 is a series of five expectation curves for the Scilly Isles, covering the period July 2 – Sept. 16, 1926, together with a curve of facts plotted according to the logarithmic scale explained above. This series is selected from among those which Capt. Cave criticised, and is perhaps above the present average of achievement.

Such a juxtaposition of a series of expectations with facts seems to be the only fair and conclusive method of testing them; but it will be seen that the method is a severe one, and it will perhaps be agreed that, if any series of 12-hour forecasts were graphed in the same way and checked for every quarter hour, they would probably not compare with facts nearly so well as these do.

The diagrams for the Scilly Isles were also tested on the basis of day-to-day expectations checked with rain or no-rain facts, and the degree of success attained was compared mathematic-

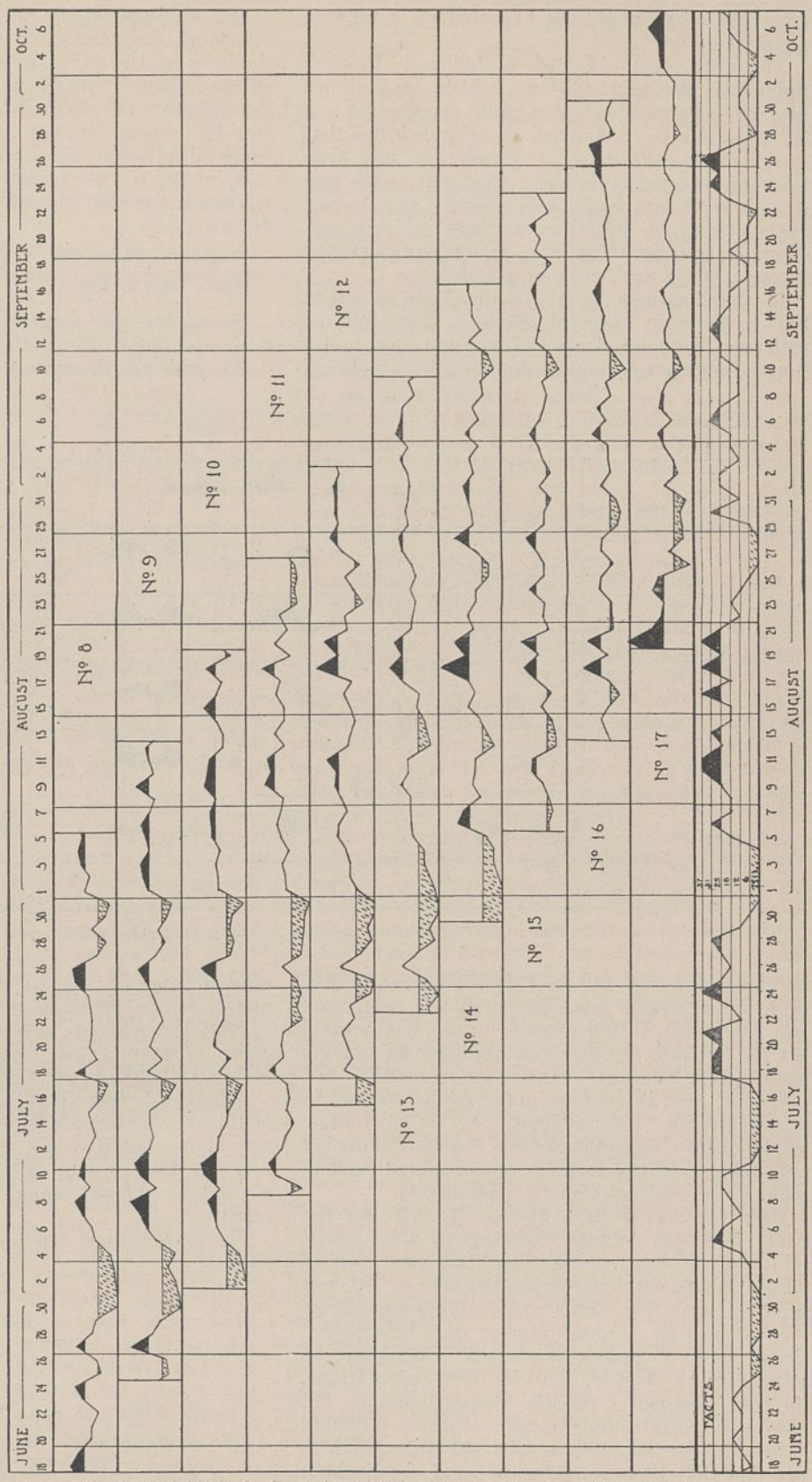

FIG. 1.—Great Britain and Ireland. Comparison of *Daily Mail* charts with observations of ten diagrams for 1926.

ally with what might be expected of a random guesser.

The data were obtained as follows: In each published curve, each day which was shown blacked was regarded as a rain expectation; if 0·2 mm. or more of rain was officially recorded that day, it was considered a success; if less than 0·2 mm. of rain, a failure. Similarly, each day which was shown shaded was regarded as a no-rain expectation; if less than 0·2 mm. of rain was officially recorded that day, it was considered a success; if 0·2 mm. or more, a failure.

In the diagrams for the Scilly Isles shown in Fig. 2, the rain expectations have been marked with an arrow pointed upwards, the no-rain expectations with an arrow pointed downwards. It should be mentioned that the published diagrams always begin on a Friday, but, since they are completed and leave their author's hands on the Wednesday, for the purpose of his own checking he always includes the Thursday's expectation, which is not published, and it has been done for the purpose of this check too. This is slightly to his advantage, for 12 definite expectations for the first Thursday are included in the series here considered, and of these 8 were successes and 4 were failures.

Over the period June 17–Dec. 3, 1926, for the Scilly Isles 640 definite expectations were made. Of these, 412 were successes and 228 were failures on the day-to-day basis explained above. At first sight this may not seem a very striking measure of success, and for a small number (say 12 expectations) such a proportion could reasonably be attributed to chance; but for 640 expectations, the odds against a random guesser making 412 successes are incredibly large. If any one doubts it, let him try spinning a coin 640 times, and he will find that he never gets anything approaching 412 of either heads or tails.

The odds against the random guesser were tested according to the theory of probability. Given that the facts for the days considered were 348 rain and 292 no-rain, also that the guesser makes 640 guesses, knowing that the normals for the period are 95 rain and 74 no-rain, so that he would guess rain 360 times and no-rain 280 times.

Assuming the above data only:

The chance that the guesser would get exactly 412 successes is

$$\frac{348 \times 292 \times 360 \times 280}{240 \times 108 \times 120 \times 172 \times 640} = 7{\cdot}00 \times 10^{-13}.$$

By adding the chances of more than 412 successes we get $1{\cdot}01 \times 10^{-12}$.

The odds are therefore $9{\cdot}90 \times 10^{11}$ to 1 against a random guesser scoring 412 or more successes under the conditions assumed.

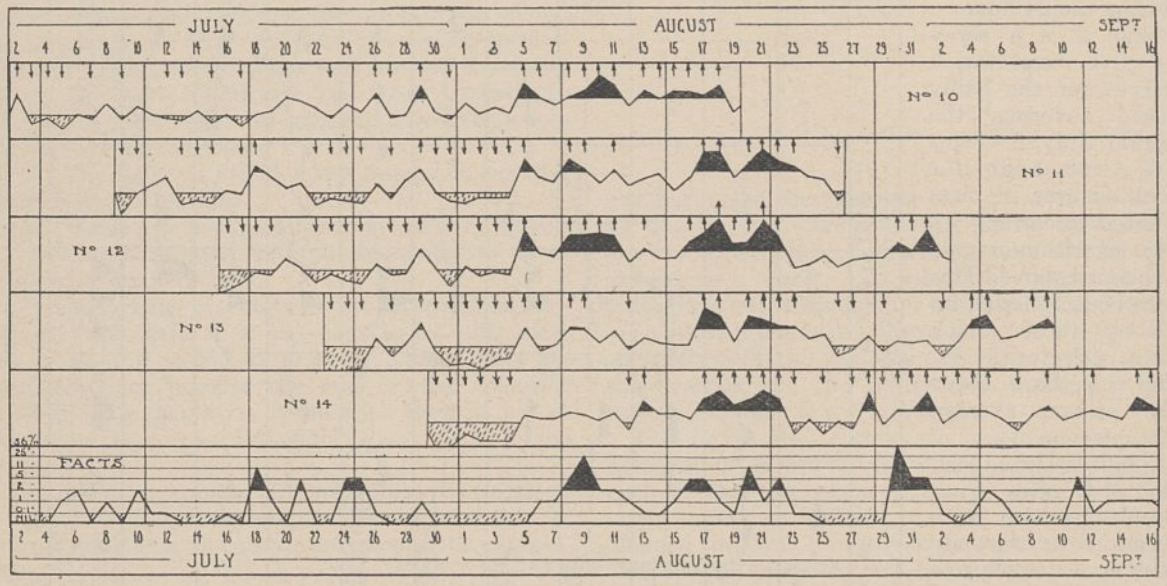

FIG. 2.—Scilly Isles. Comparison of expectations with observations, 1926.

These calculations were made by Mr. W. Hope-Jones, of Eton College, and confirmed by Dr. R. A. Fisher, of Rothamsted Experimental Station.

Admittedly there may be factors which perhaps ought to be included, and might, if included, reduce this figure, but it would appear that, in whatever way the problem may be tackled, the odds against a random guesser doing so well are practically infinite.

The expectations and facts may be tabulated as follows:

	Expectations.		
	Rain.	No Rain.	Total.
Rain Facts . .	243	105	348
No-Rain Facts .	123	169	292
Total	366	274	640

It has been the purpose of this article to show that—

A. Owing to the popular form in which these expectations are produced, Capt. Cave formed an erroneous conception of their aims, so that his arguments were unsound and his conclusions misleading.

B. A careful examination of a series of diagrams indicates that

(1) Variations from week to week are not great, and generally tend towards improvement as time advances.

(2) Although it is not claimed that rain amounts are correctly anticipated, the peaks and dips of the expectation curves correspond with those of the facts curve in many cases to the actual day, and in most cases to within 24 hours.

(3) There is a degree of correspondence between expectations and facts which cannot be wholly due to chance.

C. The above is confirmed definitely and conclusively by the calculations based on the theory of probability.

If these propositions are accepted, and it would seem hard to dispute them, then it must be agreed that the claims made in the *Daily Mail* are more than substantiated, and that what Capt. Cave condemns as no better than fortuitous prediction has been proved to be something of the order of a billion times better, and represents in fact a notable advance in meteorological science.

R. P. BUTLER.

CAPT. BUTLER complains that my weather and forecast numbers are unfair, and appeals to the *Daily Mail* for April 30. The only relevant sentence seems to be that the greater the height of the curve above the datum line the greater the probability of rain, but not necessarily the amount of rain; I do not think that this fact invalidates anything I have said. I have already explained the method of comparing the forecast diagrams with the weather, and I am quite content to leave it to the readers of NATURE to say whether the method is fair or unfair.

It is also said that the forecasts are not meant to be day-to-day forecasts; they are, however, given in a day-to-day form, and are, I think, generally so taken by the public; Capt. Butler, however, emphasises the point and says that the author is quite satisfied if the timing of his expectations is correct within twenty-four hours either way. The number of wet days with 0·04 inch of rain or more is about 120 in the year for the south-east of England, or one day in every three; any one forecasting rain for to-day and claiming a success if rain comes yesterday, to-day, or to-morrow, is putting his forecast in a very favourable position. If one were to forecast by drawing counters out of a bag, the successes under the above conditions would be very marked.

I do not understand Capt. Butler's complaint that I only took one forecast for each week for the purpose of comparing them with the weather in my diagrams. I took the complete week nearest to the actual happenings as being the most fair to the author. Capt. Butler says that each 50-day forecast has a character of its own, which is exactly what I maintained. I have selected one of the seven varying forecasts for each week and compared it with the actual weather, and I have done this for the whole period from April 15 to Oct. 27. To say, as Capt. Butler does, that doing this is like "criticising a 12-hour forecast by examining the weather of 103 minutes out of each day," seems to me to be a statement devoid of meaning. If the forecasts are in the main similar, there is nothing unfair in taking any one in preference to the six other forecasts for the same week; if they differ, it is reasonable to suppose that the one nearest to the period for which the forecast is made would be the most correct; I therefore took the first complete week of the latest forecast. Capt. Butler's diagrams show exactly what I maintained, that the forecasts for each week vary so materially as they are issued week by week that they cannot all be guides to the coming weather. Nor are his diagrams of facts compared with forecasts very striking. I pointed out that August was a particularly favourable month for the forecasts, especially in south-west England; I do not see anything very remarkable in the diagrams as extended to July and September.

The method of the forecasting is still wrapt in obscurity on the plea that to disclose the method would be an act of disloyalty to those who have backed the forecasts. Such an attitude to scientific truth has probably never before made its appearance in the pages of NATURE. It precludes one from examining the worth of the forecasts except in so far as the results declare it, and nothing that Capt. Butler has brought forward changes my opinion that chance operates largely, if not entirely, in the relation of forecasts to facts. His probability figures do not impress me very much. He has evidently treated each of the seven weekly forecasts as entirely independent, which he himself claims not to be the case. If they were not treated as independent variables, I fancy that the impressive figures he brings forward would dwindle to very modest proportions. In any case he has attempted to prove too much; if the forecasts are a billion times better than would be expected on pure chance, failures should practically never occur, whereas it is obvious, even from his own selected diagrams, that the method cannot be relied on by the farmer for his agricultural operations, or by the man in the street who wants to know whether or not to take out his umbrella.

C. J. P. CAVE.

Obituary.

GENERAL SIR CHARLES WARREN, K.C.B., G.C.M.G., F.R.S.

GENERAL SIR CHARLES WARREN, the distinguished soldier and archæologist, died on Jan. 21, in his eighty-seventh year. Born on Feb. 7, 1840, he was educated at Cheltenham College, Sandhurst, and Woolwich, passing into the Royal Engineers in 1857. He had a distinguished career both as technical officer and as a military commander in South Africa and Egypt. He commanded a column in the Boer War, and was afterwards in command of the troops at the Straits Settlements.

Like his fellow-soldiers, Gordon, Kitchener, Watson, and Wilson, Warren was greatly interested in research in Palestine. This brought him into touch with the founders of the Palestine Exploration Fund, and from 1867 until 1870 he conducted excavations at Jerusalem and made a reconnaissance of Palestine on behalf of that Society. Notwithstanding much opposition on the part of the local authorities and the difficulty of raising funds, he accomplished valuable work. This bore fruit in a number of publications. He was author of part of "The Recovery of Jerusalem: Underground Jerusalem," 1876, "The Temple and the Tomb," 1880, and the Jerusalem volume of the Survey of Palestine, with a portfolio of plates and excavations (1884). He had also devoted much attention to the question of ancient standards of measurement, and published "The Ancient Cubit and Weights and Measures" in 1903, and "The Early Weights and Measures of Mankind" in 1914. His connexion with the Palestine Exploration Fund continued throughout his life and he was for some years a member of the committee. This association had brought him closely into touch with Sir Walter Besant, secretary of the Fund. With him he founded the Quatuor Coronati Lodge of Freemasons, the object of which was masonic research, and Warren became its first Master.

WE regret to announce the following deaths:

Mr. W. M. Chauvenet, consulting chemist and mining engineer, who worked at the chemistry of ores and at structural and mining geology, aged seventy-one years.

Dr. Karl Hell, emeritus professor of general chemistry at the Technische Hochschule in Stuttgart, who died on Dec. 11, aged seventy-seven years. He was the author of numerous publications in organic chemistry.

Dr. Herbert A. Howe, dean of the college of liberal arts at the University of Denver and director of the Chamberlin Observatory at the University, who was known for his work on the positions of nebulæ and on comets and asteroids, aged sixty-eight years.

Mr. Daniel Irving, president in 1904 of the Institution of Gas Engineers, and chief engineer for many years of the Bristol Gas Company, on Jan. 12, aged seventy-one years.

Mr. John Webster, senior scientific analyst to the Home Office, who had published several papers on arsenical poisoning and on the toxicology of salvarsan, on Jan. 20, aged forty-nine years.

News and Views.

BEFORE publishing in NATURE of Jan. 8 the article by Capt. C. J. P. Cave on "Popular Long-Range Weather Forecasts," we sent an advance proof to Lord Dunboyne, whose fifty-day forecasts are published in the *Daily Mail* and formerly appeared in the *Field*. Lord Dunboyne desired to reply to the article but found himself unable to do so, and he therefore entrusted his case to his brother, Capt. the Hon. R. P. Butler, whose article appears elsewhere in this issue, together with Capt. Cave's comments upon it. Having now devoted a fair amount of our congested space to the subject we think no more can reasonably be expected, and our readers may safely be left to form their own conclusions upon the evidence which has been placed before them. We are, of course, glad to give Lord Dunboyne credit for a desire to discover principles by which long-range weather forecasts may be secured, and we should be sorry to discourage him or any one else working to achieve this aim. We must point out, however, that the appropriate place to present such principles is a scientific society, like the Royal Meteorological Society, where they would be discussed by people best able to express a judgment upon them. It is of no use to say, as Sir Theodore Cook, the editor of the *Field*, does, in a letter to us, that while Lord Dunboyne contributed the forecasts to the columns of that journal he received "the most satisfactory letters from farmers and correspondents of every kind in all parts of England." Science is not concerned with belief when processes of Nature are involved, but with evidence; and no principle or theory ought to be recognised in scientific fields unless it can survive critical discussion. When Lord Dunboyne's methods and results are submitted to such a bar of competent opinion, we shall be glad to render a further account of them.

OUR leading article of Sept. 4, 1926, on Prof. Graham Kerr's presidential address to Section D (Zoology) of the British Association at Oxford, has moved Mr. George H. Bonner to return to the subject of the advantages of a classical education in the *Nineteenth Century* for January. The author excuses himself for attempting to revive "so hoary a subject" on the ground that the question of the rival merits of 'classical' and 'scientific' is among the most vital that can be propounded, and that when the subject is thoroughly analysed it may appear that only the fringe has been touched and the real reasons for a preference overlooked. Education, as Mr. Bonner conceives it, is to confront the mind with truth in such a manner that it is immediately recognised and becomes a conscious possession. Broadly speaking, the line of argument taken is that science being confined to observed facts and 'laws,' which are merely theories subject to change with the advance

of knowledge, does not deal with truth in the sense of the apprehension of 'purpose' and the ultimate realities of the universe and God—the essential element in the training of the higher faculties of man and the development of the power of reasoning.

Mr. BONNER goes on to point out that even the 'practical' advantage, usually urged in favour of science, really lies with the classics, which induce an acquaintance with a wide variety of topics and a flexibility and adaptability of mind not to be acquired by a study of facts and the 'laws' of science. In this connexion it is of interest to refer to the closely parallel argument in favour of university education generally in a recent letter to the *Times* in reply to a criticism of the capabilities of university men in business, where it was pointed out that during the War it was pre-eminently a university training which produced the qualities of flexibility, adaptability, and ready accommodation to individuals and circumstance, requisite in the officer trained under stress of emergency. Whether or not we are prepared to follow Mr. Bonner in attributing the individual qualities of Greek literature to the influence of Egypt, it will be allowed that he takes up a strong position when he holds in relation to his main line of argument that the classics form collectively an expression of truth more complete than any literature in the world, enabling man "to see things as they are and not as they seem to be." Mr. Bonner, however, misunderstands our article if he imagines that we discount the value of the teaching of science. To point out where the discipline has failed is not to condemn it but rather to help it to achieve those results which, as a unit in a properly balanced system of education, we know it can produce.

THE Geological Society of London has recently announced the following awards: The Wollaston medal to Prof. W. W. Watts, who has distinguished himself by his work on the ancient rocks of the Charnwood Forest, the igneous rocks of the Midlands, and the stratigraphy of the Welsh border, especially Shropshire. The Murchison medal to Dr. G. T. Prior, Keeper of the Department of Mineralogy in the British Museum (Natural History), who is distinguished especially for his work on the chemical composition of meteorites. The Lyell medal to Sir Albert Ernest Kitson, Director of the Geological Survey of the Gold Coast, where he has distinguished himself by the discovery of manganese, bauxite (aluminium hydrate), and diamonds. The manganese proved to be of considerable importance, especially during the War. The Bigsby medal to Dr. Bernard C. Smith, of the Geological Survey, who has done good work in the Midlands, Cumberland, and north Wales, including some interesting researches on the former courses of rivers and on ancient swallow holes. The Wollaston Fund to Miss M. E. J. Chandler, who, both in conjunction with Mrs. Clement Reid and independently, has made considerable additions to our knowledge of Tertiary and Pleistocene plants by the separation and examination of seeds in sediments. The Murchison Fund to Dr. S. H. Haughton of the Geological Survey of South Africa, for his work on fossil vertebrates. One-half of the Lyell Fund to Dr. Leonard Hawkes, reader in geology at Bedford College, London, for his researches in petrology, especially on the igneous rocks of Iceland. The other half of the Lyell Fund to Miss Edith Goodyear, senior assistant in the Geological Department of University College, London, for her work on the stratigraphy and palæontology of the Carboniferous rocks.

DURING recent years city and suburban traffic has increased so rapidly that it is very difficult to provide transport facilities for it. The competition also between motor omnibuses and electric tramways has become very acute. The latter especially have been forced to improve the facilities they offer. In particular they run at higher speeds. Recent specifications for tramcar equipment demand a running speed of 25 to 30 miles an hour, which is practically double that demanded before the War. The length of the cars has greatly increased, and so also has their seating capacity. It is therefore necessary to use larger electric motors. It is usual to specify for two motors for each car, each being rated at from 50 to 60 horse-power. In pre-War tramway motors the armatures used to run at 600 revolutions per minute, whereas they now run at 900 revolutions per minute; also instead of being totally enclosed they are now self-ventilated. One important result of these changes is that the motors are both smaller and lighter, although they can exert nearly double the power. The design of tramway controllers has also been greatly improved, the large currents being broken by a powerful magnetic 'blow-out.' These controllers are used by the London County Council, and at Edinburgh, Manchester, Glasgow, and Newcastle-on-Tyne.

THE annual general meeting of the Royal Meteorological Society was held on Wednesday, Jan. 19, and Sir Gilbert Walker was re-elected president. The Buchan Prize, which is awarded biennially for the most important original papers contributed to the Society during the previous four years, was presented to Mr. C. K. M. Douglas. Sir Gilbert Walker delivered an address on "The Atlantic Ocean," in the course of which he directed attention to the value, when studying the movements of the atmosphere, of an understanding of oceanic circulations. He described the conditions of temperature, salinity, and density revealed by recent measurements in the Atlantic down to a depth of 10,000 feet or more. These throw light on the general character of the oceanic circulation, and indicate that though prevailing winds may set up surface currents, they probably produce no significant effect at a depth exceeding 700 feet. Icy water from the Arctic, and especially the Antarctic, flows towards and even beyond the equator at great depths, and as the air temperature is largely controlled by that of the sea, variations in the general circulation may provide the explanation of some of the big seasonal changes which occur in equatorial as well as in temperate regions.

PROF. A. S. EDDINGTON, Gifford Lecturer for 1927, who has chosen for the subject of his course "The Nature of the Physical World," gave the first of ten lectures at the University of Edinburgh on Friday, Jan. 21, on "The Failure of Classical Physics." The Earl of Balfour, Chancellor of the University, presided. Prof. Eddington said that in these lectures he proposed to explain some of the results of the modern study of the physical world which give most food for philosophic thought, and to show how we have been led to think of the material universe in a way very different from that prevailing at the end of the last century. He would not leave out of sight the ulterior object which must be in the mind of a Gifford Lecturer—the problem of relating these purely physical discoveries to the wider aspects and interests of the human soul. These relations cannot but have changed since our whole conception of the physical world has radically changed. He is convinced that a just appreciation of the physical world as it is conceived to-day carries with it a feeling of open-mindedness towards deeper significances behind it, which may have seemed illogical a generation ago; near the end of the course he would try to focus that feeling and make inexpert efforts to find where it leads. Prof. Eddington then proceeded to a consideration of some of the revolutionary changes in our views of space and matter resulting from the new theory of matter originated by Rutherford, and from Einstein's theory of relativity. Further lectures of the course will deal with time as a fourth dimension, the running-down of the universe, gravitation, the quantum theory, the nature of the stars, inorganic evolution, world building, the domain of physical science, and science and mysticism.

DR. R. CAMPBELL THOMPSON, in a lecture on Jan. 18 at Bedford College for Women (University of London) on "Conceptions of the Cosmos in Ancient Babylonia," pointed out that it is impossible to deal with the subject from any but a theological point of view. The early Babylonian ideas, like those of all early peoples of whom we have knowledge, were influenced by their view of the supernatural and by their geographic environment. The beliefs of the early Sumerian inhabitants of Babylonia appear to have been adopted by their Semitic successors without much change. After an introductory sketch of their mythological system between the approximate dates of 5000 B.C. and 2000 B.C., in the course of which he pointed out the traces of Babylonian influence in the New Testament, Dr. Campbell Thompson described, with the aid of a diagram, the cosmos as conceived by the Sumerian and Semitic inhabitants of the land. The earth, which was of course limited to the land of which they had knowledge, was surrounded by the ocean, which was again encircled by an enclosing dam. The three heavens above, with the lower earth and Hades beneath, comprised the universe. The sun god emerging from the mountains of sunrise in the east ran his course across the firmament and entered the earth again by the mountains of sunset in the west. A pastoral people inhabiting a flat land naturally had their attention turned to the sky and its heavenly bodies, and looked to them for omens. In the Babylonian cuneiform script, the sign for a god is the same as that for a star. Astronomical science, however, as opposed to astrology, developed at an early date. The Babylonian astronomers had sufficient knowledge to predict eclipses with some accuracy, though not the point from which they would be visible. Dr. Campbell Thompson illustrated his remarks by references to the creation and other myths preserved on the clay tablets which formed the libraries, and showed many beautiful slides both of the scripts and drawings. At the end of the lecture he delighted his audience by reading translated extracts from the Gilgamesh Epic on which he is at present at work.

SIR WILLIAM BRAGG'S discourse at the Royal Institution, delivered on Jan. 21, dealt with "Tyndall's Experiments on Magne-crystallic Action." In 1845, at the Royal Institution, Faraday made a great step forwards in the science of magnetism. He constructed a powerful electro-magnet; the core was formed from a link of a large chain cable and the heavy copper wire was wound for the occasion, because covered wire was not an article of commerce in those days. With this he showed that practically all substances have magnetic properties, and remarkable relations were found to exist between magnetic properties and crystalline structure. These results led to his conception of 'lines of magnetic force.' These lines he imagined to run not only through material substances when magnetised, but also through the space about a magnet; so that in his view it was possible to speak of the ether of space being magnetised and to measure its consequent energy. These discoveries of 1845 excited great interest and were widely repeated, extended, and discussed. Much work was done by Tyndall, whose results were interpreted by Faraday as supporting his own theories. Tyndall, however, preferred an interpretation, as did others of the same time, which laid much less stress on the part played by the ether and fixed attention on the material bodies concerned. In particular he subjected bodies to great pressure, and showed how their magnetic properties seemed to be changed thereby. The views of Faraday have now been wholly accepted; but all careful work has its value, and even in those days Tyndall was able by his discoveries of the effects of pressure to make a material advance in the geological interpretation of the planes of cleavage in the earth's strata. Quite recently the application of X-ray methods to the study of the crystalline structure of substances makes it possible to offer a more complete explanation of Tyndall's results. The effects of pressure are to rearrange the minute crystals which most ordinary substances contain; and so Tyndall's results form part, not so much of the branch of science for which they were intended, as for that which deals with the effects of stresses of all kinds in altering the internal arrangement and the properties of materials.

MR. E. BRUNETTI recently presented to the Department of Entomology of the British Museum (Natural History) a collection of some 60,000 speci-

mens of Diptera (two-winged flies) especially rich in Indian and North American material. The collection is the result, in part, of the entomological collecting done by Mr. Brunetti during the last forty years. The same Department has also received, under the terms of the will of the late Lieut.-Col. F. R. Winn Sampson, an important collection of insects of the group Scolytidæ (bark-beetles). The collection consists of some 11,000 insects and 1400 microscopic preparations, and the bequest includes a selection of books and pamphlets, and two microscopes. Accessions to the Geological Department include three interesting fossils of flying reptiles: the long-tailed group is represented by a specimen from the Lias of Württemberg; the short-tailed pterodactyls by an excellently preserved wing-skeleton from the Lithographic Stone of Bavaria, and by a slab with several scattered bones of a small form from the Middle Purbeck beds of Swanage. This last was found and presented by Mr. S. L. Wood, who also gave the remains of a turtle carefully pieced together, and some unusually complete jaws and teeth of Ancodon, an ancient cloven-hoofed animal, all collected by him from the Hamstead beds of Yarmouth, Isle of Wight. The Lower Devonian slates of Bundenbach have yielded most interesting fossils beautifully preserved in pyrites. To the valuable series already in the Museum, some new forms of starfishes, crinoids, and trilobites have been added. An important purchase agreed to was a collection of Ammonites, mostly preserved in pyrites, from various openings, now closed, in rocks of Bavaria and Württemberg corresponding to the Kellaways rock of Britain. There was also laid before the trustees a plaster reproduction of the most complete nest of dinosaur eggs found by the American Expedition in Mongolia; this has just been received from the American Museum of Natural History.

THE purchase has been approved for the Department of Minerals of the British Museum (Natural History) of a 9-kilogram mass of meteoric iron from Chile, probably belonging to the La Primitiva fall, remarkable for the large inclusions of the phosphide of iron and nickel, schreibersite; also specimens of twelve meteorites not hitherto represented in the collection; and a cast of the wonderful 688-kilogram ring-shaped meteoric iron of Tucson, Arizona. An interesting book purchased for the Museum Library is the very rare first edition of an account by Linnæus of his scientific expedition through the Swedish province of Skånen in 1749. This edition contained an expression of approval of the burning up of the top-soil, a custom of the inhabitants of Småland, and a practice to which Baron C. Hårleman, the patron of Linnæus, was strongly opposed. Hårleman had paid the expenses of the expedition, and he caused the withdrawal of the first edition of this work and the publication of a second without the offending comment.

MR. W. G. LOBJOIT, Controller of Horticulture at the Ministry of Agriculture, is retiring from that honorary post, and Mr. H. V. Taylor has been appointed Horticultural Commissioner of the Ministry and chairman of the Horticultural Advisory Council.

AT the meeting of the London Mathematical Society, at 5 o'clock on Thursday, Feb. 10, at the Royal Astronomical Society, a lecture entitled "Some Problems of Terrestrial Magnetism" is to be delivered by Prof. S. Chapman. Members of other scientific societies are invited to be present.

AT its meeting in Philadelphia in December last, the Botanical Society of America elected Prof. Harley H. Bartlett, of the University of Michigan, as president, and Prof. Arthur J. Eames, of Cornell University, as secretary. The following were elected corresponding members: Prof. Erwin Baur, of the Agricultural High School, Berlin; Prof. Robert Chodat, of the University of Geneva; Dr. L. Cockayne, of New Zealand; Prof. V. Grégoire, of the University of Louvain; and Prof. W. Johannsen, of the University of Copenhagen.

AT the monthly general meeting of the Zoological Society of London held recently, it was reported that the number of visitors to the Society's Gardens during the past year was 1,937,935, the receipts for admission amounting to £61,325, an increase of £2728 as compared with the figures for 1925. The numbers of visitors to the Aquarium during the past year was 436,327, the receipts for admission amounting to £17,242, an increase of £483 as compared with last year.

THE council of the Institution of Electrical Engineers has made the sixth award of the Faraday Medal to Prof. Elihu Thomson, of Boston, U.S.A., honorary member of the Institution, who is well known as one of the pioneers in the development of electrical engineering. It will be recalled that the Faraday medal is awarded by the council of the Institution not more frequently than once a year either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science, without restriction as regards nationality, country of residence, or membership of the Institution.

DR. THOMAS NELSON records in the *Lancet* for Jan. 1 (p. 16) the after-results of the treatment of ten cases of tuberculosis by Mr. Spahlinger's methods in a London hospital. The cases were selected and treated by the late Dr. Latham about twelve years ago, and comprised one case of lupus, one case of spinal tuberculosis, and eight cases of pulmonary tuberculosis. The spinal case and one of the pulmonary cases cannot now be traced. The lupus case is still alive, but all the remaining seven pulmonary cases are dead—six of them within three years of the commencement of treatment.

A SLIGHT earth tremor was recorded at the Royal Observatory, Edinburgh, between 5.20 A.M. and 5.30 A.M. on Jan. 24. A message from Nairn to the Air Ministry also reported a slight earthquake at

about 5.20 A.M., and records of the shock were obtained at Kew and Plymouth. The Kew record indicated a distance of about 500 miles for the centre of disturbance, but the disturbance was of less intensity than the Herefordshire or Jersey shocks of last year. Messages from correspondents of the *Times* in various parts of Scotland state that earth tremors were felt in the Orkneys, Deeside, Perthshire, and Fifeshire.

NOTICES have been issued of the offer of three Beit Fellowships for Scientific Research in July next. These fellowships are tenable at the Imperial College of Science and Technology, and will probably be awarded for two years. Candidates must be graduates of a university of the British Empire, of European descent, and less than twenty-five years of age. The annual value of each fellowship is £250. Application forms must be returned to the Rector, Imperial College of Science and Technology, South Kensington, London, S.W.7, by April 19 next.

THE Government of the Province of Buenos Aires, Argentina, has just distributed vol. 5 of the collected works of the late palæontologist, Florentino Ameghino, dated 1916. The volume consists of papers, chiefly on fossil mammals, published between November 1884 and May 1889, but unfortunately the original place of publication is usually omitted. A general account of the mammal-bearing deposits of Monte Hermoso is reprinted from the Buenos Aires newspaper, *La Nación*, and there is an interesting address on the "Phylogenetic Evolution of Mammals," which was given in 1889 to the Argentine Geographical Institute.

AT the first meeting of the eightieth academic year of the Pontifical Academy of the Nuovi Lincei, held in the premises of the Academy in the grounds of the Vatican and attended by his Holiness the Pope, Cardinals Merry del Val, Maffi, Vannutelli, and Ehrle, the two secretaries of the Academy, Profs. De Sanctis and Martinelli, and a number of members and others, the inaugural lecture by the president, Prof. Gianfranceschi, was followed by several papers on scientific subjects. At the conclusion of the session the secretary made preliminary announcements concerning the arrangements for the year and for the commemoration this year of the Volta centenary.

THE sixth annual report of the Industrial Fatigue Research Board contains details of the organisation, investigations, and researches for the year ending December 31, 1925, followed by an analysis of the work published by the Board up to date. The various reports issued during the last six years have been analysed and all the evidence relating to a particular problem collected into one section. The first section deals with the scope and methods of investigations, the second with hours of labour in various industries, the third with atmospheric conditions and lighting, the fourth with methods of work, and the fifth with miscellaneous points such as individual differences, learning and practice, human and mechanical factors in production. It is a very useful compilation, and should prove a valuable guide to present-day research in industrial problems.

THE trans-Atlantic telephone service to towns outside London and to several of the American States was inaugurated on Saturday, Jan. 22, by the exchange of messages between the vice-chancellor of the University of Cambridge and the president of Harvard University, Cambridge, Mass. Mr. A. L. Lowell, of Harvard, spoke first; the Rev. G. A. Weekes, who replied from the Master's Lodge in Sidney Sussex College, recalled the fact that Harvard received its name from John Harvard, a student of Emmanuel College, Cambridge, nearly three hundred years ago. Sir Ernest Rutherford, and Dr. Peter Giles, Master of Emmanuel, also spoke to Mr. Lowell, while Mr. Moran, president of the Southern Atlantic Telephone Company, spoke from New Haven, Connecticut. The extended service now includes most towns within about 110 miles of London, and on the other side of the Atlantic the States of Maine, New Hampshire, Massachusetts, Vermont and Rhode Island, and Connecticut.

THE January issue of the *Marine Observer*, the monthly review of the Marine Division of the Meteorological Office, contains the first of a useful series of articles dealing with radio telegraphy and weather forecasting. The series previously appeared in the first volume of the *Marine Observer*, when articles on weather forecasting that had formerly appeared on the monthly weather charts were replaced and extended. The first chapters deal with observation, scales, and the drafting of reports. The practical information it supplies should be of use to many besides sailors. There is now a total of 500 ships regularly contributing observations to the Meteorological Office. Many of these make daily reports to 'all ships,' and the others are invited to do so with the view of each ship-master being in a position to make his own weather chart and forecast.

THE scientific staff of the Madras Government Museum "has had," says the Report for 1925-26, "to devote almost the whole of its time to investigations." Coins and bronzes have been catalogued, a guide to the flowering plants of Madras City and its immediate neighbourhood has been pushed forward, the littoral fauna of Krusadai Island has been surveyed, and the life-histories of local insects have been studied. This work has enriched the collections but has delayed the improvement of the exhibited series.

WE have received the new edition of Messrs. C. Baker's (244 High Holborn, W.C.1) catalogue of microscopes and accessory apparatus. The B.L.M. series of microscope stands has been extended and includes mineralogical models, and the prices have been drastically reduced. A new $\frac{1}{8}$-in. oil immersion lens, N.A. 0·95, has been added to the series of objectives, which may replace the medium-power dry lens when oil-immersion high-power lenses are also being used, and is serviceable for dark ground illumination. A new series of eye-pieces has been computed by Lieut.-Col. Gifford, "Gifford ortho-

chromatic," which are claimed to be an improvement both in field and in definition, the field being half as large again as with the ordinary Huyghenian type.

ANOTHER volume of "Alumni Cantabrigienses," compiled by the late J. Venn and J. A. Venn, is announced by the Cambridge University Press. It will complete the first half of the work and bring the biographical record of all known Cambridge men down to the year 1751.

MESSRS. Longmans and Co., Ltd., announce for early publication "Flame and Combustion in Gases," by Prof. W. A. Bone and Dr. D. T. A. Townend. The book will review the results of modern research and the present state of science regarding gaseous combustion and explosions. It will consist of five sections, dealing respectively with the principal discoveries from the time of Boyle to the end of the Bunsen era (1660–1880); ignition phenomena, flame propagation through explosive mixtures, detonation flame structure and temperatures; pressure development during gaseous explosions in closed vessels; the mechanism of combustion; and catalytic or surface combustion.

NOTICE is given that applications for the Government grant for scientific investigations for the present year must be received by, at latest, March 31, at the offices of the Royal Society, Burlington House, Piccadilly, W.1. The applications must be upon a printed form obtainable from the Clerk to the Government Grant Committee, c/o the Royal Society.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A demonstrator in bacteriology at University College Hospital Medical School—Prof. A. E. Boycott, University College Hospital Medical School, University Street, W.C.1 (Feb. 7). An assistant chemist under the Northern Coke Research Committee—Prof. Briscoe, Armstrong College, Newcastle-upon-Tyne (Feb. 7). A male medical inspector of factories—The Industrial Division, Home Office, Whitehall, S.W.1 (Feb. 21). A senior lecturer in anatomy in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (Feb. 28). The Stevenson lectureship in citizenship in the University of Glasgow—The Secretary, University Court, The University, Glasgow (Feb. 28). A lecturer and demonstrator in organic chemistry in the University of Sydney—The Agent-General for New South Wales, Australia House, Strand, W.C.2 (Feb. 28). An assistant Government analyst in Nigeria—The Private Secretary (Appointments), Colonial Office, 38 Old Queen Street, S.W.1 (Feb. 28). A Director of Antiquities in Palestine—The Under-Secretary of State for the Colonies, Colonial Office, Downing Street, S.W.1 (March 14). A helminthologist at the Imperial Institute of Veterinary Research, Muktesar, P.O. Ritani, U.P., India—The Director, Imperial Institute of Veterinary Research, Muktesar, P.O. Ritani, U.P., India (March 15).

ERRATUM.—In NATURE of Jan. 22, p. 114, col. 2, line 20 ("The Life of a Nilotic Tribe"), for "effect" read "affect."

Our Astronomical Column.

COMETS.—Mr. H. E. Wood, of Johannesburg, has telegraphed the following parabolic orbit of the new comet 1927 *a* discovered by Mr. T. B. Blathwayt.

$$\left.\begin{array}{l} T = 1927\ \text{Feb.}\ 12{\cdot}720\ \text{U.T.} \\ \omega = 228^\circ\ 52' \\ \Omega = 18\ 40 \\ i = 90\ 31 \end{array}\right\} 1927{\cdot}0$$

$$\log q = 0{\cdot}02522$$

An ephemeris deduced from these elements shows that the comet is unlikely to be seen in Great Britain, for it will remain below the horizon until April, and after that will only be above it in a bright sky. Its track lies through Scorpio, Ara, Telescopium, Pavo, Indus, Toucan, Phœnix, Fornax, Eridanus. It is nearest to the earth, 106 million miles, in mid-February. It should then be a conspicuous telescopic object for southern observers.

The Comas Sola object of Jan. 10 is probably a minor planet. Its approximate position on Jan. 29 will be R.A. $7^h\ 51^m$, S. Decl. $3^\circ\ 14'$. There is not yet sufficient material to hand to deduce the orbit.

A NEW REFLECTING TELESCOPE FOR EDINBURGH.—An article in the *Scotsman* of Jan. 11 contains the welcome announcement that the Observatory at Blackford Hill, Edinburgh, is shortly to obtain a large reflecting telescope of Cassegrain type, together with a spectrograph. The exact dimensions are not stated, but as it will be "at least as great as any other in this country," its minimum aperture may be presumed to be 30 inches. The proposed field of work is stellar photometry and spectroscopy. The useful work that has been accomplished in these fields in recent years at Edinburgh gives rise to the hope of very important results being obtained when the new instrument is in working order. The article also gives an interesting sketch of the history of the Observatory, which started on Calton Hill about 1818, and was moved to its present site in 1889 as a result of the benevolence of the late Lord Crawford, who offered his valuable collection of instruments and books on condition that the State provided proper buildings and maintenance for them. The offer was accepted and the new department placed under the Scottish Office.

A LARGE SUNSPOT.—A large single sunspot which was seen with the naked eye was on the sun's central meridian on Jan. 19 and continued on the disc until Jan. 25. This is the third spot or group of spots large enough to be seen this year without telescopic aid. Other particulars are as follows:

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Area.
3	Jan. 13-25	Jan. 19·3	25° N.	1/1100 of sun's hemisphere.

A number of other spots across the sun's disc and patches of bright faculæ at the east and west limbs have been located with ease in small refracting telescopes 2 in. or 3 in. in aperture.

Research Items.

GYPSY MARRIAGE CUSTOMS IN EASTERN RUMELIA.—In the course of a correspondence on the language and conditions of the gypsies of Eastern Rumelia which passed between Dr. A. G. Paspati and Smart and Crofton in 1879, when the first named was in Constantinople, some interesting details were given of gypsy betrothal and marriage customs. In one letter of the series, which is published in Part 3, vol. 5 of the *Journal of the Gypsy Lore Society*, it is stated that the friends, male and female, of the bridegroom go to his intended bride's residence and demand her of her father. If he consents, the bridegroom and his friends go again to the father's house the next day and each receives a present, generally a handkerchief. The bride and bridegroom are then left alone while the party adjourns to an adjacent wine-shop, where they remain until evening. The bride and bridegroom dine together, drinking out of the same wooden bottle as a sign of love. After dinner the bridegroom leaves and the betrothal is considered valid. On the Friday before the wedding, a friend of the bridegroom goes with a wooden bottle to the bride, offering the groom's congratulations, and then with a donkey goes to the forest to cut wood for the ceremony. In the evening of the same day paste is kneaded for a cake to be baked and eaten on the wedding day. On the following day relatives of the groom carry the dowry to the bride. On the Sunday after the wedding the transparent red veil worn by the bride is taken off her face by the bridegroom's man by means of two slender vine sticks and laid on a rose-bush. He then carries two buckets of water on his shoulders taken from any fountain, and these the bride oversets thrice. The fourth time she follows him to the house of the bridegroom, kissing the hands of all passers-by.

A CRYSTAL MASK FROM TIBET.—Mr. H. C. Beasley has published in *Man* for January an illustration of a remarkable crystal mask from Tibet. The mask is that of the goddess Palden Lhamo, one of the Eight Terribles, as is shown by a third eye in the middle of the forehead. The body of her face is worked up from a lump of rock crystal, the features are applied in gilt bronze, and the teeth are probably human, while the eyes are of ivory. It is said that the mask was used to attract evil demons, who were then dealt with by the officiating lama. Palden Lhamo corresponds to Kali of Indian mythology, and in Japan appears as a goblin under the name Mitsume. The Chinese god of disease Yü-yüen, recognisable by his long teeth, also has a third eye, and is probably derived from Palden Lhamo. She was also believed by the Tibetans to have been reincarnated in Queen Victoria. As one of the Eight Terribles, Palden Lhamo rides a chestnut mule, the offspring of a winged mare, and the gift of the goddess of the sea. She carries a string of skulls, and she feeds on corpses given her by the goblins who haunt graveyards, while her scanty garment is a girdle made of the skin of a recently flayed man. She is often shown drinking blood from a cup formed of a human skull.

COCAINE.—Prof. E. Poulsson contributes an article to the *World's Health* for December last (which appears in a new and more attractive cover than formerly) on the properties, use, and abuse of cocaine. The coca plant, coca chewing, and the properties of cocaine as an anæsthetic are described. The effects of cocaine upon the drug addicted are then summarised. These consist of a first stage of well-being or happiness, followed by a condition of restlessness and anxiety in which self-control may be lost. Continual snuffing of the drug causes nasal catarrh and ulceration of the nasal septum. An extremely characteristic effect is an intense pricking and creeping sensation in the skin, so that the habitué has the impression that it harbours worms or lice, and seeks to get rid of these by digging with his nails or the point of an instrument, so that the body may become covered with sores and ulcers. This form of drug abuse is very widespread, but the author considers that it will be more easy to combat than the use of opium and its products. Coca plantations are of comparatively recent origin and are far from possessing the economic importance of opium plantations. It is possible also to prepare synthetically drugs which possess the paralysing power of cocaine on the sensory nerves but have little or no effect on the brain. The more these are used, the less will become the medical need for cocaine itself.

PROTECTION OF THE GREAT SKUA.—Few birds have so restricted a range as the great skua, which in Britain formerly nested only in the Shetland Isles. Its present position is discussed in the *Scottish Naturalist* (1926, p. 169). It is shown that as a result of protection, first because it kept away the sea-eagle, and more recently under the Wild Birds Protection Acts, the great skua has extended its breeding range to several new areas. It is suggested that protection has now gone far enough, and that some restraint might well be placed on the further multiplication in certain areas of this robber and pirate. Its spread in one locality is shown to have been responsible for the complete disappearance there of black-headed gulls, arctic terns, red-throated diver, kittiwakes, and whimbrel, and even the strong herring gulls and lesser black-backed gulls have been reduced to a few pairs on ground which they formerly dominated. Strange to say, the only bird which seems to hold its own in face of the aggression of these great skuas is the common snipe.

THE WARBLE-FLY IN DENMARK.—Denmark is pre-eminently a cattle country, and on this account the damage done by the warble-fly had in 1903 reached the immense sum of £275,000. The matter had become so serious that the legislature took up the question, and in March 1923 passed a first law compelling stock-holders to rid their cattle of warble maggots, or failing such action to submit to the destruction of the pests by representatives of the parish councils at the owners' expense. An account of the legislation and its effects, by Harald Faber, Agricultural Commissioner to the Danish Government, appears in the *Journal of the Ministry of Agriculture* (Jan. 1927, p. 905). The results are striking. Of the 793,250 cattle herds in Denmark, 124,893 were freed from maggots in 1923; in 1924 178,044 herds were examined by authorised inspectors, and in 29·6 per cent. of these maggots were found and exterminated. The policy of the Government has been very satisfactorily reflected in the condition of Danish hides. Before the first law was passed in 1923 (it has been continued by subsequent enactments) the ratio of hides damaged by maggots in 1922 was 20 per cent.; in 1923, after a partial application of the law, damaged hides represented 15 per cent.; in 1924, with the law in full force, the number had fallen to 4·5 per cent., and in 1925 it was 4 per cent. The monetary saving has naturally been very considerable.

SMALL HOLDINGS AND FORESTRY.—Several of the papers read before the subsection of Forestry at the Oxford meeting of the British Association last year

are reprinted in the half-yearly issue (Oct.) of the *Transactions of the Royal Scottish Arboricultural Society*. Perhaps the most important of these is the presidential address by Lord Clinton, entitled "Small Holdings in Relation to State Forest Policy." Much of the ground covered is well known to the scientific forester, especially on the Continent of Europe. It is satisfactory to British foresters to recognise that this aspect of a forest policy is now beginning to become appreciated in Great Britain. It is, in fact, the recognition of the absolute dependence of the forest for the bulk of its labour on some system of small agricultural holdings which afford a certain amount of occupation to the agriculturist at certain seasons of the year, full-time employment being obtainable at other seasons in the forest. Under the scheme adopted by the Forestry Commission, holdings are limited to 10 acres, and 150 days' work in the forest is guaranteed, but more may be granted. The advantages on both sides are obvious. The smallholder, cultivating a small area of land and with a small herd of stock for which grazing at specified times may be available, finds his main occupation in the forest. The State, outside the comparatively small full-time staff it is possible to employ in the management of forest areas, has at hand a labour supply which becomes increasingly skilled in forest work. Finally, the country acquires a settled, contented, and hardy community settled on the land. Small holdings, from the purely agricultural development point of view, are still a doubtful policy to follow. From the forestry viewpoint their successful inauguration in Britain is essential to the future progress of the afforestation work.

RUSSIAN WORK ON MICROBIOLOGY.—The Bureau of Agricultural Microbiology of the State Institute of Experimental Agronomy at Leningrad, which is under the directorship of Prof. S. P. Kostychev, has commenced the publication of a *Bulletin*. The first volume has recently appeared, and it contains an interesting series of papers on biodynamics of soils, comprising results of extensive studies of the bacterial population of various soils and its chemical activities. Other papers include a study of the chemical conditions of fixation of atmospheric oxygen by *Azotobacter agill* (Kostychev a.o.); results of a detailed research in the symbiosis of various bacilli of milk (Ulrich), and two papers on the bacteriological method of control of rodents. Unfortunately, none of the papers is provided with a summary in a western European language, and this will restrict their usefulness to scientific workers of other countries.

LOCAL COAST SUBMERGENCE.—An example of local and relatively rapid submergence of the coast of Galveston Bay is described by Prof. D. W. Johnson and Mr. W. E. Pratt in the *Geographical Journal* for January. In 1917 an oil-field was started near the mouth of Goose Creek, not far from Houston, Texas. Since then, several million barrels of oil have been taken from the field with the result that the Gaillard peninsula, near the centre, and adjacent low coastal areas, have become submerged. In an area two miles and a half long by one mile and a half wide the maximum subsidence is now more than three feet. The ground involved consists of recent sands and clays only slightly more compacted than sea-bottom muds, and the oil is extracted mainly from depths between 1000 ft. and 4000 ft. Prof. Johnson is convinced that the subsidence is purely local and has nothing to do with any general sinking of the gulf coasts. Moreover, its area corresponds with the area of extraction, it is bordered by earth fractures, and it sinks steadily as extraction continues. Prof. Johnson cites this case as a rare, if not unique, example of subsidence of the earth's coast following the exploitation of an oil-field.

EXPLORATION OF THE RUSSIAN NORTH.—The Institute for the Scientific Exploration of the North at Leningrad (*Sjezdowskaja* ul., No. 1-3) is publishing a series of its transactions in separate parts, each part containing either one complete paper, or several papers dealing with the same subject. So far, in the interval 1920–1927, thirty-four parts have appeared, dealing with widely varying aspects of the country under exploration. More numerous than any others are the reports on geography, geology, and mineral resources, which include accounts by A. E. Fersman on the tundras of Kola Island (Part 29), and on the Chibina Range of the same island (Part 16); by A. A. Grigoriev on the geology and geological history of the Bolshezemelsk tundra (Part 22); by A. A. Tchernoff, D. I. Stcherbanoff, D. Beliankin, and others, on the mineral deposits of various regions of northern Russia (Parts 10, 18, 20, 24, 35); by V. A. Lindholm on the post-Pliocene mollusca from Murman (Part 12), etc. Another valuable set of papers deals with fish and fisheries of north Russian seas as well as of the Petchora River. These papers include keys to the sea-fishes by Prof. N. M. Knipovitch (Parts 27 and 31); an exhaustive study of the White Sea herring by A. J. Rabinerson (Part 25); a description of fishes and fisheries of the Petchora River by Prof. W. K. Soldatoff (Part 17), etc. Part 19 contains studies of hydrology, currents, and fauna of the Barents Sea by Prof K. M. Derjugin (including descriptions of some new species from various orders). Ornithologists will find an interesting account on the nesting colonies ("loomeries") of *Uria troille* L. in Novaya Zemlya, in Part 26, by G. P. Gorbunoff. Several papers deal with the economic aspects of the country, these comprising papers by N. Volens on the industries, and especially the agriculture, of the Petchora region (Part 21) and of the Murman coast (Part 28), while S. V. Kerzelli deals specially with reindeer breeding (Part 13). One paper, by V. G. Bogoraz, is devoted to the problems of ethnography in northern Russia.

TAR-DISTILLATE SPRAYS.—The Ministry of Agriculture and Fisheries has issued (Dec. 1926) information based on experimental evidence as to the best use of tar-distillate sprays for fruit trees. These new 'proprietary' washes, which are rapidly superseding the caustic sprays, are made by emulsifying a certain part of the tar-distillate. Carbokrimp, Chafers' No. 1 Winter Wash, Ialine Tar Oil Winter Wash and Mortegg, applied in January at 7½-10 per cent. concentration, were found successful in controlling Rosy Apple aphis and Apple Sucker, while 6 per cent. solutions satisfactorily reduced both aphis and 'brown rot' on plums. Apple and plum trees may also be considerably freed from the caterpillars of the winter and tortrix moths, but these washes are ineffective in reducing apple scab and 'red spider'; if, however, this latter pest occurs on gooseberries, it can be successfully checked by the same sprays. In order to ensure success, the instructions issued must be carefully followed, especially as regards the time at which to carry out the operation. Spraying can only be done with safety when the buds are dormant, *e.g.* up to the end of January for plums, and somewhat later for apples. Further, the washes should not be applied before December, in order to ensure that the various pests have laid their eggs. Fine, but not frosty, weather is the most suitable. If the water of the district is very hard, an addition of 1 lb.-2 lb. powdered size or glue per 40 gallons is advised. An annual treatment

is recommended, as the effect may be more marked in the year following the season of application. Besides the destruction of insect pests, a luxuriance of foliage produced in the succeeding year is noticeable, although any green leaves in actual contact with the spray will be liable to scorch.

THE MERCURY-ARC POWER RECTIFIER.—Great progress has been made recently in improving the mercury-arc power rectifier for converting alternating current into direct current. It is now very widely used. In the December issue of the *Review* published by the Brown Boveri Co. of Baden, in Switzerland, we learn that one of their rectifiers was tested at a direct current pressure of 8000 volts. It produced a pressure of 12,000 volts between the anodes of the device when the transformer was connected for three-phase working. No disturbance occurred when the rectifier was interrupted under a load of 900 kilowatts. This shows that the voltage limit has not yet been attained. The main difficulty that has to be overcome is to disperse by artificial means the heat produced in the rectifier, as it is a stationary piece of apparatus. In the same *Review*, Mr. Seitz writes a valuable paper on the methods employed for cooling rectifier sets. The methods generally employed are direct cooling by water, indirect cooling by water, and cooling by natural or forced draught. When a continuous water supply cannot be guaranteed, a water flow alarm is supplied so that serious trouble can be avoided. When the water is very hard or when it is impure, indirect water cooling is employed, a special pump being used to keep up the circulation. Natural draught is only used when the load is very small or intermittent and when the room temperature does not exceed 15° C., thus permitting a temperature rise of about 35° C. for the rectifier. For medium and large-sized rectifiers, forced draught is used, centrifugal fans being employed to cool pipes containing circulating water. For a direct current of 1000 amperes and a mean temperature rise of 25° C., the power expended in the fan and circulating pump does not exceed one horse-power.

ESTIMATION OF PHOSPHATES IN CALCAREOUS SILOS.—In the Chemical Series of the *Memoirs of the Department of Agriculture*, India, 8, No. 6, S. Das shows that in the case of highly calcareous soils, Dyer's citric acid method for the estimation of available phosphoric acid is unsuitable, and if the calcium carbonate content of the soil ranges from 1 to 7 per cent., is equally unsatisfactory for potash determinations. After experimenting with various salt solutions, a new and trustworthy method for use with such soils is described. A 1 per cent. potassium carbonate solution is employed for the soil extraction, the proportion of soil to solvent being as 1 : 10, and after shaking for 24 hours at laboratory temperature, the dissolved P_2O_5 in the extract is estimated by the ammonium molybdate method. The underlying principle of the action of 1 per cent. potassium carbonate solution on calcareous soils is twofold; a reaction takes place with any dicalcic or such other phosphates present, with the production of insoluble tricalcium or other phosphates and of soluble potassium phosphate; and, further, any phosphorus in organic combination in humus is also dissolved.

MARINE STEAM TURBINE PROGRESS.—Marine engineering practice sometimes leads, sometimes follows, land practice. In power stations ashore, advances have been made in the matter of higher steam pressures, the highest on record being 1200 lb. per square inch. The use of steam at 300 lb. to 400 lb. per square inch is fairly common, and considerable economy has been obtained by the utilisation of such pressures. Attempts are now being made to adopt higher pressures in ships, and an account of the latest advance is contained in a paper on "Progress in Economy of Turbine Machinery on Land and Sea," by Sir Charles Parsons, Mr. R. J. Walker, and Mr. Stanley Cook, recently read to the North-East Coast Institution of Engineers and Shipbuilders. Accompanying the discussion of the value of higher pressures, superheating, and other features of modern practice, are some historical notes and tables giving important details of the various turbine installations, both ashore and afloat, which have in turn created records, and at the end of the paper there is an account of the notable vessel, *King George V.*, launched on the Clyde last summer. Though Loftus Perkins more than forty years ago crossed the Atlantic in the *Anthracite*, using steam at 350 lb. per square inch pressure, general marine practice hitherto has demanded no more than 200 lb. to 250 lb. per square inch pressure in the boilers. In the *King George V.*, however, a vessel of 3500 horse-power, the Parsons-geared turbines are supplied with steam at 550 lb. per square inch superheated to 750° F., the steam being generated in Yarrow boilers. After the builder's trials the *King George V.* was placed on service on the Clyde and ran for three weeks to the end of the season. Consumption trials were then carried out, when with coal having a gross calorific value of 13,880 B.T.U., the fuel consumed worked out at 1·1 lb. per shaft horse-power per hour, thus easily beating all previous records hitherto obtained at sea.

ELECTRIC TRACTION.—In the *Journal of the Institution of Electrical Engineers* for January, F. Lydall gives a review of the progress of electric traction throughout the world which puts the progress made in Great Britain in a much more favourable light than has been generally accepted. Broadly speaking, we can divide railway electrification schemes into suburban and main line schemes. In Great Britain electrification is almost wholly confined to suburban schemes. The Southern Railway utilises it largely. It recently extended the electrification of the south-western section by the addition of about 70 miles to the length of track equipped, and the conversion of about 250 miles of suburban lines on the south-eastern section. The 127 miles of track on the Brighton section already equipped with overhead wires are being gradually converted to the third rail system. Considerable additions are also being made to the electrified portion of the line. The Southern Railway will soon have 854 miles of track electrified on the same third rail system. In France suburban electrification is much less prominent, the principal schemes being the main line electrifications on the Paris-Orléans and the Midi railways. In Switzerland electrification of the main lines has been carried out on a large scale. In Italy electrification has been in progress for the past twenty-five years, and the mileage of track equipped exceeds 600. In Germany the electrification of railways, especially in Silesia and Bavaria, is proceeding very rapidly. By the end of the year the electrified track will be about 700 miles. In Austria the progress has not been so rapid, owing to financial stringency. It is, however, in the United States that much the greatest progess has been made. As electric operation can provide facilities greatly superior to those obtainable from steam operation in respect of schedule speed, and volume of traffic, it is natural that all the great cities in the eastern states have extensive urban and suburban services. In no less than fifteen cities of the United States steps have been taken towards the elimination of smoke from locomotives by electrification or other means.

Researches on Sex-Change in the European Oyster.

THE fundamental fact about the breeding of the edible oyster is that the manifestations of this function may vary individually and in gross from season to season in a given locality, and, in general, differ also in different localities roughly according to the degree of warmth of their environment.

A modern research on the breeding of this mollusc should therefore include (*a*) adequate records of the environmental conditions, of which—if the animals are living under healthy conditions—temperature variation may be postulated as one of the most important; (*b*) a significant amount of healthy material the age of which has been unimpeachably determined by experimental methods; and (*c*) experimental observations on the successive sex-conditions during one or more years of a significant number of individuals which are living under conditions as nearly natural as it is possible to attain. The modern standard of research is very high, and it is impossible for any one worker to attain it on this problem without lengthy and large-scale operations.

During late years considerable attention has been again given by workers in various parts of Europe to an inquiry on the sex-conditions and sex-changes of the European oyster (*O. edulis*). In 1925, R. Spärck, a young Danish biologist, published a valuable paper [1] on the subject, giving the results of several years' work (1919 to 1923) on oysters obtained from the Limfjord. In a useful review of the literature on this subject, Spärck clearly shows the confusion which existed even down to recent years with regard to our ideas of sex-phenomena in one of the commonest economic molluscs. The difference in opinion which existed amongst well-accredited workers in the nineteenth century is well brought out by Spärck, who finds in the literature that oysters are described variously as comprising hermaphrodite, male, and female individuals (Davaine), all potentially hermaphrodite (Lacaze-Duthiers), all mainly male or female (Mobius and Hoek), that oysters are simply protandric hermaphrodites (a popular conception even in recent years); that they do not spawn until three to four years of age; that they do spawn at one year; that sex-change does occur (Davaine) or does not (Lacaze-Duthiers); that there are always 100 times more males than females (Davaine); that figures given show that there is a higher porportion of females than Davaine states (Mobius and Hoek). From these details there can be no doubt that the earlier workers had found out or surmised most of the facts, but the difficulty at the present time is to sort them out and place them in their true order; hence the need for modern critical research.

The confusion in the past has been largely due to the failure of workers to produce experimental facts, and also to the failure to differentiate fact from opinion; and indeed, until more biological work is stated in the order, experiment, observations, inference, the cycles of words used in the oyster literature of the nineteenth century are likely to be repeated in the twentieth.

In Spärck's work the difficult subject of inshore temperature variation is accounted for with a daily record at 8 A.M. of the water at Oddesund, at a position not precisely stated and the daily temperature-variation of which is not given, nor its relations to the variation on the beds whence oysters were taken for examination. Charts of the Limfjord show the 3-fathom line to lie close to the shore at Oddesund itself, but about half a mile to a mile off shore in other parts. It is well known that the temperature of shallow water on such an extensive foreshore will follow that of the air closely, and in summer the mean temperature will rise to a varying degree above the mean temperature of the air (compare when plotted together, the author's Fig. 15, which is apparently *mean* air, and Fig. 11), unless replaced by tidal water sweeping in directly from the open sea. It might easily happen, therefore, that while the temperature at 8 A.M. at Oddesund on a given day were 14° C., at another position a mile away and half a mile from the shore the temperature might easily at some period of the day be 16° C. or more (compare the author's statements on pp. 41 and 21). It is not sufficient to assume that the surface readings at Oddesund at 8 A.M. in the morning will give a correct picture of the variation in temperature over the oyster beds; the assumption is unjustifiable, but if it were justified the proof should be given. The author's treatment of temperature records from other regions is mostly unconvincing in a similar manner. The oyster biologist should indeed command a good general and practical knowledge of hydrography, and ought to make constant use of thermometric instruments on the beds, or at least to have one up his sleeve.

Those conclusions which Spärck bases on the Oddesund temperature records—for example, that there is no fixed temperature limit below which oysters will not spawn—cannot, therefore, be regarded as substantiated by adequate observational data. His definition of the oyster as a *protandric alternating hermaphrodite* is, however, supported by an increasing body of evidence, and may stand the test of time. His observations on seasonal sex-condition lead him to a conclusion similar to that formerly propounded—apparently unknown to the author—by B. Helland Hansen, namely, that complete egg-development is a product of time and temperature (calories). There will no doubt be sufficient data accumulated in the near future to settle this interesting problem.

It is also stated that egg-development ceases at 10° to 12° C.; that at (sustained summer periods of) temperature of 20° to 22° C. each individual may become female once a year; or only every three or four years (at sustained summer periods) at 14° to 16° C.; but the two latter at least of these statements are debatably inferential and not founded on experimental or demonstrated data.

Three valuable cases of sex-change from male to female were observed experimentally, but the number of failures to observe change is not noted, nor are the sex-changes themselves critically discussed. An observation is made by Spärck, that in regions of low salinity (and relatively high temperature) in the Limfjord, oysters appear to grow much more slowly than in regions of high salinity and relatively low temperature (p. 21); one suspects that the author is arguing in a circle from size at breeding to age and age to size, but if experimental data could be obtained to verify these statements, an important addition would be made to our knowledge on shell growth. Besides interesting remarks on seasonal feeding, on greening, on enemies, and on the fluctuations in the local stock of oysters, Spärck discusses the general effect of external conditions on sex, and arrives at the conclusion that "an alteration in the surrounding conditions results in an alteration in the kind of sex."

J. H. ORTON.

[1] "Studies on the Biology of the Oyster (*Ostrea edulis*) in the Limfjord, with Special Reference to the Influence of Temperature on Sex-Change." Report of the Danish Biological Station, **30**, 1924 (1925).

The Third Pan-Pacific Science Congress.

THE third Pan-Pacific Science Congress was held at Tokyo on Oct. 30–Nov. 11, 1926, under the auspices of the National Research Council of Japan and through the generosity of the Imperial Japanese Government. It must well have been one of the most remarkable scientific meetings ever held. The main objects of the Congress, like those of the first held in Honolulu in 1920, and of the second held in Australia in 1923, were (1) to initiate and promote co-operation in the study of scientific problems relating to the Pacific region, more especially those affecting the prosperity and well-being of the Pacific peoples; and (2) to promote a feeling of brotherhood and to strengthen the bonds of peace among Pacific peoples. It was laid down that all branches of physical and biological science formed proper subjects for discussion, provided that they bore upon some Pacific problem.

The Congress was attended by 150 delegates from countries outside Japan, and by 400 Japanese members. At the opening meeting, speeches of welcome were made by the Prince of Kan-in and by the Prime Minister of Japan. In addition to the general opening and final meetings, two joint meetings of all members of the Congress were held. At the first of these such papers were read as constituted a review of the present state of knowledge of the physical and biological oceanography of the Pacific, and at the second such papers as dealt with special plans for international co-operation. At five other sessions the different branches of science were grouped together so as to form two broad divisions, namely, the physical and the biological. At the remaining sessions simultaneous sectional meetings were held, there being sections for astronomy, meteorology and terrestrial magnetism, radio waves, geology, seismology, architecture, botany, zoology and fisheries, agriculture, geography, hygiene and medicine.

The object of the broad divisional meetings was an attempt to realise solidarity of feeling and action, and this attempt was eminently successful. At the meetings of the physical division the papers were grouped under the following headings: Meteorological and time-service by radio transmission and causes which give rise to its disturbance; form of the geoid as deduced from geodetic observations, measurements of gravity and plumb-line deviations; suitable projections for maps on different scales; crustal movements and geotectonics, earthquakes, crust-tides, and variation of mean sea-level; study of volcanoes in their various aspects; thermal springs; metallogenetic epochs and their bearing upon structural unity; distribution of rare elements.

At the meetings of the biological division the subjects were grouped under the following headings: Rational methods for the protection of useful aquatic animals and plants; genetics in relation to the improvement of important crops, more particularly rice, and of live stock; distribution of bonitos and tunnis and their ecological studies; distribution and life-history of freshwater eels; international co-operation in the investigations of pelagic fish eggs and larvæ; preservation of natural monuments; rational methods of storing cereals; scientific bases for plant quarantine.

In all, more than 430 papers were presented and briefly described, printed abstracts being provided in advance. The full text of the papers, when published, will be of enormous value.

At the final general meeting many resolutions were passed on the recommendation of divisions, sections, and special committees, and, in particular, rules were drawn up for the constitution of a permanent Pacific Science Association, the function of which will be to organise future congresses. An invitation from the delegation of the Netherlands East Indies to hold the next congress in Java in 1929 was accepted.

Before and after the Congress long excursions were made, covering the land from Hokkaido to Kyushu, while two days in the middle of the Congress were devoted to shorter excursions. In all, there were about twenty excursions, and practically all overseas delegates were shown the beauties and wonders of Nikko, Hakone, Kyoto, and Nara.

Throughout the Congress itself and during the excursions, all overseas delegates and their families were the guests of the Japanese. The extent of the hospitality was only equalled by the perfect organisation, and both were the wonder of all visitors. The president of the Congress was Prof. J. Sakurai, the vice-president Prof. A. Tanakadate, and the general secretaries Profs. N. Yamasaki and K. Matsubara. In consideration of the great importance of these congresses, from both the national and international viewpoints, the Japanese Government, upon the recommendation of the National Research Council, had made a grant to be used for defraying the expenses.

Social functions formed a prominent part of the whole proceedings. Three garden parties were given by members of the Imperial family, and others by the Minister for Foreign Affairs and Baron and Baroness Fujita. Dinners were given by the Prime Minister, the president of the Congress, and the Mayors of Tokyo, Kyoto, and Osaka, while luncheons were given by the presidents of the Imperial Academy and of the Pan-Pacific Association of Japan. Theatrical performances of distinctive Japanese type were provided by Baron and Baroness Mitsui, and by the directors of the Imperial Theatre, while there were entertainments at each of the mayoral dinners. In addition there was much hospitality and entertainment of a more sectional and private character. No delegate from overseas will ever forget the cordiality of the welcome received from all types of Japanese citizens.

J. P.

Loutreuil Foundation of the Paris Academy of Sciences.

THE Paris Academy of Sciences received thirty-three applications for assistance under the Loutreuil Foundation, and has made the following grants:

(1) Establishments specially named by the founder.

Muséum national d'histoire naturelle (15,000 francs), École nationale vétérinaire de Lyon (7000 francs), École nationale vétérinaire de Toulouse (7000 francs). These three grants are for the same purpose, to permit these establishments to complete the sets of foreign periodicals in their libraries which have been interrupted during and since the War.

Institut national agronomique. 3000 francs to Jean Guérillot, for the purchase of apparatus for carrying out researches on the action of radio-activity in plant biology.

(2) Establishments admitted for a year by the president.

Conservatoire national des arts et métiers. 15,000 francs to Léon Guillet for the installation of a radio-spectrograph in the metallurgical laboratory. 2500 francs to Emilio Damour for the purchase of apparatus for the glass laboratory.

(3) Independent requests.

4000 francs to Charles Alluaud, as a contribution to a zoological expedition to Morocco.

6000 francs to Benjamin Baillaud, for the construction and installation, in the time signal department of the Paris Observatory, of a pendulum maintained by light rays and a photo-electric cell.

2500 francs to Jules Baillaud for carrying on experiments with the view of establishing a primary standard of light.

3000 francs to Henry Chabanier, for the purchase of apparatus for carrying out researches on nephritis, and particularly on the mechanism of œdema resulting from lesions of the kidneys.

3000 francs to Henri Chaumat for the construction of a new wattmeter with an arrangement permitting the determination of the angle of phase of a magnetic field and of the current producing it.

9000 francs to the Comité français de Géodésie et Géophysique (Section of Atmospheric and Telluric Electricity) as a contribution to the cost of the sixth expedition dealing with the new magnetic network of France.

3000 francs to Hipployte Janvier for his biological studies in the Chilian Hymenoptera.

2000 francs to Paul Nottin for the continuation of his researches on the saccharification of starch.

5000 francs to Jean Mascart for assuring the publication of documents concerning the study of the variable stars, centralised at the Lyons Observatory.

2000 francs to Paul Pallary for his researches on the fauna of Morocco and the extension of the glacial régime in the Moyen-Atlas and the upper basin of Oumer Rebia.

10,000 francs to Pierre Teilhard de Chardin as a contribution to a new palæontological expedition in China.

9000 francs to Jean Thibaud for extending his researches on the structure of the atom and the radiations of radio-active substances.

4000 francs to Henri Deslandres for the publication by the Meudon Observatory of synoptic charts of the upper solar atmosphere and the details characteristic of this layer.

2000 francs to Joseph Guillaume to assist him to continue, in his private observatory, the observations which he had pursued for thirty-three years at the Lyons Observatory.

6000 francs to the Comité de patronage de la faune coloniale française, for starting this important work.

6000 francs to the Faculté française de médecine de Beyrouth for contributing to the publication of the "Flore de Syrie."

University and Educational Intelligence.

BIRMINGHAM.—The subject of the Huxley Lecture to be delivered by Prof. Elliot Smith on Feb. 1 is "Science and Culture," the realisation of Huxley's ideals. The lecture will be open to all members and friends of the university.

CAMBRIDGE.—Through the University Association, a sum of £1025 has been bequeathed by the late Michael Emil Lange, of Christ's College, for the further endowment of the University.

EDINBURGH.—The International Education Board of New York has given a sum of £74,000 as a contribution to the cost of the new Department of Zoology and in recognition of the work of Prof. J. H. Ashworth, professor of zoology in the University. The new Department will be at the King's Buildings, West Mains Road.

LONDON.—The two following courses of free public lectures at University College are announced: "Reproduction," by Dr. A. S. Parkes (on Feb. 7, 14, 21, 28, Mar. 7 and 14), and "The Action of the Sense Organs," by Dr. E. D. Adrian (on Feb. 9, 16, and 23). The lecture hour in each case will be 5 o'clock.

OXFORD.—Mr. A. G. Tansley, lecturer in botany in the University of Cambridge, has been appointed to succeed Sir Frederick Keeble as Sherardian professor of botany at Oxford. Mr. Tansley was president of Section K (Botany) of the British Association at the Liverpool meeting in 1923, and is the author of a number of papers and other works on plant ecology.

FIVE fellowships tenable for two years, each of the annual value of £200, will be awarded in 1927 to graduates of the University of Wales. Applications for the fellowships must be received before June 1, by the Registrar, University Registry, Cathays Park, Cardiff, from whom further information may be obtained.

THE International Federation of University Women held its fourth conference at Amsterdam on July 28-Aug. 2, 1926. It has published a report (pp. 176, price 1*s.* 6*d.* post free, obtainable from the Secretary, 92 Victoria Street, London, S.W.1) containing much interesting information bearing on the various subjects discussed: international fellowships for research and travel, interchange of secondary school teachers, the problem of a language of international intercourse, the means of reconciling marriage with a professional career, and several others. The accounts given by ten distinguished members of the Dutch Federation of the work of university women in Holland and its colonies are of outstanding importance, indicating as they do, with considerable fullness, the place of university women in the national economy. Prominent among the sciences in which women have shown capacity for advanced work is biology. Of 245 women in Holland who have completed university studies in this branch of science, 45 are married and have no professional occupation, 129 are teaching, chiefly in secondary schools, and 41 are scientific workers in universities, including 21 in agricultural stations and 11 in museums, etc. Of 216 who have completed a medical course, 183 are practising doctors. Nearly half of them are married (59 to medical men) and 56 of these have full-time practices; 35 medical practitioners work in the Dutch East Indies, 19 holding government appointments. In pharmacy, women assistants (1698) largely outnumber the men (308), although there are only 217 fully qualified female pharmacists to 643 male. In dentistry there are 576 men to 132 women. In the Dutch colonies there are women physicians (35), dentists (22), chemists (10), biologists (9), doctors-in-law (9), teachers (16), and one theologian.

Calendar of Discovery and Invention.

January 30, 1826.—A great achievement was brought to a successful termination on Jan. 30, 1826, when Telford's famous suspension bridge over the Menai Straits was opened and the London mail-coach crossed to Anglesey. Hitherto the passage of the Straits by boat had often been difficult and dangerous. Among the most graceful of such structures, the bridge has a central span of 579 feet. Its main features are the sixteen chains formed of flat wrought iron bars 10 ft. long, $3\frac{1}{4}$ in. wide, and 1 in. thick.

January 31, 1858.—In a decade which saw the Great Exhibition, the discovery of the first coal-tar colours, the invention of the Bessemer process, and the laying of the first Atlantic cable, there was no greater experiment than the building of a steamship to run between England and Australia carrying sufficient coal for the round trip. The *Great Eastern* was begun in 1854 and, after extraordinary difficulties, was launched in the Thames on Jan. 31, 1858. Though a commercial failure, she was a splendid specimen of naval architecture and a worthy monument to her designers, Scott Russell and Brunel.

January 31, 1895.—In a letter to NATURE in September 1892, Lord Rayleigh directed attention to a slight difference in the densities of nitrogen prepared from two different sources. This letter led to the collaboration of Lord Rayleigh and Sir William Ramsay. In April 1894, Ramsay wrote to his wife, "I am at work on nitrogen but not from the commercial point of view. . . . Nitrogen of air is heavier than nitrogen from ammonia in the ratio 251 to 250. That would correspond with the addition of some light gas to the heavy one, or of some heavy gas to the light one." In August 1894 he was able to say, "I have isolated the gas. Its density is 19·075." The new gas was named argon, and the full story of its discovery was told by Rayleigh and Ramsay at a special meeting of the Royal Society held on Jan. 31, 1895.

February 2, 1891.—In 1887, Lord Rayleigh pointed out how particles of silver might be deposited in layers half a wave-length of light apart. Four years later, on Feb. 2, 1891, before the Paris Academy of Sciences, Gabriel Lippmann explained the discovery of the process of colour photography by interference.

February 3, 1851.—The idea of using a swinging pendulum to demonstrate the rotation of the earth was due to Leon Foucault, who described his experiments to the Paris Academy of Sciences on Feb. 3, 1851. Some of his demonstrations were made in the Panthéon, but when, a year or two later, the Panthéon again became a church, the pendulum was shown in motion at the Champs de Mars.

February 4, 1812.—Preserved in the Deutsches Museum, Munich, is the apparatus by which Sömmering in 1809 sent signals by electricity. His attention had been attracted to the subject by the successful use of the semaphore during Napoleon's Austrian campaign. Commencing in 1809 with communicating between points 38 feet apart, on Feb. 4, 1812, he was able to send signals almost $\frac{3}{4}$ of a mile.

February 5, 1870.—At the Academy of Music, Philadelphia, on Feb. 5, 1870, before an audience of more than 1500 people, Henry Heyl publicly exhibited on the screen a series of posed pictures showing the movements of a couple waltzing. The effect was obtained by placing photographs round the edge of a disc which was driven step by step in strict time with the music of the orchestra. This was the first public motion picture show, and the Academy has been popularly called "the birthplace of the movies."

E. C. S.

Societies and Academies.

LONDON.

Royal Society, Jan. 20.—J. Topping and S. Chapman: On the form and energy of crystalline sodium nitrate. The total potential energy has been found for a series of configurations of the ions of the crystal, by the addition of the potential energy due to the intrinsic repulsive forces between the various ions, to the electrostatic potential energy, which was calculated in a previous paper. The stable configurations of the crystal corresponding to a minimum value of this energy has been found for various values of the distance b between the N and O ions of an NO_3 group. The value of b suggested is about 0·96 Å.U., which is somewhat larger than the value of 0·72 Å.U. given in the former paper.

C. N. Hinshelwood: Quasi-unimolecular reactions—the decomposition of diethyl ether in the gaseous state. The decomposition of gaseous diethyl ether is a reaction which obeys the unimolecular law at high pressures, but becomes more nearly bimolecular at lower pressures. A sufficient amount of hydrogen completely stops the falling off in the unimolecular velocity constant at low pressures; helium and nitrogen have little or no influence, while the reaction products in considerable excess have a slight retarding influence. There are enough collisions to activate the molecules if the energy of activation is assumed to be distributed among about eight degrees of freedom. These and other 'quasi-unimolecular' reactions are most simply explained on Lindemann's theory.

W. G. Burgers: An X-ray investigation of optically anomalous crystals of racemic potassium chlorosulpho-acetate. In an investigation of crystals of racemic potassium chlorosulpho-acetate $\left\{\begin{matrix}\mathrm{CHCl}\,.\,\mathrm{SO_3K} \\ | \qquad\qquad +1\frac{1}{2}\mathrm{H_2O} \\ \mathrm{COOK}\end{matrix}\right\}$ by F. M. Jaeger, it was shown that these crystals exhibit an anomalous optical behaviour, and that variations occur in the angles between some of their faces. Investigation of the crystals by X-rays shows that the crystals are truly orthorhombic, and that the irregularities of their habit must be caused by a slight difference in orientation of successively crystallised layers. The optical anomalies may be due to strains in the crystals. The space-group of the crystals is C_{2h}^{14}, the underlying lattice Γ_0. The dimensions of the unit cell, which contains eight groups of the above formula, are $a = 8·58$ Å.U., $b = 8·60$ Å.U., $c = 23·76$ Å.U.

J. Topping: On the mutual potential energy of a plane network of doublets. The mutual potential energy of a set of coplanar doublets with their axes all perpendicular to the plane has been found at the net-points of (1) a square network, and (2) an equitriangular network. If the number of doublets per unit area be the same in both cases, the energy per unit area differs only by about 2 per cent. This result may be applied to a layer of polarised molecules on the surface of a fluid, so that a fairly definite estimate of the energy can be made for any probable mode of packing of the molecules.

D. Buchanan: Periodic orbits of the second genus near the straight-line equilibrium-points in the problem of three bodies. The particular problem considered pertains to periodic oscillations in the vicinity of the Lagrangian straight-line equilibrium-points, when the two finite bodies move in circles and the third body is infinitesimal. The first-genus orbits near these equilibrium-points were first obtained by Darwin. The orbits with which this paper is more particularly concerned are those of Class A of Moulton's 'Oscillating Satellite.' With respect to

rotating axes, they have the shape of the figure 8, with the top and bottom of the 8 bent up from the page. They re-enter after one revolution. The second-genus orbits considered are in the neighbourhood of these figure-8 orbits, but re-enter only after many revolutions. The ratio of periods of orbits of the two genera is a function of distance between them at initial times.

L. F. Richardson: The deferred approach to the limit. This is an investigation of the validity of an arithmetical process, here called the 'h^2-extrapolation,' which has previously been used for solving differential and integral equations.

J. E. Lennard-Jones and B. M. Dent: Some theoretical determinations of the structure of carbonate crystals. Part 1. This paper provides data for the calculation of the potential energy of any crystal of the calcite type for which the forces between the constituent ions are known. Two crystals, namely, $MgCO_3$ and $CaCO_3$, are considered in detail, and theoretical determinations are made of the size and shape of the rhombohedral cells. In addition, the investigation determines an absolute value for the energy of these crystals is obtained. Part 2. A theoretical relation is obtained between the size of the rhombohedral cell of the carbonate crystals and the magnitude of the forces between the metallic and oxygen ions.

J. A. Gaunt: The first step in the approximate solution of differential equations by interpenetrating lattices.

J. W. McBain and W. B. Lee: Adhesives and adhesions: true chemical compounds as adhesives. Pure crystalline substances fully rival well-known adhesives in the strength of joint obtainable by them and may yield joints between optically polished metal surfaces the breaking strength of which may approach one ton per square inch. Pure liquids give results of a lower order of magnitude. In all cases the thinner the film, the stronger the joint. This rule holds for ordinary adhesives as well, provided that the film completely fills the space between the surfaces joined. There is direct parallelism between joint strength and the mechanical properties of the materials joined. Joint strength rises with tensile strength and elasticity, and falls with atomic volume and compressibility. Good lubricants with high spreading coefficients are poor adhesives. Joint strength is often much the same, whether tested in tension or in shear. Disorderly arrangement greatly enhances strength and joint strength.

W. L. Bragg: The structure of phenacite, Be_2SiO_4. The structure of phenacite, Be_2SiO_4, is examined, and an attempt made to find the positions of the silicon and oxygen atoms. The structure proposed resembles the simpler structure of the olivine group (Mg_2SiO_4, Fe_2SiO_4) in that its form may be explained as a packing together of oxygen atoms whose centres are 2·7 A.U. apart, with the atoms of metal and silicon between groups of oxygen atoms, but the arrangement is more complex. In phenacite, silicon atoms lie at the centre of tetrahedral groups, and similar positions are probably occupied by beryllium atoms. A rearrangement is achieved at the expense of slight increase in volume associated with each oxygen atom, when the structure is contrasted with such structures as $BeAl_2O_4$, where close-packing holds. The structure is determined by 21 parameters, 15 of which are measured.

P. A. M. Dirac: The physical interpretation of the quantum dynamics. To interpret physically calculations of quantum dynamics, a number of special assumptions are previously made; for example, that the elements of the matrix that represents the total polarisation determine the frequencies and intensities of the spectral lines, in analogy with the classical theory, or that the square of the amplitude of Schrödinger's wave-function determines a probability. A general method is given for obtaining physical results from a mechanics that uses non-commutative multiplication. The theory for any number of degrees of freedom is worked out. The results obtained in this way appear to be the most general that can be got from quantum dynamics, and probably give all the information that the physicist requires. For the mathematical investigation a general transformation theory of matrices of matrix mechanics is here worked out.

T. R. Merton: On measurement of intensity of spectrum lines. The wedge method of determining the intensities of spectrum lines is discussed, and a new technique is described. A comparator has been constructed for rapidly identifying spectrum lines, and at the same time determining their intensities in terms of a standard continuous spectrum.

T. R. Merton: On temperature and pressure regulation in prismatic photographs. The errors in measurement and the loss in definition in prism spectrographs, due to variations in the temperature and barometric pressure, are discussed, and a description is given of methods by which these errors have been overcome.

Geological Society, Jan. 5.—Charles S. Elton: The nature and origin of soil-polygons in Spitsbergen. Polygonal soils are divided primarily into mud-polygons and stone-polygons. The mud-polygons are formed in two quite different ways: there are larger ones produced by frost-expansion of the soil in winter, and smaller ones formed by drying of the soil in summer. There are probably several factors at work in the formation of stone-polygons. A new factor is described in this paper; mixed materials become differentially arranged in a vertical direction, so that there is mud below, grading into stones on the surface. The mud freezes in winter, expands, and forms regular mud-polygons, invisible from the surface at that stage. Later, as the overlying stones become disintegrated, the centres of the mud-polygons reach the surface, and when they freeze in winter exert a lateral pressure forcing the stones outwards, forming at first, rings, and later, stone networks.—Frank Dixey: The tertiary and post-tertiary lacustrine sediments of the Nyasan rift-valley. The series of lacustrine sediments extending along the north-western shores of Lake Nyasa, formerly thought to be of recent age, are now known to include the deinosaur beds of late Jurassic or early Cretaceous age, as well as six groups of beds ranging through Tertiary and post-Tertiary times. These sediments extend over an area 78 miles in length and 12 miles in maximum width, and they occupy the floors of several minor rifts that run parallel with the main rift-valley. The beds extend increasingly farther inland according to their age, and the oldest group (the Sungwa beds) rises to a height of 1000 feet above the present level of the lake. The different groups rest upon the worn edges of the deinosaur beds and all older rocks, and they are themselves separated by a series of unconformities; moreover, the sediments all dip towards the floor of the main rift, and each group is inclined in this direction at a steeper angle than that of the group immediately overlying it.

EDINBURGH.

Royal Society, Jan. 10.—Miss Frances M. Ballantyne: Air-bladder and lungs: a contribution to the morphology of the air-bladder of fish. A large mass of material, embryological and adult, of ganoids,

lungfish, and teleosts has been examined. The facts brought forward help to complete the evolutionary history of the air-bladder of modern fish from the right lung of the primitive ancestral form.—George Slater: The structure of the disturbed deposits of Möens Klint and Lönstrup, Denmark. The disturbances of Möens Klint are local and superficial and extend for 4 miles. They may be divided into two groups, in each of which the structure shows a definite relationship to a 'core' of chalk, of asymmetrical or drumloid form of roche-moutonnée outline. Thrust planes are developed on the iceward limbs of the 'cores,' and these are associated with drift-deposits intercalated in the chalk. To the south of the area seven squeezed anticlines occur separated by thrust planes. The disturbances south-south-west of Lönstrup extend for 2½ miles. The material involved consists entirely of drift of two types, 'clay and sand,' constantly repeated, and associated with thrust-planes. The structure differs from that of the Möen area in the fact that the beds have a uniform direction of dip to the north-north-east, but agrees with the phenomena seen at Möen on the iceward limbs of the 'cores.' The Lönstrup sections represent the tectonics of a stagnant glacier as reflected in the lower englacial material.—Errol I. White: The fish-fauna of the cementstones of Foulden, Berwickshire. This fauna consists chiefly of fishes, which, with the exception of a few large, widely distributed species represented by odd scales and teeth, are small local forms not previously described. Five new species are recorded, and of these four belong to new generic types of palæoniscids to which the names Fouldenia, Aetheretmon, Carboveles, and Strepheoschema are given: these are interesting on account of the specialisation they show in various directions, and specially to be noted are the degeneration of the squamation in Carboveles and the platysomid-like deepening of the body in Strepheoschema.

MANCHESTER.

Literary and Philosophical Society, Dec. 14.—F. E. Weiss: Some recent advances in our knowledge of inheritance in plants. In the main, Mendel's work has been confirmed, but irregularities and exceptions have made subsidiary hypotheses necessary. The numerical ratios obtained by Mendel in the segregation of characters have been satisfactorily explained by the separation of the chromosomes in the reproductive cells, and Prof. Morgan and his collaborators in America have worked out a very complete theory of the actual distribution in the chromosome filaments of the material carriers or genes of the unit characters. Though Morgan's views have been generally adopted, they must still be regarded as open to criticism. Recently it has been shown that it is difficult to reconcile them with the fact that in different, closely allied species of Crepis the number of the chromosomes is different, yet without apparent loss of important characters. Variation in the number of chromosomes occurs in many plants. Certain giant races possess twice the number of the nuclear constituents, whereas in other cases varying numbers of chromosomes do not appear to have caused fundamental differences in the plant. Very variable genera such as Rosa, Rubus and Cratægus possess multiple numbers of chromosomes. Millardet's original discovery of complete inheritance in certain strawberry hybrids of all the characters of one of the parental plants, and an absence of subsequent segregation, has been confirmed, and occurs in a number of other plants. More attention will probably have to be paid in the future to the 'field' or environment in which the genes develop, and this may also throw some light on the conditions which produce changes of these genes and result in the formation of variations and mutations.

PARIS.

Academy of Sciences, Dec. 20.—E. Goursat: Some partial differential equations.—Maurice Hamy: Some experimental researches. A study of a method for evaluating the errors due to the eyepiece micrometer of meridian telescopes.—L. de Launay: The possible rôle of transmutations in geology. Outline of a theory concerning the formation of the chemical elements and their distribution on the earth.—A. Desgrez, L. Lescœur, and Mlle. S. Manjean: The influence of the ionic reaction on the decomposition of sulphide waters by a current of inert gas: hydrological applications. The effect on the rate of removal of hydrogen sulphide by a current of inert gas from a mineral water the pH of which has been changed by the addition of salts is shown in a series of curves.—Benjamine Segre: The generalisation of the transformation of Laplace.—René Garnier: Certain linear differential equations and the problem of Plateau.—E. Vessiot: Systems of equations and continuous transformations.—Lainé: An equation of the form $s = p\phi\ (x, y, z, q)$ integrable by the method of Darboux.—Georges Valiron: The values of the holomorph functions in a circle.—Octave Onicescu: The adjusting an ensemble of values.—Paul Dumanois: Concerning the use in internal combustion motors of slightly inflammable combustibles. A study of the conditions under which a petroleum product such as white spirit (boiling-point range 130°-180° C.) can be used in an aviation motor.—P. Salet: The constancy of the velocity of light. Reply to the criticisms of La Rosa on conclusions given in an earlier communication.—P. Helbronner: Results of the operations of the meridian chain of Corsica and of the junction of this with the islands of the Tuscan archipelago.—Th. Vautier: Forms and deformations of aerial waves.—Pierre Bricout: The value of the potential at the interior of a cluster of electrons in movement.—G. Bruhat and M. Pauthenier: The surface tension of insulating liquids submitted to the electric field. A thermodynamic proof that the surface tension of an insulating liquid is independent of the electric field.—G. Colange: The mechanism of the electrolytic interruptor. A description of a new type of electrolytic interruptor.—A. Couder: A new type of photographic telescope. An improvement of Schwarzschild's method, using two mirrors with a reflecting telescope.—G. Vaugeois: The influence of the nature of the support on the radon evolved.—Henri Belliot: Photographic inversion by heat.—E. Carrière and Ducasse: Determination of boiling-point and dew-point curves of mixtures of hydriodic acid and water under a pressure of 746 mm. of mercury.—Pierre Chevenard and Albert Portevin: The influence of carbon and silicon on graphite formation in white cast irons. In the alloys studied the carbon varied from 1·7 per cent. to 4·5 per cent., the silicon from 0·2 per cent. to 6 per cent. The results are given in a three-dimension diagram, with silicon, carbon, and temperature of graphite formation as variables.—H. Colin and Mlle. A. Chaudin: The law of hydrolysis of saccharose by acids. A repetition of Wilhelmy's research with instruments of high precision on the inversion of sugar by acids (nitric acid, oxalic acid). The quantity $\frac{1}{t}\log\frac{a}{a-x}$ increased with time. From this it is concluded that the hydrolysis of sugar by dilute acids is not a simple monomolecular reaction, neither is it the resultant of two reactions one of which is instantaneous.—Mlle. Suzanne Veil: The evolution of iron sulphide in contact with water. A study of the changes in the magnetisation coefficient of sulphide

of iron produced by heating with water to various temperatures.—J. Cournot and Eugène Pérot: The cementation of aluminium by copper.—B. Bogitch: Concerning the granulation of scoria. In the process of granulating metals or slags by pouring the molten material into water, explosions are fairly frequent. These can be avoided or much reduced in number by taking certain precautions.—Charles Prévost: A closed cycle of reactions concerning some derivatives of erythrene.—Antonin Némec: The determination of the requirements of agricultural soils in phosphoric acid by the colorimetric method. The influence of lime and iron.—Ch. Brioux and J. Pien: The lime requirements of acid soils. Electrometric curves of saturation and the Hutchinson-MacLennan indices. Buffer action towards bases. Comparison of the results obtained by the Hutchinson-MacLennan calcium bicarbonate and electrometric methods showed good agreement. For soils of equal *p*H values, clay soils and soils containing much humus require more lime for neutralisation than light sandy soils.—Maurice Azéma: The mechanism of excretion in the Ascidiidæ.—Jacques Pellegrin: The disappearance of opposite fins in African fishes of the Clariineæ group.—Alphonse Labbe: An experimental phyletic line, Canthocampus→Cyclops.—Jean Jacques Trillat: The secondary action of the X-rays on micro-organisms. These experiments show the marked influence of the secondary radiations excited by the primary radiation on a metallic radiator placed near the micro-organisms. The bactericidal action is greater the higher the atomic number of the metal forming the radiator.—Henri Hérissey and J. Cheymol: The chemical composition of geine (geoside). The formula given is mainly based on the facts that hydrolysis with gease gives vicianose and eugenol in equal molecules, whilst hydrolysis with acids gives *d*-glucose, *l*-arabinose, and eugenol.—N. Bezssonoff: Is the antiscorbutic action due to two different substances ?—J. Meunier and Mlle. G. Saint-Laurens: Human biliary calculi containing a high proportion of copper. Recent work has shown that the presence of copper in plant and animal tissues is fairly general, and its presence can now scarcely be regarded as accidental. The maximum amounts hitherto found are of the order of 60 mgm. per kilogram. The calculi examined contained 3 grams per kilogram.

Official Publications Received.

BRITISH AND COLONIAL.

Proceedings of the Edinburgh Mathematical Society. Vol. 44 (Session 1925–26), Part 2, December. Edited by Dr. T. M. Macrobert and Prof. H. W. Turnbull. Pp. 57-153+viii. (London: G. Bell and Sons, Ltd.) 5*s*. net.

Proceedings of the Geologists' Association. Vol. 37, Part 4, December 21st. Edited by A. K. Wells. Pp. 346-462+plates 17-29. (London: Edward Stanford, Ltd.) 5*s*.

Transactions of the Royal Scottish Arboricultural Society. Vol. 40, Part 2, October 26. Pp. 71-182+27-34. (Edinburgh: Douglas and Foulis.) 3*s*.

Catalogue of the Seventeenth Annual Exhibition of the Physical Society and the Optical Society, January 4th, 5th and 6th, 1927, Imperial College of Science and Technology, Imperial Institute Road, South Kensington. Pp. 128+xxiv. (London: Physical Society, Imperial College of Science.)

The Journal of the London Mathematical Society. Vol. 1, 1926. Pp. iv+272. (London: Francis Hodgson.)

The Optical Convention, 1926. Catalogue of Optical and General Scientific Instruments. Pp. x+326. (London: The Optical Convention, 1 Lowther Gardens.) 6*s*. net.

Proceedings of the Optical Convention, 1926. Part 1. Pp. x+491+v+26 plates. Part 2. Pp. viii+493-1051+v+23 plates. (London: The Optical Convention, 1 Lowther Gardens.) 60*s*. net.

Department of Agriculture, Federated Malay States and Straits Settlements. Bulletin No. 38: A Preliminary List of Food-Plants of some Malayan Insects. Compiled by B. A. R. Gater, from the Records obtained in the Entomological Laboratory from 1920 to 1926, by G. H. Corbett and B. A. R. Gater. Pp. xvii+95. (Kuala Lumpur.) 50 cents.

Journal of the Chemical Society: containing Papers communicated to the Society. December. Pp. viii+iv+2971-3248. (London: Gurney and Jackson.)

Catalogue of Indian Insects. Part 11: Brenthidæ. By Richard Kleine. Pp. xiii+50. (Calcutta: Government of India Central Publication Branch.) 1.2 rupees; 2*s*.

Bureau of Education, India. Occasional Reports, No. 13: Bilingualism (with Special Reference to Bengal). By Michael West. Pp. xiii+354. (Calcutta: Government of India Central Publication Branch.) 2.4 rupees; 4*s*.

Aeronautical Research Committee: Reports and Memoranda. No. 1016 (M. 36): Some Physico-Chemical Studies on the Effect of Sunlight on Cotton. By Dr. Guy Barr and Isabel H. Hadfield. (B.1.c. Fabrics-Aeroplanes. 61-62-63.—M.C. 132, T. 1961, T. 2184, T. 2241.) Pp. 22+9 plates. 1*s*. net. No. 1043 (Ae. 230): Photographs of the Flow round a Model Screw working in Water, especially in the 'Vortex Ring State.' By C. N. H. Lock and H. C. H. Townend. (A.3.d. Airscrews, 92.—T. 2278.) Pp. 5+3 plates. 9*d*. net. (London: H.M. Stationery Office.)

Annual Report on the Working of the Museum Department during 1925–26. Pp. xii. (Malta: Government Printing Office.)

FOREIGN.

U.S. Department of Agriculture: Bureau of Biological Survey. North American Fauna, No. 48: Voles of the Genus Phenacomys. 1: Revision of the Genus Phenacomys; 2: Life History of the Red Tree Mouse (Phenacomys Longicaudus). By A. Brazier Howell. Pp. iv+66+7 plates. (Washington, D.C.; Government Printing Office.) 20 cents.

Annual Report of the Meteorological Observatory of the Government-General of Työsen for the Year 1923. Compiled by the Meteorological Observatory of the Government-General of Työsen. Pp. iv+156. (Zinsen)

The Memoirs of the Imperial Marine Observatory, Kobe, Japan. Vol. 3, No. 1: An Attempt to Detect a Direct Effect of the Solar Activity on the Air Temperature at some Stations in the Central Part of Japan. By Rikiti Sekiguti. Pp. 21+7 plates. (Kobe.)

Proceedings of the Imperial Academy. Vol. 2, No. 8, October. Pp. xxiii-xxiv+361-458. (Ueno Park, Tokyo.)

U.S. Department of Agriculture. Farmers' Bulletin No. 1495: Insect Enemies of the Flower Garden. By C. A. Weigel and William Middleton. Pp. ii+54. (Washington, D.C.: Government Printing Office.) 15 cents.

Department of Commerce: Bureau of Standards. Miscellaneous Publications, No. 75: Annual Report of the Director of the Bureau of Standards to the Secretary of Commerce for the Fiscal Year ended June 30, 1926. Pp. iv+45+3. (Washington, D.C.: Government Printing Office.) 5 cents.

Proceedings of the United States National Museum. Vol. 69, Art. 4: The Collection of Ancient Oriental Seals in the United States National Museum. By I. M. Casanowicz. (No. 2630.) Pp. 23+20 plates. Vol. 69, Art. 7: Descriptions of New Reared Parasitic Hymenoptera and some Notes on Synonymy. By C. F. W. Muesebeck. (No. 2633.) Pp. 18. Vol. 69, Art. 9: Review of the American Xylotine Syrphid-Flies. By Raymond C. Shannon. (No. 2635.) Pp. 52. Vol. 69, Art. 11: The Chrysotoxine Syrphid-Flies. By Raymond C. Shannon. (No. 2637.) Pp. 20. Vol. 69, Art. 13: American Two-Winged Flies of the Genus Microphthalma Macquart, with Notes on Related Forms. By J. M. Aldrich. (No. 2639.) Pp. 8. Vol. 69, Art. 15: Polychaetous Annelids from Fiji, Samoa, China and Japan. By A. L. Treadwell. (No. 2641.) Pp. 20+2 plates. Vol. 69, Art. 16: Identity of Hallowell's Snake Genera Megalops and Aepidea. By Leonard Stejneger. (No. 2643.) Pp. 3. Vol. 70, Art. 2: Descriptions of Larvae and Pupae of Two-Winged Flies belonging to the Family Leptidae. By Charles T. Greene. (No. 2651.) Pp. 20+3 plates. Vol. 70, Art. 3: A Fossil Palm Fruit from the Middle Eocene of Northwestern Peru. By Edward W. Berry. (No. 2652.) Pp. 4+1 plate. Vol. 70, Art. 5: A Collection of Birds from the Provinces of Yunnan and Szechwan, China, made for the National Geographic Society by Dr. Joseph F. Rock. By J. H. Riley. (No. 2654.) Pp. 70. Vol. 70, Art. 6: Nematode Eggs from the Gill Region of a Shark Carcharhinus Milberti. By G. A. MacCallum. (No. 2655.) Pp. 2. (Washington, D.C.: Government Printing Office.)

CATALOGUES.

The Francis Lamp Lock. Pp. 4. (London: Francis Lamp Locks, Ltd.)

Microscope Record. No. 10, January. Pp. 32. (London: W. Watson and Sons, Ltd.)

Diary of Societies.

SATURDAY, JANUARY 29.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Neville Hall, Newcastle-upon-Tyne), at 3.—P. F. Hope: Steam and Electric Locomotives for Colliery Purposes.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. E. W. Tristram: English Medieval Wall-Painting (2).

INSTITUTE OF BRITISH FOUNDRYMEN (Birmingham, Coventry, and West Midlands Branch) (at Engineers' Club, Birmingham), at 6.30.—T. Teisen: Modern Gas-Fired Annealing and Other Furnaces.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE.—Sir W. Larke: Steel Commercially Considered.

MONDAY, JANUARY 31.

CAMBRIDGE PHILOSOPHICAL SOCIETY (at Cavendish Laboratory, Cambridge), at 4.30.—Sir Joseph Larmor: What Determines the Resistance and Tilt of an Aeroplane?—L. H. Thomas: The Effect of the Orbital Velocity of the Electrons in Heavy Atoms on their Stopping of α Particles.—Dr. F. H. Constable: Surface Adsorption and the Velocity of Chemical Action at Gas Solid Interfaces.—H. D. Ursell: The Evaluation of Gibbs' Phase Integral for Imperfect Gases.—*To be communicated by title only*:—Prof. G. H. Hardy: Note on Ramanujan's Arithmetical Function $\tau(n)$.—Prof. G. H. Hardy and J. E. Littlewood: Notes on the Theory of Series (iv.): On the Summability of the Fourier Series of a Nearly Continuous Function.—R. Vaidyanathaswamy: The Pedal (3, 2) Correspondence.—W. Hunter: Lines and Planes in a Metrical Space.

INSTITUTE OF ACTUARIES, at 5.—V. P. A. Derrick: Observations on (1) Errors of Age in the Population Statistics of England and Wales, and (2) the Changes in Mortality indicated by the National Records.
ROYAL SOCIETY OF ARTS, at 8.—Dr. L. C. Martin: Recent Progress in Optics (Cantor Lectures) (3).
ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.30.—Presidential Address to Students and Presentation of Prizes.

TUESDAY, FEBRUARY 1.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. S. Huxley: Problems of Animal Growth and Development (1).
INSTITUTION OF AUTOMOBILE ENGINEERS (jointly with Royal Aeronautical Society) (at Royal Society of Arts), at 7.—A. H. R. Fedden: The Supercharging of Aero Engines.
INSTITUTE OF METALS (Birmingham Section) (at Engineers' Club, Birmingham), at 7.—Dr. G. D. Bengough: Corrosion.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—T. H. B. Scott: Presidential Address.
INSTITUTE OF METALS (North-East Coast Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—C. E. Pearson: Methods of Measuring Temperatures.

WEDNESDAY, FEBRUARY 2.

INSTITUTION OF MINING ENGINEERS (Annual General Meeting) (at Institution of Mechanical Engineers), at 11 A.M.—H. E. Mitton: Miners' Dwelling-houses.—The Haulage of Men Underground. Report of a Committee of the South Yorkshire Coal Trade Association.—R. Clive: The Occurrence of Gas.—A. D. Brydon: Surveying Boreholes by the Briggs 'Clinophone' and 'Clinoscope.'—J. P. Rees: The Effect of Ventilation on the Cooling Power of the Air (Eleventh Report to the Committee on 'The Control of Atmospheric Conditions in Hot and Deep Mines').—Dr. J. S. Haldane: (*a*) The Maximum Efficiency of Heat-engines, and the Future of Coal and Steam as Motive Agents; (*b*) The Thermal Efficiency of a Carnot Engine.—At 2.30.—Dr. W. Hancock: (*a*) A New Hygrometer for Mines; (*b*) Local Air-conditioning Underground by Means of Refrigeration (Twelfth Report to the Committee on 'The Control of Atmospheric Conditions in Hot and Deep Mines').
GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Prof. V. C. Illing: The Geology of the Naparima Region of Trinidad.—Dr. W. L. F. Nuttall: Tertiary Foraminifera from the Naparima Region of Trinidad.
ROYAL SOCIETY OF MEDICINE (Tropical, Dermatology, and Therapeutics Sections), at 5.30.—Special Discussion on The Treatment of Leprosy.
INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—C. F. Phillips and others: Informal Discussion on The Purpose and Design of Broadcast Receivers.
INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.30.—J. L. Hunt: Escalator Tunnels and other Works at Piccadilly Circus.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch, Graduate Section) (at Middlesbrough), at 7.30.—J. L. Taylor: Oil Tankers.
ROYAL SOCIETY OF ARTS, at 8.—N. Evers: Chemistry and the Supply of Drugs.
SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—T. H. Barry: Arsenic in Printing Inks.—G. D. Elsdon and J. R. Stubbs: The Immersion Refractometer and its Value in the Analysis of Milk.—Dr. P. Haas and Barbara Russell-Wells: Irish Moss Mucilage and a Method for its Determination.
EUGENICS SOCIETY, at 8.

THURSDAY, FEBRUARY 3.

ROYAL SOCIETY, at 4.30.—Prof. W. A. Bone and A. Forshaw: Studies upon Catalytic Combustion. V. The Union of Carbonic Oxide and other Gases with Oxygen in Contact with a Fireclay Surface at 5000° C.—A. Egerton and S. F. Gates: (*a*) On Detonation of Gaseous Mixtures of Acetylene and Pentane; (*b*) On Detonation of Gaseous Mixtures at High Initial Pressures and Temperatures.—M. W. Garrett: Experiments to Test the Possibility of Transmutation by Electronic Bombardment.—F. C. Lay, W. Ll. Prichard, and J. A. Sutcliffe: The Latent Heat of Vaporisation of Benzene at Temperatures above the Boiling Point.—H. A. Fells and J. B. Firth: (*a*) The Function of Water present in Silicic Acid Gel. The Structure of Silicic Acid Gel, Part II.; (*b*) The Phenomena arising from the Addition of Hydrogen Peroxide to Silicic Acid Gel.—E. Newbery: Anodic Overvoltage Measurements with the Cathode Ray Oscillograph.—C. Cuthbertson: (*a*) Absorption of Radiation in the Extreme Ultra-violet by the Inert Gases; (*b*) On a Relation between the Refractive and Dispersive Constants of the Inert Gases.—Prof. C. V. Raman and K. S. Krishnan: The Diffraction of Light by Metallic Screens.—R. G. Fraser: The Effective Cross Section of the Oriented Hydrogen Atom.—Sir Richard Paget: The Nature and Artificial Production of the, so-called, Voiced and Unvoiced Consonants.—L. Pauling: The Theoretical Prediction of the Physical Properties of Many-Electron Atoms and Ions.—B. F. J. Schonland and J. Craib: The Electric Fields of South African Thunderstorms.—Prof. J. C. McLennan, J. H. McLeod, and W. C. McQuarrie: An Investigation into the Nature and Occurrence of the Auroral Green Line λ 5577 A.—Sir Almroth Wright: A Further Contribution to the Study of the Phenomena of Interaction.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: Acoustical Problems treated by Lord Rayleigh: (1) Æolian Tones.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Lt.-Col. K. Edgcumbe and F. E. J. Ockenden: Some Recent Advances in Alternating-Current Measuring Instruments.
SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (jointly with Bristol and Fuel Sections) (at Bristol University), at 7.30.—J. W. Reber and M. Scott: Production of Power from Towns' Refuse.
CHEMICAL SOCIETY, at 8.—J. W. Baker and Dr. C. K. Ingold: The Nature of the Alternating Effect in Carbon Chains. Part XIV. The Directive Action of Some Groups of the Form $-CR'R''.CO.R$ in Aromatic Substitution.—J. W. Baker and I. S. Wilson: The Nature of the Alternating Effect in Carbon Chains. Part XVII. The Directive Action of the Groups $.CH_2.CH_2.NO_2$, $.CH:CH.NO_2$ and $.C(NO_2):CHR$ in Aromatic Substitution.—A. Ferguson and I. Vogel: (*a*) The Storch Equation, a General Dilution Formula and the Validity of the Law of Mass Action at Limiting Dilutions; (*b*) The Calculat on of the Equivalent Conductivity of Aqueous Solutions of Strong Electrolytes at Infinite Dilution. Part II. Application to Data at 0°, 18°, and 25° C.; (*c*) The Calculation of the Equivalent Conductivity of Aqueous Solutions of Strong Electrolytes at Infinite Dilution. Part III. The Mobilities of the Hydrogen and the Hydroxyl Ions.
RÖNTGEN SOCIETY (at British Institute of Radiology), at 8.15.—Dr. J. M. W. Morison: New Radiological Department, the Royal Infirmary, Edinburgh.—H. D. Griffith: The Physics of Carbon Arc Therapy.
INSTITUTION OF MECHANICAL ENGINEERS (Glasgow Branch).—Prof. A. L. Mellanby and Prof. W. Kerr: Use and Economy of High Pressures in Steam Plant.
INSTITUTION OF MECHANICAL ENGINEERS (Manchester Branch).—E. W. Tipple: Machine Tools.

FRIDAY, FEBRUARY 4.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.
GEOLOGISTS' ASSOCIATION (Annual General Meeting) (at University College), at 7.—Presidential Address: Some Aspects of the Mountain Building Problem.
SOCIETY OF CHEMICAL INDUSTRY (Manchester Section, jointly with Manchester Section of Oil and Colour Chemists' Association) (at 16 St. Mary's Parsonage, Manchester), at 7.—C. W. Gamble: The Constants of Colour—Hue, Purity, and Luminosity.
INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—W. Reavell: Engineering Salesmanship.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—W. L. F. Wastell: Psychology and the Print.
PHOTOMICROGRAPHIC SOCIETY (at 4 Fetter Lane), at 7.—H. Wrighton: The Photomicrography of Metals.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—P. R. Jackson: The Theory of the Gyroscopic Compass.
PHILOLOGICAL SOCIETY (at University College), at 8.—Prof. E. Weekley: Romance Notes.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. E. V. Appleton: Wireless Transmission and the Upper Atmosphere.
OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB.—Speaker—Mr. Hodges.

SATURDAY, FEBRUARY 5.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—Dr. C. P. Symonds: Cerebral Abscess; Some Points in Diagnosis and Localisation.—Dr. Farquhar Buzzard: The Treatment of Traumatic Facial Paralysis.
ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—W. de la Mare: Craftsmanship in Verse.

PUBLIC LECTURES.

SATURDAY, JANUARY 29.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Some Invasions of Ancient Egypt.

SUNDAY, JANUARY 30.

GUILDHOUSE (Eccleston Square), at 3.30.—Rabbi Dr. I. Mattuck: The Soul of Judaism.

MONDAY, JANUARY 31.

KING'S COLLEGE FOR WOMEN (Household and Social Science Department), at 5.15.—F. Hodges: The Future of the Mining Industry.

TUESDAY, FEBRUARY 1.

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Sir Thomas L. Heath: Conceptions of the Cosmos in the Classical Period.
UNIVERSITY OF BIRMINGHAM.—Prof. G. Elliot Smith: Science and Culture (Huxley Lecture).

WEDNESDAY, FEBRUARY 2.

KING'S COLLEGE, at 5.30.—Dr. O. Vočadlo: The Wends: The Ancient Slavonic Inhabitants of Northern Germany.
UNIVERSITY COLLEGE, at 5.30.—Major W. E. Simnett: Special Libraries.—At 6.—Prof. A. L. Bowley: Tests of the Trustworthiness of Public Statistics (Newmarch Lectures) (1).

THURSDAY, FEBRUARY 3.

KING'S COLLEGE, at 5.30.—Dr. J. A. Hadfield: The Mind: Psychotherapy.
NORTHAMPTON POLYTECHNIC INSTITUTE, at 7.—R. Genders: Steel and its Thermal Treatment: Engineering and other Special Steels.
ROYAL SOCIETY OF ARTS, at 8.—Prof. C. H. Reilly: Developments in Building Methods (Chadwick Public Lecture).
FULHAM PUBLIC LIBRARY, at 8.—Dr. J. R. Leeson: The Infinitely Small and the Infinitely Great: The Structure of the Universe from the Electron to the Nebula.

FRIDAY, FEBRUARY 4.

LONDON SCHOOL OF ECONOMICS, at 5.—F. Debenham: The Economic Aspects of the Polar Regions. (Succeeding Lectures on February 11 and 18.)

SATURDAY, FEBRUARY 5.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—V. Gordon Childe: The Aryans, our Linguistic Ancestors.

SUNDAY, FEBRUARY 6.

GUILDHOUSE (Eccleston Square), at 3.30.—Maulvi A. R. Dard: The Soul of Islam.