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CONTENTS.

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Professional Registration.

A SIGNIFICANT feature of professional life in post-War Europe to which the Committee on Intellectual Co-operation of the League of Nations has several times directed attention, is the tendency of professional workers to organise themselves in defence associations and frequently to attempt to establish a register of those qualified to practise, accompanied by legal restriction of professional practice to such persons. The case of the accountant, against which a Departmental Committee has recently reported, is the latest in sequence of a series of unsuccessful attempts to establish such registers in Britain. Restrictive registration was granted to the profession of dentistry in 1921. An architects registration bill was unsuccessfully introduced into the House of Lords in November 1928, and a similar attempt to obtain registration of opticians proved abortive in 1927, strong opposition being displayed in the House of Commons by the medical profession. In the profession of science, like tendencies are to be discovered, notably in the profession of chemistry, and it is probably largely the anomalous position in which the chemist finds himself in Great Britain, where the title of chemist is already restricted by law to the pharmacist, that has delayed the presentation of a bill before Parliament. The Pharmacy Bill which was presented to Parliament by certain private members in 1923, although it proposed to restrict the title of chemist to persons registered by the Institute of Chemistry, was drafted without consulting the professional organisations of chemists, such as the Institute of Chemistry and the British Association of Chemists, and did not represent a professional movement for registration.

While such attempts have in some cases proved premature from various causes, they indicate a tendency towards a definite change in the social structure of the country. To the more artificial system of political parties the growth of professional organisations, like that of the trades unions, opposes an occupational organisation similar to that of the medieval guild system. It is not, of course, contended that until recently professional organisation has not existed or that professional registration has not been tried. What is new is the expansion in the numbers of scientific workers and the growth of the professional spirit. Such workers have almost inevitably contrasted their own position with that of members of the medical profession, and the development of the medical profession since the passing of the Medical Act of 1858 has proved

a powerful stimulus to other and younger professions to seek similar lines of development as they become sufficiently numerous or important. In the field of science, the activities of the Association of Scientific Workers and of the British Association of Chemists illustrate this tendency. The former has debated the formation of a General Scientific Council and the institution of a Science Act, while the latter has recorded among its definite objects the legal re-definition of the term chemist and the formation of a legal register of all who are qualified to practise chemistry.

The newer branches of the profession of science, however, in contrast to the older professions of medicine and law, suffer the handicap that their members are rarely in direct relation with the public but are mostly themselves employed persons, and this factor constitutes a main difficulty in a movement towards registration.

There are two main obstacles to the activities of both these organisations. The Association of Scientific Workers is handicapped by sectionalism among scientific workers and the absence of real co-operation between different branches of science. In particular, the Association has not yet received any full measure of support from the most numerous class of scientific worker at the present time—the chemist—probably in consequence of the relatively highly organised position of the profession of chemistry. Indeed, while there is a profession of chemistry, it is doubtful whether we can speak with as much truth of a profession of science. The British Association of Chemists, while not altogether free from the handicap of lack of co-operation between different branches such as the consultant or analyst and the industrial chemist, finds a main obstacle to its progress in the question of title and the existence of the Pharmacy Acts. In a memorandum upon the questions submitted by the Departmental Committee on the Poisons and Pharmacy Acts, the Council of the Pharmaceutical Society recently recognised that other persons than those registered under the Pharmacy Acts practise chemistry in its different branches without statutory recognition. While persisting in the view that the title chemist could not be relinquished by pharmacists, the Council suggested that the creation of a register of chemists in which persons registered under the Pharmacy Acts took their place as pharmaceutical chemists would overcome the difficulty. The suggestions as to the means of producing such a register are left to the initiative of organisations representing chemists. Such an inclusive register might well remove the immediate difficulty, but the drawbacks to a register including the members of two entirely distinct professions are obvious. Alternative titles have been suggested, and the term "chemical practitioner" adopted by the British Association of Chemists, although cumbersome, has found some support. When, however, a sufficient volume of organised support for the registration proposal is forthcoming from the profession of chemistry, the question of title is unlikely to prove a permanent obstacle.

Even the failure of movements towards professional registration may indicate or emphasise the conditions essential for success. Primarily the desire for professional registration arises from a belief among members of a profession that such a step would result in an improved status and economic position for the members of that profession. While such aims are justifiable, they would not be accepted as a main reason for closing the profession. It must be shown that the enhanced status by, for example, increasing the efficiency of the services rendered would be an industrial or public advantage.

Although formed largely to defend the economic interests of their members and to fill a definite gap among the existing organisations of science, the Association of Scientific Workers and the British Association of Chemists have never pursued a narrow policy, but have endeavoured to awaken a wider sense of public responsibility among scientific workers and secure their fuller participation in public affairs. Although the latter body is still registered under the Trade Union Acts, neither organisation has ever shown any tendency to associate itself with the militant side of trades unionism. Trades unions have their own value in the present structure of industry, and scientific professional organisations deeply imbued with a spirit of service might well exercise an influence out of all proportion to their numerical strength, given the right opportunities of contact.

As it is, in such newspaper references as are made to the activities of either the Association of Scientific Workers or the British Association of Chemists, there is a tendency to stress unduly their material or economic interests and to ignore their wider aims. The two are, however, inseparable. No branch of science can render its full service to the State whilst its members are relatively handicapped in status or pay. First-class work, or the necessary proportion of first-class men, cannot be expected as the result of second- or third-class treatment. On the other hand, any great improvement in such respects can only come as scientific workers succeed in bringing home to the general

public their wider aim and educating the community in the value and place of pure science.

Under present conditions both these aims are of urgent importance. We have alluded recently to the dearth of first-class recruits for pure research. It is equally important to the community that science should assume a fuller share of responsibility for leadership and take a much wider part in public affairs. The relation between the scientific worker and the control and ordering of the life of the community under the impact of applied science presents a difficult problem for democracy. Some of the most complex situations confronting statesmen to-day can be traced directly to the indifference of those responsible for the discoveries of science to the consequences attending their utilisation. Scientific workers have been so absorbed in the progress of their researches that they have frequently neglected to take their share in assisting the control of forces which have been released by their work. This is the point on which Prof. Zimmern and other workers in the field of intellectual co-operation insist, and the wider recognition to-day of the importance of a right relationship between science or learning and leadership is largely due to their efforts.

Those scientific workers who have most clearly envisaged the contribution which science can make to the security and welfare of the State, and who are eager to see scientific workers taking full responsibility in the community, are among the most convinced supporters of the movement towards professional registration. The professional organisation which must precede registration offers some prospect of counteracting the political impotency of science in Great Britain. The publicity which such a movement requires and obtains serves to give a much-needed platform from which the services the chemist or other scientific worker renders to the community can be broadcast. The influence of science on public affairs as well as upon industry is now so profound and so rapidly increasing that in most branches of science an effective case could probably be presented for registration as in the public interest. The fact that the benefits of registration accrue slowly—a space of anything up to fifty years is required to eliminate from the register the lesser qualified persons who must be admitted in the first instance—only adds urgency. In a society the structure of which is increasingly dependent on the results of modern scientific discoveries, and in which ignorance or disregard of scientific facts can have far more serious consequences, measures to maintain or enhance high standards of qualification and integrity in those who practise in any branch of science are essential and demand public support.

For another reason the growth of professional organisation, if not of professional registration, among scientific workers may prove a public advantage. The solution of many important problems to-day is determined by factors which can be resolved by impartial and scientific inquiry. No forum exists from which those findings can be effectively made known without distortion by vested or political interests and from which, if necessary, unprejudiced public opinion can be organised to secure appropriate action. It is at least possible that the growth of professional registration will assist in the removal of one of the fundamental defects of modern democracy—the difficulty of securing for the community the advantages which would result from the enforcement of the recommendations of an impartial tribunal when its findings are not entirely in accord with the declared policy of any powerful party, or are, as is usually the case, regarded with disfavour by those whose interests are most immediately concerned.

The Problem of Epigenesis.

(1) *Grundriss der Entwicklungsmechanik.* Von Prof. Dr. Bernhard Dürken. Pp. vii + 208. (Berlin: Gebrüder Borntraeger, 1929.) 12·50 gold marks.

(2) *Die Determination der Primitiventwicklung: eine zusammenfassende Darstellung der Ergebnisse über das Determinationsgeschehen in den ersten Entwicklungsstadien der Tiere.* Von Prof. Dr. Waldemar Schleip. Pp. xii + 914. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1929.) 85 gold marks.

(3) *Experimentelle Zoologie: eine Zusammenfassung der durch Versuche ermittelten Gesetzmässigkeiten tierischer Formen und Verrichtungen.* Von Prof. Dr. Hans Przibram. Band 6: *Zoonomie; eine Zusammenfassung der durch Versuche ermittelten Gesetzmässigkeiten tierischer Formbildung (Experimentelle, theoretische und literarische Übersicht bis einschliesslich 1928).* Von Prof. Dr. Hans Przibram. Pp. viii + 431 + 16 Tafeln. (Leipzig und Wien: Franz Deuticke, 1929.) 40 gold marks.

THE question of epigenesis may be justly said to constitute one of the two root problems of zoology. For if we think it out there are two main things to be discovered about an animal, namely: (1) How does it fulfil its functions?—in a word,

considered as a machine, how does it work ? and (2) How does it come into being ?—that is, how did it develop and grow ? A subsidiary question to the last is : If there be such a thing as evolution, how and why did the powers of growth change from generation to generation ? For, as the late Dr. Bateson reminded us so long ago as 1894, the conception of evolution as the remoulding of the adult structures of an animal as we could alter the features of a wax doll by melting the wax and remodelling it, is an entire illusion, since the members of the parent species and of that to which it gives rise both begin as tiny formless germs and what is changed is *the powers of growth*. Now when we begin to analyse growth, we can either directly observe its successive phases—and this is the scope of descriptive embryology ; or by operating on the germ by chemical and physical agencies we can seek to discover the part which each visible element plays in the upbuilding of the adult individual—and this is the object of experimental embryology.

How this science has grown since its first beginnings with His in 1874 ("Unser Körperform und die physiologische Problem ihrer Entstehung") is witnessed by the three splendid works which are the subject of this review. Each of the three is worthy of unstinted praise : though we may differ from the authors in some of the conclusions reached by them, yet in each case the collection and setting forth of the matter is worthy of our sincere admiration. We hope that too long a time may not elapse before all are translated into English.

As an introduction to the subject Dürken's manual is to be preferred, because it is concise, well illustrated, and includes only typical cases which serve to exemplify the main principles of the subject, so that a beginner can get a good grasp of these principles without being overwhelmed by too much detail. Schleip's large and well-illustrated volume attempts to give a more or less complete account of the present state of our knowledge of the subject, and it will for a long time constitute a classic work of reference. Przibram's work—thorough and excellent as all his work is—is even more ambitious in its scope than that of Schleip, for it includes not only the facts of experimental embryology in the narrower sense, but also a considerable amount of the results of Mendelian experiments. It is, however, extremely condensed and, not being adequately illustrated, somewhat difficult to follow : it seems to us that its chief value will reside in its being a manual in which references to all the important papers on the subject can be easily looked up.

It must be obvious to the reader that, within the limits of the longest review for which space can be found in NATURE, it would be impossible to refer to a tithe of the new matter contained in these volumes, and so we must limit ourselves to a discussion of the main problems involved and to the attitude of the three authors towards them. In fairness, however, it should be added that this new matter is almost entirely confined to an elaboration of subjects dealt with by the older authors such as Roux, Hertwig, Driesch, Herbst, Boveri, Conklin, and Wilson, and does not consist to any considerable extent of discoveries in newer fields. The number of animals the eggs of which can conveniently be handled and which are tolerant of experiments is limited, and the same familiar figures crop up in successive text-books of experimental embryology. After all, as Driesch has wisely remarked, the biological experimenter cannot produce life at will—he must wait until he finds it, and he is therefore in the same position as a physicist would be if he could only study fire when he found it in the crater of a volcano.

When we approach the analysis of the development of the egg, the first question we encounter is whether the organs of the adult exist in the egg preformed in miniature and development consists essentially in an unfolding and growing bigger of these rudiments, or whether the egg is at first undifferentiated material which from unknown causes afterwards becomes more and more complicated and development is consequently an 'epigenesis'. This problem is *the* problem of experimental embryology ; in varied forms it reappears in every experiment on development which has been made.

The answer to this question given by the earlier experiments of Driesch was that some eggs, such as those of starfish and sea-urchins, consist of undifferentiated material ; but others, like those of Ctenophores, show a specialisation into parts destined to form particular organs of the adult. The experiments of Wilson, Conklin, and Crampton proved that the eggs of Annelida and Mollusca belong also to this latter category. To eggs of the first kind Driesch gave the name of 'equipotential systems', since when the egg had divided into eight cells any one of these was capable of forming a tiny larva perfect in all details, and, moreover, when the egg had developed into a hollow sphere or blastula, any considerable piece of this blastula would round itself off and form a perfect blastula of reduced size, which would give rise to a correspondingly reduced larva. On these results, which were a complete surprise to him, Driesch founded his

theory of vitalism, arguing that if the organism were to be regarded as a physico-chemical machine, such things could not happen, for no conceivable machine could be divided into parts, each of which would function as a similar machine of reduced size. He inferred that there must be in every egg a non-material force or 'entelechy' which was capable of controlling the physical and chemical changes taking place in the germ, so as to direct them towards a definite end. This power of direction was named by Driesch 'regulation'. This revolutionary idea of Driesch, transcending the bounds of materialistic explanation, evoked the fiercest opposition amongst those biologists by whom life was regarded as nothing more than complicated chemistry. Yet the arguments of Driesch have never been successfully met. The utmost that can be urged against them is the assertion that, although we cannot explain life by physics and chemistry now, some day in the distant future, when we have made further discoveries, we may possibly be able to do so.

Of the authors reviewed in this article, Dürken is inclined to favour Driesch whilst Schleip and Przibram oppose him, but the alternative explanations of the two latter authors when examined in detail resolve themselves into saying the same things that Driesch said, in different phrases. All three authors agree in showing that between equipotential and specialised eggs every conceivable grade of intermediate exists, and that even the eggs of *Echinus* itself are not quite so equipotential as Driesch imagined. Schleip quotes the work of Hörstatius as proving that when the upper half of a blastula is cut off, though it will round itself off so as to form a reduced blastula, yet this will never form endoderm or proceed any further in development. The vegetative half, however, when severed will produce a completely viable gastrula. By a triumph of manipulative skill, Hörstatius succeeded in separating the vegetative pole of a blastula and grafting it in various positions on another blastula in which an appropriate defect had been produced. He thus proved that in all cases development begins in the graft, and that this graft can change cells that would otherwise produce ectoderm into endoderm, in other words, act as an 'organiser' of development.

Driesch attributed specialisation in eggs to a 'premature stiffening of the cytoplasm' which prevented the 'entelechy' from moulding the fragment of the egg into a reduced whole. Przibram in other language comes to exactly the same conclusion. He says that the formation of definite organs is in all cases due to a *solidifying* of a portion of the cytoplasm, forming what he calls an 'apoplasm' which, if we understand him right, he does not regard as fully alive. In proportion as 'apoplasms' are deposited the potentialities of the germ are successively limited, and the reason why the higher animals approximate in their working to mechanisms is the large number of 'apoplasms' included in their make-up. Only fluid cytoplasm is completely living and possesses all the potentialities of the race, and Przibram is driven to conclude that these potentialities, so far as embodied at all, must be contained in the molecules of the cytoplasm, and that, therefore, these molecules constitute the real entelechy. Schleip similarly concludes that there must be an ultra-microscopic structure in the cytoplasm which, like a crystal, tends to assume a definite form and to complete itself when a fragment is severed.

In making these admissions, however, it seems to us that both Schleip and Przibram deliver themselves into the hands of Driesch. For in the crystallisation of an inorganic substance from a solution, the crystal assumes a definite form because its molecules have definite corresponding shapes, as Sir William Bragg has taught us. But what kind of structure, whether molecular or super-molecular, are we to envisage in cytoplasm? When the limb of a young newt is cut off and the stump proceeds to regenerate a new limb, are the molecules in the stump in the form of infinitesimal fingers and toes? Moreover, when the stump is cut at different levels and only the missing piece is regenerated, are we to assume that at each level in the limb before amputation the molecules are miniatures of the part distal to them? If we are able to swallow these fantastic assumptions, what are we to say of the experiment recorded by Dürken in which the tail bud of one newt embryo was grafted into the body of another near its forelimb and developed into a new limb? Presumably the cytoplasm of the tail bud was 'organised' so as to produce the tissues of an adult tail. How then was this organisation so completely changed as to produce a limb instead? No wonder that Dürken says that in cases like this, physical and chemical explanations leave us completely in the lurch, and we must have recourse to the conception of the 'biological field', an influence not in the living matter itself, but in the space, presumably the ether, around it.

Schleip seeks to disprove Driesch's theory by pointing out that the supposititious entelechy sometimes does foolish things, as in the case of the eggs

of Nematoda subjected to centrifugal force each of which produces two partial embryos instead of one whole one. But in this objection lurks the childish conception that the entelechy, if it exists, must be the embodiment of Divine Wisdom. The entelechy is not all-seeing—it is a rudimentary 'striving' which reacts to its immediate environment, in this case the 'apoplasm' or ball of dead matter ejected from the egg by centrifugal force.

The term 'organiser' we owe, of course, to Spemann, who wisely abstains from giving any chemical explanation of it. In the course of his marvellous experiments on the newt, Spemann showed that a piece of the dorsal lip of the blastopore of one newt gastrula grafted on the flank of another would change the fate of all the cells in its neighbourhood and force them to develop into a supplementary nerve-cord and underlying notochord. The reviewer might humbly plead that exactly the same conception was reached by him and published in a paper which appeared in 1918 entitled "The artificial production of Echinoderm larvæ with two water-vascular systems and also of larvæ devoid of a water-vascular system" (*Proc. Roy. Soc.*, B, vol. 90). In this paper he showed that when under the stimulus of hypertonic sea-water a second hydrocœle bud was produced in the pluteus, it completely altered the fate of all the tissues near it. It unfortunately did not occur to him to invent the term 'organiser'.

Of what nature is the influence emitted from the 'organiser'? Here again all physical and chemical analogies fail to help us. If the influence were merely a physical or chemical force it would *combine* with the growth-forces of the organised tissue, and what we should observe would be the *resultant* of the two forces. The complete domination of one part by another is not a physical but a vital phenomenon and an instance of Driesch's 'regulation'.

It would be a fair conclusion to draw from all that has been discovered in the field of embryology to say that in broad outline there are three stages in development, namely: (1) Division of the egg into cells—that is, segmentation; (2) differentiation of these cells so as to form the three primary layers—ectoderm, endoderm, and mesoderm; (3) the action of portions of one layer on the neighbouring parts of other layers so as to form definite organs—that is, the action of organisers.

The ultimate question, however, whence the original organisation of the cytoplasm of the egg is derived, must now be faced. The only answer possible is the nucleus. It is true that, as we have seen, many eggs when ready for fertilisation have an already differentiated cytoplasm. But the cytoplasm of these eggs *when young* is undifferentiated, and during ripening their nuclei are engaged in emissions into the cytoplasm. In particular the nucleolus has been repeatedly observed to become broken into fragments which pass through the nuclear membrane and become dissolved in the cytoplasm. If we take such a specialised egg as that of the Nematode *Ascaris*, Boveri has shown that if it is subjected to centrifugal force *when young*, large portions of the cytoplasm can be shorn away and yet the reduced egg will give rise to a typical embryo. To this conclusion Schleip and Przibram also consent. But it seems to us that a further conclusion follows which they have not clearly envisaged. When differentiation of the cells of the blastula takes place, this must be due to further emissions from the nuclei. But the nuclei in these early stages of development are all alike, and by means of pressure experiments, these nuclei, as Hertwig has put it, may be juggled about like a heap of marbles without altering the result. Moreover, so far as can be judged by the most minute cytological examination, they remain unchanged in their essential make-up throughout the whole of development. So we reach the conception of an *intermittent action of the nuclei on the cytoplasm* giving rise to successive differentiations, that is, stages of development; and as it is by means of these stages that development is directed towards a definite end, if there be an entelechy, we may conclude that the mode of its action is by nuclear emissions. These emissions are the physical correlates of what Uexküll in his "Theoretische Biologie" (1927) calls the 'Impulse' to development and the distinguishing of which, he avers, constitutes the utmost limit to which biological analysis can go.

Comparative embryology, however, can go further, and Schleip rightly insists that experimental embryology ought to be comparative. These embryonic stages are soon discovered to be merely smudged and simplified forms of larval stages which in allied forms lead a free life in the open, seeking their own food and combating their own enemies. These larval forms in turn are seen to be nothing but modified and simplified editions of adult forms in the past history of the race. Therefore, in the last resort, development is found to be due to the successive coming to the surface of a series of racial memories, and the entelechy might be defined as a 'bundle' of such memories.

The so-called Mendelian 'genes', however, constitute a problem for the embryologist; for the

conception of the hereditary make-up which they induce in the minds of geneticists is totally at variance with that which the embryologist draws from the study of development. Schleip and Przibram struggle valiantly to reconcile the two conceptions and fail. Dürken alone boldly questions the validity of the whole conception of the genes and points out how much it is purely arbitrary and theoretical. If the results of a crossing experiment agree with expectation based on the ordinary Mendelian rules, then it proves the reality of genes; if the results do not agree, the geneticist denies that it disproves them, because he immediately postulates the action of an undiscovered 'gene' which complicates the result. The real answer to the conundrum was given by Johannsen, when, in his latest publication, deploring the damage and confusion of thought caused by the invention of the word 'gene', he states that it represents a mere superficial disturbance of the chromosomes and gives no insight into the real nature of heredity. Even Przibram points out that X-rays will produce "unzählige" mutations, and that there is no correlation between the rays and the nature of the mutation. With these remarks we thoroughly agree.

E. W. MacBride.

Fourier's Series.

Introduction to the Theory of Fourier's Series and Integrals. By Prof. H. S. Carslaw. Third edition, revised and enlarged. Pp. xiii + 368. (London: Macmillan and Co., Ltd., 1930.) 20*s*. net.

PROF. CARSLAW'S excellent book is so well known that it needs little general introduction. The first edition, published in 1906, was a work on "Fourier's Series and Integrals and the Mathematical Theory of the Conduction of Heat". The second edition followed in 1921, in two volumes. The great advances in the theory of Fourier's series had caused the earlier chapters to develop into a self-contained book on analysis, including much matter on sequences and integration in addition to the theory of Fourier's series. It is of this work that the present book is the new edition.

Though there has been no radical change in character, much new matter has been introduced. In the old edition the discussion of the convergence of Fourier's series was limited to functions satisfying Dirichlet's conditions. This was unsatisfactory, because the sum of two such functions need not satisfy the conditions. The notion of functions of bounded variation has now been introduced, and the discussion has been enlarged so as to include them. Perhaps at this point it would have been well to make clear that (as is proved in a later chapter on the Riemann-Lebesgue lemma) the condition of bounded variation need only be satisfied in an arbitrarily small interval surrounding the point at which the convergence is considered. The difficulty could have been avoided by proving the Riemann-Lebesgue lemma at an earlier stage. In passing, it is perhaps worth while to suggest that the familiar and cumbrous condition "if x is an interior point of an interval (a, b) in which $f(x)$ has bounded variation" might well be shortened to "if the limits $f(x \pm 0)$ exist absolutely". The relation between the condition just mentioned and the condition "if the limits $f(x \pm 0)$ exist" is exactly parallel to that between absolutely and non-absolutely convergent series.

An account of Parseval's theorem (for a bounded R-integrable function) is another noteworthy improvement. In the excellent chapter on Gibbs's phenomenon, Prof. Carslaw records his interesting discovery that the phenomenon was pointed out by one Wilbraham, of Trinity College, Cambridge, more than fifty years before Gibbs's famous letter to Nature.

There is again an appendix on practical harmonic analysis and periodogram analysis. The first part of this is the 'practical' complement to the real variable theory of the preceding chapters, but the later work is still without a counterpart in real variable analysis. The analogy between the practical methods of periodogram analysis and certain results concerning almost periodic functions suggests a possible source for the appropriate theory.

In place of the bibliography in the old edition, there is an appendix on the theory of sets of points, leading up to the Lebesgue integral and its application to Fourier's series. Like all the rest of the book, this is clearly and attractively written. One can only wish that there had been more of it and that it had been incorporated into the book at an earlier stage. If the theorems on Fourier's series which involve the notion of measure are harder than those which do not, they are far more interesting and illuminating. Moreover, there is need for an English book on the subject of moderate size. In taking leave of the third edition, we may express the hope that in the fourth Prof. Carslaw will enlarge or again subdivide his book to supply this need.

Scientific Nominalism.

Les concepts scientifiques. Par Hélène Metzger. Ouvrage couronné par l'Académie des Sciences morales et politiques. (Bibliothèque de Philosophie contemporaine.) Pp. x+196. (Paris: Félix Alcan.) 12 fr.

THE twentieth century, and especially the last decade, has seen a remarkable development of consideration by working scientists of the philosophic implications of their labours. Biologists, as well as workers in the physical sciences, are studying the theory of knowledge in the light of their own work.

In the volume before us, Madame Metzger endeavours to generalise the categories within which scientific concepts may be grouped. She starts from the thesis that classification is a primal need of the human mind. We need to sort out the infinite complexity of experience, to make some choice of the matter of our own thought. Only by what is in ultimate analysis a process of classification can we embrace many phenomena in a single series of considerations.

Classification, Madame Metzger points out, is necessarily based on analogy, which may be to a greater or a lesser extent the construction of the mind itself. In considering a group comprising a number of phenomena or of series of phenomena, the mind so frames the boundaries, both of the group itself and of each series within the group, that they may conform to the analogical framework within which the mind chooses to work.

Having established the thesis that classification, based on analogy, provides the foundation of all mental activity, including that of the scientist, Madame Metzger proceeds to the analysis of the various patterns of those groupings of experience that underlie the formulation of various hypotheses that have held the field in science, and especially in chemical science. In each theory she traces the use of analogy as the basis of the concept of scientific law. Almost as pervasive as the concept of analogy is, she shows, that of evolution or development, which she distinguishes as "divergent, parallel, or convergent", each in turn based on analogy, that is, on a grouping of phenomena in such a fashion that it may be possible to ascribe to each group certain common properties or common relationships, while the groups themselves, considered as entities, may be similarly connected by common properties or relationships. "Perhaps", says Madame Metzger, "the complete image of Nature cannot be embraced in the monument erected by human intelligence . . . but the partial success attained assures us that evolutionist frameworks are, at least to some extent, in harmony with reality."

The final part of the work considers to what extent 'scientific nominalism' does in fact extend our interpretation of scientific concepts, and ends on a warning that classification tends always to be based on a process of abstraction which gives only a partial reflection of Nature.

DOROTHEA WALEY SINGER.

Our Bookshelf.

The Science of Folk-Lore. By Dr. A. H Krappe. Pp. xxii + 344. (London: Methuen and Co., Ltd., 1930.) 10*s.* 6*d.* net.

DR. KRAPPE was inspired to write this survey of the field of folk-lore by his visit to the congress held in London in 1928 to celebrate the jubilee of the Folk-Lore Society. The necessity for such a handbook was presented to him through his opposition to the methods and outlook of the so-called 'anthropological school'. Hence the existence of a handbook, published by the Society and prepared under the editorship of the late Miss C. S. Burne, is not mentioned. Throughout Dr. Krappe is very critical of Andrew Lang and the colleagues who with him were the foremost exponents of the anthropological method in Great Britain, nor will he admit the historical point of view of the late Sir Laurence Gomme. Nevertheless, he recognises the results achieved by the anthropological method in the hands of such a master as Frazer, whom indeed he regards as transcending all schools. He himself belongs to the school which subjects the material of folk-lore to the strict canons of literary and historical criticism.

Dr. Krappe, of course, has no difficulty in showing that the results attained by the uncritical application of the anthropological method are often unwarranted and sometimes absurd. That, indeed, might apply to any method injudiciously used. On the other hand, while the method of which he is the exponent may prune away some exuberances in the handling of fairy tale, folk-tale, and myth, as has already been done by certain English writers, yet even in Dr. Krappe's treatment of such subjects as magic, ritual, and superstition, the interpretation of the ultimate residuum after the application of the literary method must rest with the comparative method of the anthropologist whether the matter *sub judice* be an independent invention or the result of diffusion from a single origin.

Romance of the Planets. By Mary Proctor. Pp. xii + 272 + 8 plates. (New York and London: Harper and Bros., 1929.) 7*s.* 6*d.* net.

MISS PROCTOR must certainly be counted unfortunate in having brought out this little book just before the discovery of the extra-Neptunian planet, Pluto. She has narrowly missed being the author of the one up-to-date book on the planets, and the romance

of the discovery is by no means the least interesting aspect of it. However, she is in time for the forthcoming opposition of Eros, and her diagram of the path of the asteroid on that occasion should be of particular interest just now. The book is the fourth of a series dealing with the various bodies in the solar system. "These books have no scientific pretensions," says the preface, "nor do they deal with heavy celestial mechanics or troublesome mathematics; rather do they incline to an account of the latest theories and advances in astronomical research given in an entertaining, conversational manner." Books of this kind will always have their use, and "The Romance of the Planets" may be recommended as a very readable and accurate account of its subject, requiring the minimum of intellectual effort on the part of the reader. The question of the habitability of the planets is well to the fore, and is treated historically with numerous quotations. Quotations, in fact, are a prominent feature of the book, and are usually apt, though it is with something of a shock that we find Tennyson's almost hackneyed lines:

"the great world's altar-stairs
That slope through darkness up to God",

attributed to F. A. Pouchet! The illustrations are well chosen and moderately well reproduced.

Alternating Current Bridge Methods: for the Measurement of Inductance, Capacitance and Effective Resistance at Low and Telephonic Frequencies; a Theoretical and Practical Handbook for the Use of Advanced Students. By Dr. B. Hague. (The Specialists' Series.) Second edition, revised and enlarged. Pp. xvi + 391. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 15*s.* net.

THIS book is a theoretical and practical handbook for the use of advanced students. The best methods at present in use for measuring inductance, capacitance, and effective resistance both at low and at telephonic frequencies are given. The considerable amount of new matter in this edition has in our opinion increased its usefulness.

During the past six years, several notable uses of the alternating current bridge method to practical measurements have been made and these are duly described. An immense amount of research work has recently been done on the measurement of dielectric losses in cables and insulators at very high voltages, and bridge methods have been found as a rule better than wattmeter methods.

The principle of the Kelvin double bridge has been usefully extended to making alternating current measurements. The theory underlying the use of bridge networks is given, and the author's treatment will be easily understood by students. We think the book would be still more useful if the author had included methods of making measurements at radio frequency.

Hints, however, are occasionally given which will be a help to those working at very high frequencies. In particular, the sections dealing with bridges using condensers and the various methods which have to be adopted for shielding them will be found useful.

Deposition of the Sedimentary Rocks. By Prof. J. E. Marr. Pp. vii + 245. (Cambridge: At the University Press, 1929.) 7*s.* 6*d.* net.

PROF. MARR'S little volume gives a general account of the conditions which have controlled the distribution of the sedimentary rocks in time and space. It is not concerned except incidentally with the actual characters of the various types of sediments. These are divided according to their mode of origin — primarily into land and sea deposits. The latter are further divided according to the particular belt of sedimentation in which they are believed to have been laid down. These belts are—(i) the 'belt of variables', in which occur those sediments originally deposited nearest the shore line; (ii) the intermediate or 'mud belt'; and (iii) the 'organic belt'.

The introductory chapters discuss chronology and the use of fossils in correlation. The final two chapters consider the relationship between climatic belts and belts of sedimentation, and between the principle of uniformitarianism and organic evolution.

The author's treatment of his subject is throughout philosophical, with a refreshing absence of dogmatism. Detail is only introduced where necessary to illustrate points under discussion. The book forms an excellent introduction to the study of stratigraphy, and may also be recommended to those whose interest in geology is cultural rather than professional.

Morphologic Variation and the Rate of Growth of Bacteria. By Prof. Arthur T. Henrici. (Microbiology Monographs: General, Agricultural, Industrial, Vol. 1.) Pp. xiii + 194. (London: Baillière, Tindall and Cox, 1928.) 13*s.* 6*d.* net.

THIS book comprises a series of personal researches of a statistical character undertaken with the view of attempting to bring order out of the chaos which has so far filled the field concerned with the form and structure of bacteria.

The object of the book is to show that, contrary to orthodox teaching, the cells of bacteria are constantly changing in size, form, and structure in obedience to the operation of relatively simple laws. The author's investigations tend to show that the growth of bacteria in artificial culture is governed by the same laws that affect the development of multicellular organisms; the cells in turn exhibiting an embryonic form during a period of rapid growth, a mature or differentiated form during a period of slow growth or rest, and a senescent form during the period of death.

Altogether a most interesting and stimulating monograph. R. ST. J.-B.

Solvents. By Dr. Thos. H. Durrans. (Monographs on Applied Chemistry, Vol. 4.) Pp. xv + 144. (London: Chapman and Hall, Ltd., 1930.) 10*s.* 6*d.* net.

THIS is a book which deals mainly with the newer solvents for nitrocellulose. Its interest is for the technician engaged in the manufacture of nitrocellulose lacquers and enamels rather than for the general scientific reader.

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.*]

The Fechner-Weber Law in Wool Sorting.

IN the course of research work regarding the determination of the fundamental basis upon which wool 'quality' is assessed, an interesting illustration of Fechner's law has been brought to light.

An examination of a range of worsted tops comprising all qualities usually accepted by the trade from 48's to 80's has yielded interesting results. The tops were selected and vouched for by several authorities in the trade as being typical of their particular quality, and investigation revealed the interesting fact that the mean finenesses of the fibres comprising the samples of successive qualities of wool form a geometric progression. This result is in direct agreement with the Fechner-Weber law which states that "in order that the intensity of a sensation may increase in arithmetic progression the stimulus must increase in geometric progression, or in Fechner's notation $I = c \log S$".

An examination of French, German, and Italian standards has revealed that the same law is followed with, of course, a different number of grades in each country. It is not surprising to find that this should be the case, since the wool sorter's estimate of quality is made through the visual and tactile senses. The fact that the results of wool sorting follow Fechner's law affords a convenient basis for international agreement for an agreed scale of fibre fineness. So far as we are aware, the confirmation of this psycho-physical law, in its application to the wool industries, has not previously been noted.

S. G. BARKER
(Director of Research).

Wool Industries Research Association,
Torridon, Leeds, Oct. 6.

Natural Transport of Stones and Marine Animals.

AN article on the "Transport of Stones by Attached Seaweed" in NATURE of Feb. 8 suggests some interesting lines of thought. During the last two years, I have explored some 600 miles of coast in Western Australia, but have seen nothing comparable to the cases cited below or in the paper quoted, the only feature of interest in this connexion being the *Cymodocea* drift; the long ribbon-like leaves are rolled together by the waves and masses of several tons commonly present a wall two feet high and a chain long to the waves, and so give the beach a temporary degree of permanence, with shallow temporary pools on the landward side.

The case is very different in New Zealand. The coasts of Canterbury include cliffs, reefs, shingle, and sand, and the algal vegetation is luxuriant, including numerous float-bearing fucoids, notably *Cystophora retroflexa*, and also the immense kelps *Durvillæa antarctica* and *Macrocystis pyrifera*. One would expect that under such conditions supporting evidence could be found for Mr. Symington Grieve's views, as quoted in the above article, but although I have several curious observations to offer, I have never seen anything to suggest that stones attached to the holdfasts of algæ contribute materially to the breaking down of cliff faces or to the building up of stone beaches.

The article referred to mentions an account by my former teacher Dr. Charles (not James as given) Chilton, on the transport of stones by ascidians. Sponges are much more frequently concerned; at Timaru, for example, drift sponges may be seen in great numbers on a shingle beach, attached to stones or to the sessile queenshells *Chlamys*. No doubt the increasing size of the sponge leads to the dislodgment of the object to which it is attached, as also happens with fucoids attached to stones or to crumbling limestone or papa rock, or *Macrocystis* on the pinna shell *Atrina zelandica*. But the sponges did not accomplish much in the building up of the Timaru stony beach, which was small until a large mole was built out into the sea a few years ago; the mole not only stops the shingle as it drifts northwards from the mouths of the Pareora and Waitaki Rivers, but also it holds the beach permanently there in a way that *Cymodocea* or sponges could never do. As for the battering of cliffs by suspended stones, the latter are by no means hurled at the cliff, but trail sluggishly along the bottom with the upper fronds of the weed swaying backwards and forwards nearer the surface, and the usual fate of the stones seems to be to get wedged in between other larger stones and held firmly. There is a narrow range in the size of stones transported by any such means, and a small stone and a weed would seem a poor combination in comparison with a good Pacific breaker.

I am, however, the more ready to think that the differences between Mr. Symington Grieve's views and my own impressions are due to genuine local differences, because I can mention a number of curious phenomena which, though possibly paralleled in the North Atlantic, are not mentioned in any accounts which have come under my notice. First, there are rocks in New Zealand which, so far as mechanical forces are concerned, must be more kelp-worn than water-worn. *Durvillæa* invariably grows between tide marks in channels or exposed points where there is a maximum disturbance of the water; at a rough estimate, the discoid holdfasts, which commonly overlap or fuse, are 10 in. across, the stipe is cylindrical and 1½ in. in diameter, the fronds are ½ in. thick, and the whole plant 10 ft. in length. The fronds, which are torn into ribbons by the continued impact on the rocks, are full of air-spaces, and very buoyant, but nevertheless extremely tough. As a wave recedes these fronds trail outwards after it, slithering over one another and over the rock in a dense mass, and the next wave hurls them back by the ton with terrific force against the rock. In some places more kelp strikes the rock than water, and the wearing effect must be much greater. But by a strange oversight, experimental work in New Zealand on the wearing effect of shingle grinding together has not yet been extended in the present direction. Similarly, rocks half buried in sand are devoid of life within a foot or so of the sand, and are no doubt worn down by the suspended sand.

Macrocystis grows below low water mark, at a sufficient depth for its fronds, though many yards in length, to be safe from laceration on the rocks; it thus forms a continuous fringe outside the *Durvillæa* belt. It is chiefly of interest in that its large branched holdfasts, like the discoid holdfasts of *Durvillæa*, harbour a varied community of animals, and differences of opinion have been expressed as to the efficacy of drifting kelps in transporting these animals. The late Dr. Chilton used to emphasise the view, as finally stated in the "Subantarctic Islands of New Zealand", that faunistic similarities between New Zealand and South America are, at least predominantly, indications

of a former close geographical relationship, but later work, such as that of Dr. Mortensen on the echinoderms, emphasises rather the distributing agency of currents, which transport pelagic larvæ or drifting organisms. I have recently shown (*Rec. Cant. Mus.*, vol. 3, pt. 4, p. 255 ; 1930) that *Halicarcinus planatus* White, famed as the only circum-austral decapod, is a recent arrival in the South Atlantic, and its predilection for kelp is suggestive.

It would be of much interest to determine what proportion of the common elements in the marine fauna have such possible methods of distribution. Perhaps the members of the further expedition to the Antarctic next summer may have an opportunity of studying the fauna of kelp roots at Kerguelen Island, a certain half-way stopping place for drift from the west at least. The important point is the survival or otherwise of such animals after a voyage from the original reef to the place of stranding, and therefore it may be of interest to quote some such organisms which I have observed still alive on drift kelp on the New Brighton Beach, New Zealand. Such kelp, of course, has drifted for only a few miles. Apart from such organisms as *Lepas anatifera* and *Balanus decorus* on drifting wood, and many smothered animals embedded in the kelp holdfasts, such as *Mytilus planulatus*, *Terebratella rubicunda*, *Elminius modestus*, and many others, and miscellaneous polyzoans and sponges and others attached to the stipe or holdfast, and other animals such as *Halicarcinus tridentatus* not noticed alive on the stranded kelp, the following living organisms have been observed on stranded *Durvillœa* : the above barnacles, *Plaxiphora egregia*, *P. zigzag*, *Onithochiton neglectus*, *Saxicava australis*, *Irona reflexa*, *Calyptræa novæ-zelandiæ*, *Microlenchus tenebrosus*, *M. dilatatus*, *Mytilus planulatus*, *Lumbriconereis sphærocephala*. On *Macrocystis* : many of the above, also *Mytilus canalicus*, *Chlamys zelandiæ*, *Terebratella rubicunda*, *Elminius modestus*, *Chamœsipho columna*, *Limnoria segnis*, *Eulalia microcephala*, *Nereis amblyodonta*, *Trypanosyllis gigantea*. The last-named species has hitherto been known only from the southern islands. Some of these animals, chiefly the limpets, feed on the kelp, and hollow out the *Durvillœa* holdfast, which in old specimens is attached only round the rim.

Two further cases, not affecting geographical distribution, may be mentioned. The massive trough-shell *Spisula œquilateralis* is commonly stranded at New Brighton, no doubt through the agency of an epizoic hydroid which attains a length of more than a metre, and a smaller species, apparently undescribed, forms short, but dense, tufts on *Amphidesma forsteriana*, which occurs between tide marks on the same beach. It can survive burial in the sand, and indeed depends on the agility of the mollusc in burrowing to prevent the stranding of both, which, however, frequently occurs. The second case is one demonstrated to me by the late Mr. John Hardcastle, of Timaru, who showed me water-worn stones in a gully leading on to the shingle beach at Timaru, previously mentioned. The stones were too far from the beach to have been washed there, and too numerous to have been thrown by boys, and some were too deeply buried (though I did not verify this point) to have been ploughed under to that depth. Mr. Hardcastle believed that they were used by the seals (*Arctocephalus forsteri*) as ballast during former northern migrations, and regurgitated at this resting place. Corroborative evidence on this point would be of interest.

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Inhibition and Mechanism of Photochemical Reaction in Eder's Solution.

A SYSTEMATIC investigation of kinetic aspects of the reaction in Eder's solution has revealed the fact that, although in a pure solution the reaction goes on in a somewhat different manner when it is subjected to the action of the X-rays [1] than under ordinary light rays, the difference is not an essential one and is due only to a faster rate of the reaction in the former case. Under the X-rays, for example, we do not observe an induction period, which is a conspicuous feature of light reactions ; but if the intensity of the X-radiation is very small, the induction period is observed as usual. The presence of oxygen or increase in acidity tends to inhibit reactions in both cases.

If, however, the X-rays act in the presence of certain optical sensitisers, a striking difference is observed. I have studied reactions in the presence of ferric chloride, potassium permanganate, uranyl salts (nitrate and acetate), various fluorescent dyestuffs (uranin, eosin, erythrosin), and quinine bisulphate, and have found that these substances, all of which have a sensitising effect under the ordinary light, appear to be strong inhibitors when X-rays are used. Among them, potassium permanganate appears to occupy a peculiar position, for it undergoes a reaction itself under the influence of the X-rays (the solution changes its colour), and after the reaction has been completed, the inhibition stops and calomel begins to come down copiously from Eder's solution, which process goes on also in the absence of insolation.

Ferric chloride in small concentrations (*c.* 10^{-3} gm./c.c.) does not affect the rate of the reaction. But in concentrations from *c.* 10^{-2} gm./c.c. upward, it acquires the inhibitory power, and with the rise of concentration the rate of the reaction asymptotically falls to zero. These figures are quoted only to illustrate the orders of the magnitude involved, for actually the inhibiting action of ferric chloride is complicated by the influence of the concentration of dissolved oxygen. Uranyl salts act almost in the same way, though in this case the absorption of the X-rays increases very considerably, heavy atoms of uranium entering the solution. In this case even small concentrations produce the inhibition.

The behaviour of fluorescent sensitisers (dyes and quinine) is of still greater interest. A very small admixture of dye, quite inappreciable to the naked eye, is sufficient to produce a strong inhibitory effect. For example, erythrosin in concentrations of the order of 6×10^{-6} gm./c.c. delays the reaction by 64 per cent. The inhibitory property of all these substances increases at the same rate as their sensitising action under light. For example, uranin (sodium salt of fluorescein) has the weakest sensitising and inhibiting effect, whereas erythrosin is the most powerful in both directions.

In explaining these peculiarities it is natural to divide the substances into two groups according to the concentrations necessary to produce the inhibitory effect. The one group comprises ferric chloride and uranyl salts ; dyestuffs and quinine belong to the other. The absence of sensitising effect in either group is accounted for by special conditions of X-ray absorption. The substances belonging to the first group owe their inhibitory property to a secondary effect, namely, to a considerable rise of hydrogen ion concentration as a result of hydrolysis of ferric chloride and uranyl salts. On the other hand, in the inhibitory effects of dyes and quinine sulphate, we have an obvious case of negative catalysis produced by traces of a substance.

According to Christiansen's theory, a negative

catalysis is good evidence of a chain reaction. Taking into consideration that free chlorine atoms, which are likely to arise in this case under the action of light (and X-rays),[2] enter very readily into chain reactions, we can argue that Eder's reaction is probably also a chain reaction, its mechanism being similar to that of the combination of hydrogen and chlorine. The available data in the literature, though not very exact, suggest that the quantum yield for Eder's reaction in any case is more than unity. By an indirect method, based on intensity of the inhibition, I can conclude that the length of the chain in this case is very considerable. E. SHPOLSKY.

Institute of Physics and Biophysics,
3rd Miusskaja, 3, Moscow, Sept. 7.

[1] T. Molody and E. Shpolsky, *Jour. appl. Physics* (Russian), **3**, 57; 1926; **6**, 159; 1929; E. Shpolsky, *l.c.* **7**, 83; 1930.
[2] Cf. K. Butkow, *Z. Physik*, **62**, 71; 1930.

Field Populations and Natural Control of *Lucilia sericata*.

SINCE the spring of 1929 I have been engaged at Toulouse on a study of the biological agencies which play a part in regulating numbers of the sheep 'blow-fly', *Lucilia sericata* Meign. The effect of parasites and predators was first sought by a quantitative study of the puparia derived from carrion in which the flies had bred. However, it soon became evident that the only way by which a reasonable understanding could be obtained of the inter-relations of the various biological forms in the carrion and the magnitude of their action was by a quantitative study of the carrion insect populations, from the beginning of putrefaction to the disappearance of all consumable parts.

Suitable technique for obtaining a census of all species of the populations, both in the carrion and in the soil beneath it, has been developed by exposing simultaneously uniform baits of a number equal to the number of readings required, arranging to counteract any slight variation in bait attraction or field density and sacrificing a bait per census.

These quantitative studies have demonstrated the following points:

(1) The end result, taken at pupation or emergence, gives no indication of the magnitude of the reduction in numbers of *Lucilia sericata* by biotic agencies and little idea of the way in which the reduction is accomplished.

(2) Any significant effect which parasites and predators can have on the ultimate numbers of the fly surviving takes place after the bulk of the population has been destroyed by other means.

(3) The greatest factor in the reduction of the fly population within the carrion is Dipterous competition and its associated predatorism.

(4) The species concerned are, in addition to *L. sericata*, *L. cæsar*, *L. ampullacea*, *L. sylvarum*, *Calliphora erythrocephala*, *C. vomitoria*, *Sarcophaga* spp., and *Chrysomyia albiceps*.

(5) The magnitude of the competition and the fauna taking part differ according to the season, ather, and the type of bait used.

(6) There is in the insect fauna of carrion a definite ecological succession, comprising in the main the Diptera, species of Staphylinidæ, Silphidæ, Histeridæ, Hymenoptera, Dermestidæ, and Carabidæ, which, as regards the species concerned, varies according to the season. Within a family there may be species characteristic of an early stage in the succession and other species characteristic of a later stage.

(7) *Lucilia sericata* is the first member of this ecological succession and plays the part of a coloniser. Oviposition begins a few minutes after exposure in fresh meat or within a few hours of death in entire animals.

(8) All subsequent species of Diptera in the succession contribute to accentuate the competition and ultimately reduce the population of *Lucilia sericata*; the greatest reduction found has been that by the larvæ of Sarcophagids and the semi-carnivorous larvæ of *Chrysomyia*, both of which are most abundant during the summer, and the relative effect of which in carrion is largely determined by the type of bait used; the part played by Sarcophagids in meat baits is played by *Chrysomyia* in baits comprising entire animals (rabbits). The type and rapidity of putrefaction dependent on the kind of bait determines which of these forms gains the strongest hold and the ultimate ascendancy in the carrion.

(9) The part played by certain of the carrion beetles is negligible in the light of the part played by Dipterous competition, while the relation of

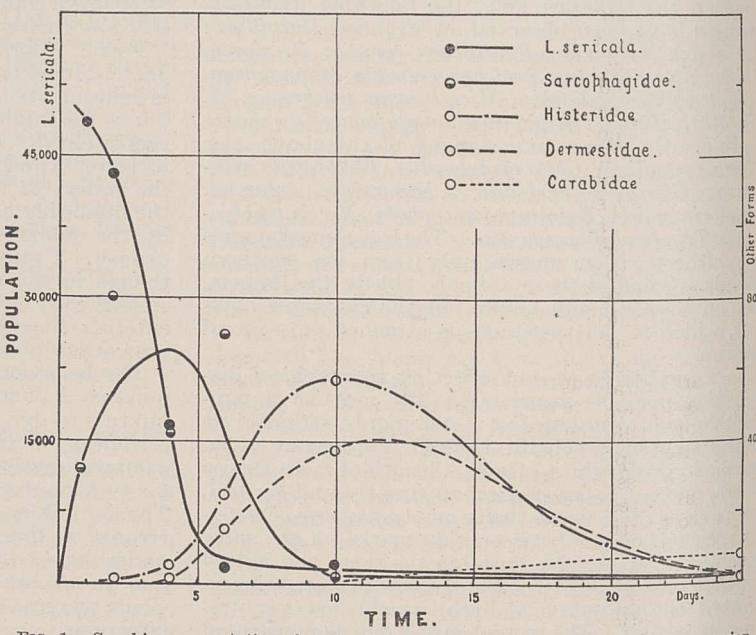

FIG. 1.—Graphic representation of carrion insect populations, showing ecological succession. (*L. sericata* scale on the left. Scale for other forms on the right.)

forms, such as Histerids, more definitely associated with the Diptera during their late larval and puparial stages, is more significant. Dermestids are of little consequence to the fly population, for they are largely concerned with the drying carrion rather than with the Diptera.

(10) No absolute idea can be obtained of the real effect of parasites or predators on the adult population of *Lucilia sericata* without an understanding of the inter-relations of the fauna of the carrion complex, particularly in the light of the differences associated with type of carrion, season, and also, no doubt, size of the carrion.

The accompanying illustration (Fig. 1) indicates

the type of results obtained. These particular results, given as live units, were secured under midsummer conditions in 1929; the bait, half a sheep's head laid on a piece of mutton, contained approximately 1 kgm. of consumable meat. The initial population of *L. sericata* was approximately 50,000 (the decreasing population twenty-four hours after exposure was 48,562), while the final field emergence was 231 flies. During the summer of 1930, under slightly hotter conditions, with a rabbit bait of approximately equal weight of consumable meat, and with *Chrysomyia* playing a rôle comparable to that of Sarcophagids in the former bait, an initial population of approximately 60,350 *L. sericata* plus 2850 *L. cæsar* yielded a final *Lucilia* population of 30 while the final *Chrysomyia* population was 2611.

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Determination of the Abundance Ratios of Isotopes from Band Spectra.

IN band-spectroscopic determinations of the abundance ratio of isotopes, an important but hitherto neglected point of view appears as soon as one attempts to make any calculations of greater accuracy.

Suppose the isotopes A_1 and A_2 exist in the abundance ratio m. In molecular compounds with atoms B they will form molecules A_1B and A_2B also in the abundance ratio m. Now raising the temperature of the mixture, so that several vibrational states of the molecules come into play, this abundance ratio will not remain fixed for each state. Provided there is a thermodynamical equilibrium, the molecules will be distributed according to the Boltzmann expression $Ae^{-E/kT}$, where E, the vibrational energy of the molecules, is different for different isotopes.

Carrying out such calculations on boron monoxide, $B^{11}O$ and $B^{10}O$, at room temperature, the abundance ratio of their normal state ($v=0$) is found to be approximately equal to m. But already in the first excited vibrational state ($v=1$) this ratio is changed into $1{\cdot}3m$. From the Condon parabola of the intensity distribution in the β-bands of boron monoxide one finds by the aid of the Franck-Condon principle that transitions from the normal state ($v=0$) chiefly will hit the first three vibrational levels ($v'=0, 1, 2$) in the excited electronic state. A. Elliott (NATURE, **126**, 203; 1930) photographed this spectrum, using activated nitrogen as the source of emission. From intensity measurements on different plates he finds an approximately constant abundance ratio m for bands corresponding to transitions from $v'=1, 2$ in the excited state. However, in bands corresponding to transitions from $v'=3$ he finds a remarkable increase of 30 per cent in this value. This observation is in perfect agreement with our calculation above, as the population of molecules in the vibrational state $v'=3$ is chiefly fed through collisions between active nitrogen and the boron monoxide molecules from $v=1$ in the normal state. Moreover, the results of Elliott indicate that the Franck-Condon principle is valid also in this special case of low temperature, where the electronic transition is caused through collisions between particles of approximately equal masses.

Occasionally, Naudé's results on the determination of the abundance ratio of O^{16} and O^{18} (*Phys. Rev.*, **36**, 333; 1930) may be correct as based on intensity measurements of bands corresponding to transitions from the normal state $v=0$ in the NO (β) spectrum.

Generally, however, correct values of the abundance ratio m from band-spectroscopic data afford determinations of m as a function of v, taking their weighted mean values from the energy distribution in the gas. Practically correct values are also obtained through intensity measurements on absorption bands belonging to $v=0$ in the normal state, if the absorption gas is kept at low temperature.

G. STENVINKEL.

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University of Stockholm,
Sept. 12.

Change of the Dielectric Constant of Ethyl Ether with Temperature.

I HAVE made a study of the dielectric constant of ethyl ether as a function of temperature with the aid of high frequency electromagnetic oscillations, using the method described by M. Wolfke and W. Keesom, *Comm. Leiden*, 190 *a*.

The construction of the measuring condenser has permitted the cooling of ethyl ether down to $-150°$ C. by the use of petrol ether as a cooling liquid, which was contained in a Dewar vessel, provided with a special refrigerator, cooled with liquid air. The uniformity of temperature throughout the substance under investigation was ensured by the use of a double stirrer and by the thinness of the layer of the cooling liquid. Temperatures were determined by means of

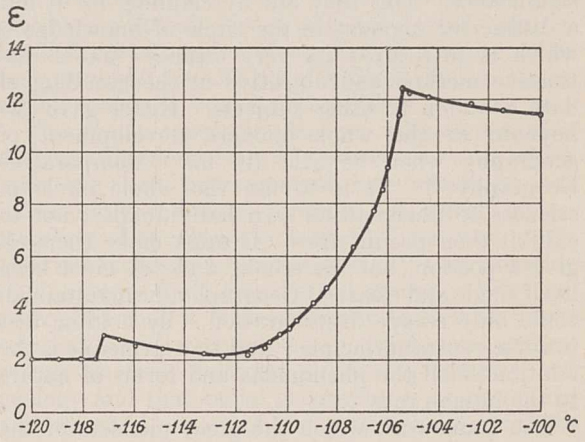

FIG. 1.

a platinum resistance thermometer, wound on the surface of the measuring condenser and calibrated with the aid of the normal thermometer of the Cryogenic Laboratory at Leyden.

The dielectric constant of very carefully purified ethyl ether increases with the lowering of temperature from 4·18 at 30·6° C. up to the highest value 12·39 at $-105{\cdot}4°$ C. and decreases very rapidly beyond that point. At the melting point, $-117{\cdot}2°$ C., there appears a distinct change in the dielectric constant, which was not observed by any of the previous workers. At temperatures lower than $-118{\cdot}9°$ the dielectric constant has a nearly constant value, equal to 2·04.

The changes of the dielectric constant of ethyl ether with the temperature described above are represented on the accompanying graph (Fig. 1).

J. MAZUR.

Physical Laboratory,
Technical Institute, Warsaw,
Sept. 30.

The Scope and Aims of Human Geography.*

By Prof. P. M. ROXBY.

IT is to Ritter and Humboldt that we owe the real beginnings of human geography as an integral and, indeed, from Ritter's point of view, the crowning part of the subject matter. To appreciate the greatness of their work we must realise how critical for the whole future of geography was the period in which they lived. It was a period in which great masses of new geographical data were being accumulated, but so long as these remained unsystematised and unrelated, they tended only to increase the inchoate and amorphous character of a subject which was rather a torture to the memory than a stimulus to the mind. It was a period, too, in which many independent, specialised sciences dealing with particular aspects of earth lore such as geology and meteorology were rapidly developing so that the domain left to geography itself, according to the prevailing conception of its character, was increasingly uncertain. It was Ritter and Humboldt who rescued what seemed indeed to be a moribund subject and gave it coherence, individuality, and an immensely enhanced significance. This they did by claiming for it not a distinctive segment in the circle of knowledge—which is to destroy its very essence—but a distinctive method and objective in the handling of data common to other subjects. Ritter gave the keynote to the whole modern development of geography when he said (in his "Comparative Geography") "It is to use the whole circle of sciences to illustrate its own individuality, not to exhibit their peculiarities. It must make them all give a portion, not the whole, and yet must keep itself single and clear." Geography, he maintained, could only escape disintegration "by holding fast to some central principle; and that principle is the relation of all the phenomena and forms of nature to the human race".

The framework which the great pioneers of the early nineteenth century defined for the building up of a geographical synthesis, which in Ritter's view culminated in man's relationship to the earth, was sufficiently wide to permit of many converging contributions. Workers in many fields of geography were henceforth guided by the same fundamental principles and methods, and whether in geomorphology, in climatic or human geography, the central object became to exhibit the earth as a whole made up of related and interacting parts.

It is no doubt true that some of the workers in contributory fields have been initially trained in the special science which supplied the data, that is, have been in the first instance geologists or zoologists, but it is equally remarkable that many of them, when once they have acquired the geographical outlook, have changed their objective and become primarily interested in placing or interweaving their contribution in the geographical synthesis as such. For it is from these main sources—geomorphology, climatic and biological (plant and animal) geography—that we derive the data for building up that systematic geography of natural environments which is at once the objective of 'physical' geography and the starting-point of human geography.

The fundamental objectives of geography are the same to-day as those which the Greek philosophers of Asia Minor and Alexandria conceived. There is a 'modern geography' only in the sense that there has been a restatement of its scope and content in the light of all the new knowledge of the earth which more specialised branches of inquiry have revealed. It was the work of the great pioneers of the nineteenth century to disentangle it from these associated subjects and to ascertain the guiding principles through which and the means or technique by which contact and relationship with them could be most fruitful and helpful in the attainment of the ends for which all science stands. This clarification of its scope and methods was essential if geography was to be in a position to seize the opportunities for increased usefulness afforded by the conditions of the modern world. For the two circumstances which, granted vision and understanding on the part of its exponents, have inevitably enhanced the significance and value of our subject are surely these: that on one hand our more complete knowledge of the earth and of the distribution of phenomena over its surface has made it possible to formulate far-reaching and valuable generalisations as to their co-ordination and relationship for which the material had hitherto been lacking, and on the other that the rapidly increasing interdependence and inter-sensitiveness of the different regions and peoples of the planet have made a synthetic view of the world as of a whole made up of interrelated parts—which is the prime object of geography—essential to human progress.

It is against this background of modern geography as a whole that the special aims and contributions of that part of it which we call human geography must be considered. The separate, departmental 'political geography' of the early nineteenth century is for ever discredited. Whatever value human geography may have is involved in its association with all the rest of the subject matter. It is on the question of the precise nature of the relationship that difference of view arises.

From the ranks of geographers themselves—as distinct from the views on the influence of natural conditions on human societies put forward from time to time by philosophers and economists such as Feuerbach, Engels, and Marx, or historians such as Buckle and Meyer—the two chief contributions have come from the school of thought associated with the name of Ratzel and that associated with the name of Vidal de la Blache.

* From the presidential address to Section E (Geography) of the British Association, delivered at Bristol on Sept. 5.

'Determinism' and 'possibilism' are the respective labels which have been attached to the two schools, and although labels, here as elsewhere, are liable to mislead, they sufficiently indicate a fundamentally different emphasis and attitude between the two in their treatment of the relationship of human societies to their natural environments. In the first or Ratzelian School the main emphasis is undoubtedly on the control of human activities by natural conditions, on the limitations which these impose, on the permanency of the stage, "always", as Ratzel insisted, "the same and always situated at the same point in space", and of the influences which it exerts, on the inevitability of particular developments, given a certain milieu. This attitude is even more pronounced in the works of some of the disciples of that other school of French human geographers or, as it is perhaps better to call them, geographical sociologists, who drew their inspiration from Le Play's "Les ouvriers européens", although Le Play himself cannot be identified with all their views. Geographical 'determinism' reaches its culmination in the "Comment la route crée le type social" of Demolins, who maintains that if history were to begin all over again it must in all essentials follow the same lines, given the same setting of the stage. Apart from the question of bias on the compelling power of physical circumstances, a criticism which has been levelled, as I think rightly, against the Ratzelian School, is that it is excessively dogmatic, and that, notwithstanding the vast amount of material which Ratzel himself and many of his disciples have sifted and classified with great skill, we are far as yet from having the data necessary for many of the big generalisations which they make.

The same criticism can certainly not be brought against Vidal de la Blache and his followers, whose discussions of these issues, while often extremely suggestive and illuminating, are rarely dogmatic or final in their conclusions or implications. The master himself did indeed deal in his larger works with what may justifiably be called 'principles' of human geography, but his teaching was always that the larger generalisations could only gradually emerge from a series of detailed and exact regional studies, and we shall all admit, I think, that his disciples have been very true to his precepts. The conception appears in the approach and particularly in the form even of the more ambitious work of Brunhes which bears the title "La géographie humaine". It is scarcely possible in a few sentences to characterise la Blache's concept of human geography, but I find its dominant note and one which brings it into salient contrast with the Ratzelian School in the following paragraph:

"L'être géographique d'une contrée n'est point une chose donnée d'avance par la nature, une offrande du monde inanimé; elle est un produit de l'activité de l'homme, conférant l'unité à des matériaux qui, par eux-mêmes, ne l'ont point. . . . Si une contrée est une personne, c'est par l'effort de ceux qui l'habitèrent." The emphasis here and throughout his work is not so much on the determinative influence of the stage *per se*, although this is always presented as a vital factor, as on the creative power of human groups to adapt themselves to and, within limits, to mould the natural environment, to leave their impress upon it and thus in the course of generations to transform it and give it a personality which is the outcome of the interaction. This personality is not constant. It may change with man's use or abuse of his habitat.

With this indication of some dominant tendencies in the setting and perspective of human geography I pass to an attempt to define more closely its subject-matter and its different aspects. I believe that in essence human geography consists of the study of (*a*) the adjustment of human groups to their physical environment, including the analysis of their regional experience and of (*b*) inter-regional relations as conditioned by the several adjustments and geographical orientation of the groups living within the respective regions. The term 'adjustment' I take to cover not only the 'control' which the physical environment exerts on their activities but also the use which they make or can make of it. Human geography is the study of an interaction rather than of a control. The adjustment has distinct but usually closely related aspects which form the main branches of human geography. The relationship between them is from the geographer's point of view as intimate as that between the different branches of physical geography. The four principal aspects may be distinguished as the racial, economic, social, and political.

The racial aspect implies an adjustment of a different character from the others, one over which man has had little control but which he can increasingly influence through his better understanding of the issues involved. I am well aware that in touching on racial geography I am treading on dangerous and controversial ground. Yet I am convinced that it is as necessary to find the right relationship between human geography and anthropology as it is between physical geography and geology and that racial geography is as significant and essential a part of the geographical synthesis as is geomorphology. I think it is true to say that racial determinism, that is, the explanation of characteristics in terms of race alone, apart from environmental conditions, is becoming as discredited as geographical determinism, the explanation of everything in terms of physical environment.

The tendency in anthropology is certainly not in the direction of appraising racial types, so far as they can be definitely distinguished, according to an absolute scale of value or efficiency, but relatively to the geographical environments in which they are found. Their somatic traits are discussed in terms of regional adaptations and the fruitful hypothesis is put forward that so far from racial varieties being unchanging and fixed for all time they are continually undergoing slow modification and in process of becoming. Now the unit of the geographer's study is not race as such any more than it is climate as such or any other physical element. His unit is the place or region. It is this concept—and I do not think it can be emphasised too strongly—which gives distinctiveness and

individuality to his work. With the relationship of climate and other physical factors to race in a region, the geographer is closely concerned and there are few more important aspects of his study than the composition, actual or potential, of the societies occupying the region.

In the world of to-day there are many regions of ' closed ' human associations, if I may borrow a useful term from plant geography, regions such as China or the Mediterranean lands as a whole where the dominant racial type or types in possession are so numerous and well adjusted that the entry of any important new racial element is extremely unlikely. But there are other regions of ' open ' human associations, at present thinly peopled but capable of holding a much larger population, whose racial future is uncertain. Such, for example, are tropical Australia and parts of Malaya, of Africa, even of Asia. Is it possible or desirable for the geographer in his study of these regions to confine himself to their resources and economic possibilities and not to consider at all, in the light of all that he can learn from anthropology, the relative aptitudes and adaptability, climatic and otherwise, of various racial groups for developing them and the extent and manner in which co-operation between different groups may be secured for this end ?

Take, for example, the highly important pronouncement made by General Smuts last autumn in one of his Rhodes' lectures at Oxford. In the course of his plea for the advance of native Africa through the introduction of a higher civilisation in the form of white settlement, he advocated " a strong forward movement in the policy of settling the highlands of Eastern Africa which stretch in an unbroken belt, hundreds of miles broad, from Kenya to South Africa ". It is not for me to express an *a priori* opinion on the wisdom of this suggestion, but it raises vitally important issues of human geography.

These issues are at once racial and economic in character. Do we yet know enough about the effects of a high plateau climate in equatorial latitudes on peoples of North European stock ? Even if it be granted that satisfactory acclimatisation of such peoples in the Kenya Highlands can be achieved, are the conditions of the plateau belt as a whole intervening between them and ' temperate ' South Africa sufficiently similar to warrant the prospects of an equally good adjustment ? The tentative generalisation has been made that, from the point of view of the success of ' white ' plantations, there is a vital difference between the 4500/6000 feet altitude of the Kenya Highlands and other smaller mountainous ' islands ' to the south and the 3500 feet level which seems to characterise most of Tanganyika. Or again, what are the prospects of making the ' fly belt ' suitable for white settlement ? Or, granted favourable climatic and other physical conditions, have the economic relations likely to be established between the proposed white settlers and the native Bantu tribes been sufficiently considered from the point of view of the uses which the two groups are likely to make of the land ? It is not cartographical surveys alone—although these are vital and the basis of all others—which need to be made before such questions can be answered.

Similar questions arise concerning the future of southern Brazil, Malaya, parts of central and eastern Asia, and many other regions where groups with different racial characteristics and aptitudes are in competition. The racial aspect is only one of several, but the study of racial distributions, based on anthropological material in the same sense that geomorphology is based on geological material, seems an essential element in the content of human geography. Personally I feel it to be a distinct gain that, in at least one university, geography should be closely associated with anthropology, so long as it is not identified with it, just as in others it is more closely associated with economics or history or with physical science.

It is unnecessary for my present purpose to elaborate what is implied in that aspect of man's adjustment the study of which forms the subject-matter of economic geography. It is of course a fundamental and basic aspect, including the geography of production (with agricultural and industrial geography as its principal subsections) and the geography of exchange (commercial geography in the more technical sense).

Economic geography serves one of its highest functions if it is closely linked with other aspects of human adjustment to physical environment which have so far received less attention. Of these one of the most interesting and profoundly important is that which for want of a better term we usually call social geography. This may be broadly defined as the analysis of the regional distribution and interrelation of different forms of social organisation arising out of particular modes of life which themselves represent a direct response—although we may concede to M. Febvre not necessarily the only possible response—to distinctive types of physical environment. A classical example of the importance of this aspect is of course the age-long conflict between nomadic, patriarchal pastoralists and peasant cultivators, socially organised on a territorial basis, along the grassland borders of the hot deserts in Africa and Arabia and round the edges of the steppe-belt in Euro-Asia.

In modern times the problems connected with the interregional relations of differently organised groups in Africa and elsewhere have been greatly complicated by the impact of industrial Europe on their lives. It has particularly affected the traditional societies of intertropical Africa, the monsoon lands, and the South Sea Islands, where mode of life and social organisation, once established as an adjustment to their milieu, often remained in essentials unchanged until they were so suddenly, and in some cases so tragically, drawn into the maelstrom of modern commerce. In the last analysis this disturbance is one of the chief causes of world-wide unrest, since equilibrium with environment is the first essential of happiness for human groups.

One of the greatest needs of our time is to discover what for each type of regional environment or

milieu are the real factors in readjustment through which alone the recovery of equilibrium can be attained. What is involved is readjustment to all the local conditions of the habitat in the light of its new contact with other regions, its new place in the total scheme of world relationships. Modern Denmark would seem to be an admirable example of a successful readjustment of this kind. Statesmanship in such an Empire as ours is increasingly concerned with the task of harmonising the interests of many groups cradled in different environments, diverse in race, mode of life, and experience, but, under the conditions of the world to-day, increasingly interdependent. Particularly is this apparent in the problem of the readjustment of African societies, one of the most critical and complex of our time and one for the solution of which Great Britain has incurred heavy responsibilities. Such problems are as much geographical in character as those concerned with the regional planning of English districts, and equally demand detailed surveys by investigators capable of analysing the social life and experience of human groups in their whole geographical setting and of appreciating the significance of the new elements in their environment.

The modern tendency in geography to think of the earth in terms of natural as opposed to artificial divisions should not lead to the neglect of political geography in the proper sense of the term ; for the function of political geography is to study and appraise the significance of political and administrative units in relation to all the major geographical groupings, whether physical, ethnographic, social, or economic, which affect mankind. It is essentially an aspect of adjustment to geographical environment, and it is precisely because it is so closely related to other aspects of adjustment, which in the influences that they exert are often conflicting, that equilibrium is so difficult to attain. The study of the mode in which geographical conditions have helped to mould the evolution of States in the past is of absorbing interest, however complex and difficult. The existence of favourable areas of characterisation possessing a considerable amount of natural protection, such as the English Plain and the Central Lowlands of Scotland, within which the social contact of orginally different racial and social groups was easy, certainly provided the medium through which in western Europe strong nation-States tended to take shape. The group consciousness which we call nationality seems to have followed rather than preceded the actual formation of such States. Nationality arose in relation to environment and widened its scope and allegiance with the increase of economic and political contact.

Since the forces promoting the contacts and economic interdependence of regions are operating on a much bigger scale in the world of to-day than ever before, we might expect to see this process of political integration even more strongly marked, and the rapid territorial growth of the United States and other large political entities can be quoted as examples of it. But in Europe we see this process arrested and even reversed.

Nationality, as tested by linguistic and cultural affinities, rather than the economic orientation indicated by the physical conditions, has been accepted as the main criterion of the new units, although there is frequent departure from this principle. The new Europe is admittedly a great experiment in political geography. Its success would seem to depend on the possibility of reconciling the different factors. The most stable political units are undoubtedly those which most correspond to geographical realities, but these realities are not wholly limited to considerations of physical and economic geography. The distribution of groups related in culture and language is also a geographical reality. The ideal State from the geographical point of view is one which neither divides groups culturally related nor interferes with the flow of trade along natural arteries and between regions economically interdependent. It may be, although as yet the indications are not very hopeful, that the urgent need of Europe for greater economic integration can be reconciled with the desire of the small nationality groups for cultural and political autonomy. It may be that economic federation or agreement among small sovereign-States within the framework of the League of Nations will prove the only alternative to the ' super-State ' solution of the problem of European political geography propounded by Naumann in his " Mittel Europa ". At any rate, nationality, considered apart from its geographical setting, may be a very dangerous conception.

I have tried to indicate the essential character of the principal aspects of human geography, each of them from the point of view of the adjustment of human groups to their geographical environment. It is permissible and desirable to pursue special studies of these various aspects of our subject, but they find their fullest fruition when they are brought together and inter-related in a full and comprehensive treatment of regions. We can never really appreciate the problems of such countries as India, China, and Russia until we have a comprehensive interpretation of their human ecology, to use the expressive term employed by the American geographer Barrows. In the future it is probable that geographical specialism in the universities will be less concerned with aspects (such as geomorphology, climate, and economic geography) —although this will always have its place—and more concerned with regions (the Mediterranean, tropical Africa, the Far East, and so on). The geographer's parish must indeed be the world, but it is too large a parish for all parts of it to be studied in detail by any one man. He must, if he is entrusted with a university department, delegate responsibility for as many regional chapels-of-ease as he can find associates and colleagues to work them.

We may claim for human geography that, rightly studied, it is a vital element in training for national and international citizenship. It can enable us " accurately to imagine the conditions of the great world stage " and the place of the different regions within it. It is a valuable mental discipline, calling

for an exact sense of proportion in appraising the value of many factors and more specifically developing the great quality of sympathetic understanding. The point of view and type of outlook which it fosters were never more needed than in the present critical stage of human development. Yet not only through its value as an educational instrument, but also through the programme of constructive work which it advocates, can it contribute to the realisation of the ideal of "unity in diversity", and that seems the only possible ideal for the life of humanity on a planet which, however small applied science may make it, will always retain its infinite variety.

Chemical Measurements by Colour.

By Dr. L. C. MARTIN.

IT is a pity that the word 'colorimeter' has been applied to two entirely distinct classes of instrument. The name is given most appropriately to those instruments which actually measure colour, albeit in relative terms, and not to those in which the chemical concentration of a solution is the subject of determination. The latter, which form the topic of the present article, are strictly colour comparators, and it would be an advantage if they could so be called. The alternative names chromometer and chromatometer also fail to give the proper indication, but would be preferable to 'colorimeter'.

There are many chemical substances which, although difficult to determine quantitatively in very dilute solutions by chemical methods, have the property of strong selective absorption of light. According to the law of Beer, the absorption coefficient of a solution is directly proportional to the concentration. Since this law holds with fair accuracy for most dilute solutions, it follows that the colour change in transmitted light obtained by varying the concentration (within certain ranges) can be exactly imitated by increasing the thickness of the medium which must be traversed; thus, if 1 cm. of solution *A* gives the same colour as 10 cm. of solution *B*, we should expect (provided that the above law held) that the amount of material dissolved in unit volume of *A* is ten times that of *B*. The application of this principle to find the concentration of a solution of unknown strength, given one of the same material and of known strength, is quite clear. Failing a means of using different thickness of solution, the alternative is to prepare a number of samples of known concentration and to endeavour to place the unknown in its relation to the rest—a method much less elegant, but of value when Beer's law is likely to break down. In practice, no such liberties as indicated above in the 'ten to one' example are advisable. According to Thorpe, if the strength of the standard differs by more than 10 per cent from that of the test liquid, it is usual to dilute one or the other (in a known ratio) before comparison, so that the lengths to be compared are approximately equal.

It is not possible in a short article to do more than indicate some of the numerous applications of the method. It is used in the estimation of small quantities of the salts of copper, tin, lead, iron, cobalt, manganese, and other metals; also in the determination of dyes and natural colouring materials. Krüss mentions the estimation of salicylic acid in surgical wadding, and the examination of the coloration given by animal charcoal. Other applications are met in the operations of the oil, sugar, and brewing industries. Special instruments with artificial standards are applied in the determination of the sugar content of the blood of diabetic patients. An account of practical methods will be found in Lunge-Berl's "Chemische-technische Untersuchungsmethoden", vols. 1, 2, 3, and 4, and in books such as "Colorimetric Analysis", by B. Snell.

The early methods of application of the principle were of the simplest description; an account of them is given in Thorpe's "Dictionary of Applied Chemistry", vol. 2, p. 340. Flat-ended tubes placed side by side were often employed, sky-light being reflected through their lengths by a mirror. It is well known, however, that the exact comparison of separated colour fields is very difficult. In 1910 Autenreith and Königsberger [1] used a colorimeter with a Helmholtz 'Doppelplatte' for approximating the comparison fields. A movable hollow wedge affords the means of varying the thickness of the test solution. This was used for the determination of hæmatin in blood and other medical work. Another early suggestion aiming at better optical accuracy was that of H. Krüss,[2] who suggested the use of the Swan or Lummer-Brodhun double prism in order to secure a comparison field with an indefinitely narrow separation.

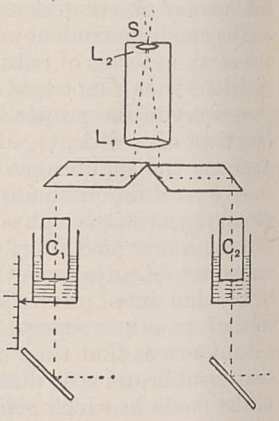

FIG. 1.

The most practical arrangement was, however, due to Duboscq,[3] who gave the instrument its most usual modern form, Fig. 1. The rays traversing the vertical cylinders holding the solutions are brought into one field by the use of two rhomb reflectors; or a single symmetrical rhomb can be employed. A lens brings these groups of parallel rays into one focus, where a telecentric stop is placed so as to prevent stray light from reaching the eye. The eye-lens helps to bring the sharp line of separation into exact visual focus in the field of view. In order to vary the thickness of solution traversed, the vessels containing the solution (shaded in the figure) can each be moved on vertical slides by rack and pinion. Thus the flat-ended cylinders, either closed tubes or glass rods

made of the finest and most colourless glass, dip more or less into the liquid, and the consequent thickness of the layer on each side can be read off on a suitable scale. Alternatively, the rods alone may be moved. The light is usually derived from the sky, and reflected upwards by a mirror through each tube; it is advisable, however, to use an artificial source with a 'daylight' filter and a suitable diffusing screen if inconsistencies due to the variation of the sky are to be avoided. A good example of such an instrument as described above is made by Messrs. Hawksley and Sons, Ltd.

There are numerous variations of the usual pattern, such as may be found in the catalogues of the various makers. We shall, however, only have space to mention efforts which have been made to overcome certain difficulties. The simple account above assumed that the colour is entirely produced by the substance in solution. It may be, however, that the solvent is coloured, or has other coloured substances present. To meet this difficulty, the Bürker compensating colorimeter of Messrs. Leitz, Fig. 2, is provided with two auxiliary vessels of the same depth introduced into the respective beams. One is filled with a solution of accurately known strength while the other is filled with the solvent only. The two cylinders or rods are now moved together; they dip into the two cups, one of which contains the solvent, and the other holds the solution under test. Naturally, the cup containing the solution is placed beneath the auxiliary vessel containing the solvent only, so that when balance is obtained the thickness of the strata of liquid in each beam is equal, which is not the case in the simpler form of the instrument. Hence any *difference* of coloration in the two fields must be entirely due to the solute; equality can be established by the adjustment of the plungers provided that the standard and test solutions are of comparable concentrations.

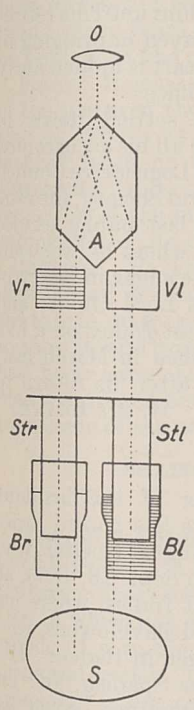

Fig. 2.

The accuracy of such measurements is naturally facilitated by the precision of manufacture of the parts. The cylinders should be accurately ground, and, in cases where the greatest accuracy in the thickness of the cells is required, the plane and pieces may be pressed on in optical contact and maintained in position by suitable clamps; thus the uncertainties and chemical objections connected with the use of cements can be avoided.

The accuracy of comparison also depends on the visual sensitiveness of the eye. Where pure intensity comparisons are concerned, the optimum sensitiveness of the eye corresponds to a difference threshold (dI/I) of about 2 per cent. If we may be permitted a little mathematical shorthand, the intensity of the light transmitted by a thickness t of a solution of concentration c is given by

$$I = I_0 e^{-kct},$$

k being the absorption coefficient for unit concentration. It is easily found that (dI/I) with t constant $= -kt\,dc$, while (dI/I) with c constant $= -kc\,dt$. With low concentrations we need a greater thickness to obtain a given absolute accuracy of measurement, and with small thickness we need greater concentrations. Let the transmission coefficient of the layer, that is, $I/I_0 = T$, then $-kt = (\log T)/c$, so that if $dI/I = 0{\cdot}02$ (say) $= -kt\,dc$, we obtain $dc/c = 0{\cdot}02/\log T$, so that the proportional accuracy would depend on having a fairly big absorption of light, but just as in the case of the polarimeter, this makes the visual accuracy smaller and a compromise must be reached. The settings, moreover, do not involve pure intensity comparisons and are likely to depend more on 'saturation discrimination'. The usual presence of dichroism may also cause here changes which help to make the settings more sensitive; in fact, the thorough discussion of the accuracy of the instrument is a very complicated matter. In certain cases the use of a suitable filter might vastly enhance the sensitiveness.

This note would be incomplete without a reference to the recently introduced instruments which effect the comparison by the aid of a photo-electric cell or cells, as in the equipment manufactured by the Cambridge Instrument Co., Ltd. There are a number of ways in which the photo-electric comparison can be effected. It is possible to use two cells in a bridge form of circuit as in the Cambridge instrument, the cells being exposed to beams passing respectively through a test solution and through a standard solution; any deviation from equality can be recorded by a suitable valve amplification system adapted for alternating current. Alternatively, the light may be passed alternately through two such tubes, the two beams falling intermittently into the same cell. A lack of equality of the photo-electric currents is detected by a synchronised rectifier and suitable amplification. Nor are photo-electric cells the only possibility for recording changes of absorption. The Moll 'nephelometer and absorptiometer' furnishes objective records of comparative absorption with the aid of a pair of balanced thermopiles of the Moll pattern. This instrument is made by Messrs. Kipp and Zonen. A considerable improvement on the visual accuracy is effected by the physical detectors.

Such instruments can obviously be applied for obtaining continuous records of fluid products during the course of manufacture, and illustrate once more the ways in which optical methods of control may save much time and trouble.

[1] *Chem. Zentr.*, **1**, 2032; 1910.
[2] *Zeit. anorg. Chem.*, **5**, 325.
[3] Duboscq lived about fifty years ago, and it has not been possible to trace any original description of the Duboscq instrument. The firm of Duboscq has now been succeeded by Pellin. Messrs. Jobin and Yvon, Paris, also make colorimeters.

Obituary.

SIR FRANCIS WATTS, K.C.M.G.

THE death of Sir Francis Watts, which occurred on Sept. 26, terminates a career of devoted service to the West Indies. The son of John Watts of Ilfracombe, Francis Watts was born in 1859. He was educated privately and at Mason College, Birmingham, the forerunner of the present University of that city. His official connexion with the West Indies commenced in 1889, when he was appointed analytical chemist in Antigua, but an earlier association with these islands was formed as chemist to the Montserrat Company, Ltd. It was this earlier association which directed his early studies to citric acid. He was transfered in 1898 to Jamaica for a brief period, but returned to the Leeward Islands as Government Chemist and Superintendent of Agriculture.

In 1898, on the recommendation of the Royal Commission appointed to report on the depression caused by the slump in sugar, was formed the Imperial Department of Agriculture for the West Indies. The first years of that Department saw a great development of the sugar industry throughout the West Indies, and Francis Watts played a prominent part in that development, notably in the establishment of central factories in Antigua and St. Kitts, which was rendered possible by the grant-in-aid given by the Imperial Government to the West Indies in 1902 to enable them to tide over the period between the signing of the Brussels Convention for the abolition of the sugar bounties and the date on which it came into force. When, therefore, the time came, in 1909, for the selection of a successor to Sir Daniel Morris, the first Commissioner and head of the Imperial Department, the choice naturally fell upon Francis Watts. This early association with sugar is reflected in a number of papers published in association with Tempany on the chemical problems associated with sugar production. But his knowledge of the industry covered a much wider sphere. He held decided views on the sugar problems of the Empire, as is shown by his virile contribution to the discussion on the report on the production and consumption of sugar within the Empire presented at the conference organised in 1919 by the Society of Chemical Industry.

Until recent times, when oil has assumed major importance in Trinidad, the prosperity of the West Indies has been based on agriculture. Of the major crops, sugar has always been subjected to vicissitudes, and not the least of the functions of the Imperial Department of Agriculture has been the search for subsidiary crops. In this search Watts was not backward, as his studies on lemon grass, pawpaw, and so on, indicate. The Imperial Department established, in the *West Indian Bulletin*, its own organ, and in that *Bulletin* is to be found a record of these investigations. The *Bulletin*, in fact, constitutes a record of his activities.

As a result of the report of the Tropical Agricultural College Committee appointed by Lord Milner in 1919, the West Indian College was founded in 1921 and installed on a site, at St. Augustine, presented by the Government of Trinidad and Tobago. At the same time the headquarters of the Imperial Department was transferred from its former location in Barbados to Trinidad, and Sir Francis Watts, who had received the C.M.G. in 1904 and been created K.C.M.G. in 1917, was appointed to the post of principal of the College. From April 1, 1922, the two institutions were amalgamated under the title of the Imperial College of Tropical Agriculture, and the joint post of Principal of the College and Commissioner of Agriculture for the West Indies was held by him until his retirement in 1924. What part he played in bringing to fruition a scheme so dear to his heart is hidden away in the archives of the Colonial Office.

After his retirement Watts settled down in Trinidad and threw himself with all his accustomed energy, both as a member of the Legislative Council and as president of the Agricultural Society, into the affairs of the community. His last public service was to pay a visit to Mauritius, where he was sent as commissioner to report on the sugar industry of that island at the same time as Lord Olivier and Mr. D. M. Semple visited the West Indies on a like mission. His report was published in March last, and his death occurred shortly after his return to Trinidad.

H. M. LEAKE.

PROF. CORNELIO DOELTER.

ANOTHER prominent member of the brilliant school of Viennese mineralogists has passed away at an advanced age. Cornelio August Doelter, who died on Aug. 8 last, was born on Sept. 16, 1850, at Arroyo, Porto Rico, in the West Indies, where his father was a German planter and slave-owner, who had emigrated from Emmendingen in Baden. His mother, Francisca Cisterich, was Spanish, and on this account his name was sometimes given as Doelter y Cisterich. At the age of six he was taken to Paris, and he studied later at Freiburg in Baden, Heidelberg, and Vienna, graduating at Heidelberg in 1872. For a time from 1873 he was attached to the Austrian Geological Survey, and in 1875 was a *privat-dozent* in the University of Vienna. From 1876 until 1906 he was professor of mineralogy in the University of Graz in Styria, where in 1906 he was also Rector of the University. In 1907 he succeeded G. Tschermak as professor of mineralogy and petrography in the University of Vienna, from which post he retired with the title of emeritus professor in 1922.

Doelter's earlier papers from 1873 dealt with volcanic rocks, during which period he produced monographs on the volcanoes of the Ponza Islands, the Cape Verde Islands, and of southern Tyrol. From 1884 he did intensive work on the synthesis of minerals and rocks and on silicate fusions. At a later period he was much interested in the changes in colour produced by the action of radium, X-rays, and other radiations on gem-stones and other minerals; and he wrote several papers on the cause of the blue coloration of rock-salt.

Doelter wrote a number of books on chemical mineralogy, petrogenesis, precious stones, colour of minerals, and the mineral resources of the Balkans and Asia Minor; but his *magnum opus*, by which he will be best remembered, is his "Handbuch der Mineralchemie". This great work of reference (not entirely free from misprints) was commenced by him in 1911, after he had reached the age of sixty, and, although nine large volumes have appeared, it unfortunately remains uncompleted at his death. L. J. S.

REV. J. G. HAGEN, *S.J.*

REV. JOHANN GEORG HAGEN, *S.J.*, who had been director of the Vatican Observatory for more than twenty years, died in a nursing home in Rome on Sept. 5, at the age of eighty-three years.

Father Hagen superintended the photography of the plates of the Astrographic Zone for declination N. 55° to 64°, which had already been commenced when he went to the Observatory. The University Observatory at Oxford helped in the reduction of the measures of these plates after the completion of its own section of the Astrographic Catalogue. He also gave much attention to the distribution of obscure nebulosity; he claimed to see this in many regions where photography failed to show it, and pointed out that some of the regions had been noted as nebulous by Sir W. Herschel. Many astronomers now admit the reality of at least some of the nebulosities announced by Hagen.

Father Hagen's name was already widely known before he went to the Vatican Observatory; more especially for his "Atlas stellarum variabilium", with its numerous appendices. This contained accurate charts of the fields surrounding the variable stars, with magnitudes of suitable comparison stars. It has been of great use to observers of these objects.

WE regret to announce the following deaths:

Capt. William Colbeck, magnetic observer and cartographer with the Southern Cross Expedition to the Antarctic in 1898–99, on Oct. 19, aged fifty-nine years.

Mr. S. L. Hinde, formerly Commissioner of the East Africa Protectorate, who contributed to the ethnological, anthropological, and natural history collections of the British Museum, and was the author of "Fall of the Congo Arabs" and "The Last of the Masai", on Oct. 18, aged sixty-seven years.

M. Philippe Glangeaud, professor of geology in the University of Clermont, *correspondant* of the Section of Mineralogy of the Paris Academy of Sciences, author of works on the Massif Central of France, aged sixty-four years.

M. Emile Godlewski, honorary professor of agricultural chemistry in the University of Cracow and *correspondant* of the Section of Rural Economy of the Paris Academy of Sciences, known for his work on vegetable physiology, on Sept. 11, aged eighty-three years.

Mr. E. H. Wilson, Keeper of the Arnold Arboretum, Harvard, since 1927, known for his botanical explorations, on Oct. 15, aged fifty-four years.

News and Views.

HOMAGE was paid to the memory of a great chemist, the late Prof. W. H. Perkin, by the Chemical Society at the first ordinary scientific meeting of the new session on Oct. 16, which was devoted to the acceptance and unveiling of a memorial plaque and the delivery of a memorial oration. The plaque, which (like the Harrison memorial) is the work of Mr. Ernest Gillick, is one of three; the others are destined to commemorate Prof. Perkin's distinguished association with the Universities of Manchester and Oxford. In presenting the plaque to the Society on behalf of the Perkin Memorial Fund Committee, Prof. R. Robinson said that the intention to offer suitable congratulations to Prof. Perkin on the attainment of his seventieth birthday had, to the immense regret of his colleagues, been frustrated by death, so that an occasion of joy had been changed into a memorial. It was fitting that the Chemical Society should possess a visible memorial of one who had served it so long and so well. Elected a fellow in 1884, he served on the council and as vice-president for several terms. He received the Longstaff medal in 1900, and was president from 1913 to 1915. Almost his last labour in the cause of chemistry was the delivery of the first Pedler lecture. The gift was unveiled by Mr. A. J. Greenaway, formerly editor of the Society's *Journal*, a life-long friend and at one time a colleague of Prof. Perkin; it was received on behalf of the Society by the president, Prof. J. F. Thorpe, who also paid tribute to the distinction of its late fellow and former president.

PROF. W. N. HAWORTH, responding to the president's invitation, delivered an oration on the late Prof. W. H. Perkin's life and work. Perkin's span of life was, he said, coextensive with the rise and development of modern structural chemistry. A pupil of Sir Edward Frankland, he studied also under the guidance of Wislicenus and afterwards of Baeyer, in whose laboratory he commenced his series of researches on the synthesis of closed carbon chains. Before he left this subject he had synthesised every naturally occurring monocyclic terpene, and had investigated the constitution of camphor and its analogues. On his return to Great Britain, he worked for a short time at Manchester on the natural colouring matters brazilin and hæmatoxylin before being appointed to a chair at the Heriot Watt College, Edinburgh, where he commenced his researches on berberine and cryptopine. Invited to occupy the chair of organic chemistry in Owens College, Manchester, in 1892, he built up there a great school of research, while at the same time giving much thought and care to his lectures. He combined exceptional skill in manipulation with sound judgment and acute observation; moreover, the help and encouragement which he gave to his pupils resulted in an *esprit de corps* and a personal loyalty which were the greatest incentive to good work and to progress in research. Of his period at Oxford from 1912 until 1929, Prof. Haworth said that Perkin's great work is appreciated by none more than by Oxford itself. William Henry Perkin consecrated

his ability and intellect to the ideal "that original research is in itself and by itself the most powerful weapon that ever can be wielded by mankind in struggling with the great problems which Nature offers on all sides for solution".

THAT the Church Congress, which recently met at Newport, should have devoted a session to the discussion of eugenics, is a sign of the times; and eugenists may congratulate themselves upon having moved public opinion to this extent. The Dean of St. Paul's (Dr. Inge), who read a paper on the subject, confined himself to its moral aspects. He urged that Church-people ought to include their duties to posterity among the new moral obligations which the advance of knowledge has laid upon them. There is still a weight of prejudice to be removed, and it is the mental attitude of Churchmen to these questions that he desires to see modified. The desire to improve the intrinsic qualities of future generations, or to stop their further deterioration, is a purely disinterested and public-spirited quest. Is the Church to help these disinterested workers, or is it to ridicule and misrepresent them? The Dean expressed the view, held by all who have studied the subject, that a civilisation which gives its whole attention to environment, and pays no attention whatever to the inborn qualities of the children, is heading for disaster. He declared that there is dysgenic selection going on, the cumulative effects of which must result in progressive degeneracy. He thinks that the Church should not be indifferent to a system of *laissez-faire* which largely increases the number of criminals, fallen women, and others who prey upon society.

THE scientific aspects of eugenics were dealt with at the Church Congress by Dr. A. F. Tredgold, a member of the Consultative Council of the Eugenics Society. He said that while the amount of social inefficiency due to physical unfitness is very great, that due to mental unfitness is still greater and of even more importance. While a proportion of cases of both physical and mental unfitness are caused by faulty environment, the great bulk of such cases are a consequence of hereditary defects and are transmissible. On this point he thought that the eugenists have made out their claim, and that the prevention of propagation by these mentally and physically unfit individuals would result in an improvement of the race and a considerable decrease of social inefficiency. Dr. Tredgold observed that increased medical knowledge and facilities for treatment, humanitarian sentiment, and the general trend of social legislation combine to encourage the survival and propagation of the unfit, and to make life easier for them than for the fit. There are indications that the number and ratio of the inefficient and the unfit are increasing. If this process be allowed to continue, national degeneracy will only be a question of time and a sum in arithmetic. Partial interference by man in the shaping of his racial progress can only end in disaster; and Dr. Tredgold is of opinion that eugenics is not only necessary, but also the logical consequence of the steps which man has already taken.

AMONG the early scientific worthies buried in Westminster Abbey is the famous Dr. Isaac Barrow, scholar, mathematician, and divine, who was born in London in October 1630, three hundred years ago. The son of Thomas Barrow, linen-draper to Charles I., he was educated at the Charterhouse and Felsted, entered Peterhouse, Cambridge, and in 1649 became a fellow of Trinity. Finding the times unfavourable to churchmen, he devoted himself to medicine, botany, chemistry, geometry, astronomy, and poetry, and in 1656, at Constantinople, read all the works of St. Chrysostom. Home again in 1659, in 1660 he became professor of Greek at Cambridge, in 1662 professor of geometry at Gresham College, London, in 1663 was included in the first list of members of the Royal Society after receiving its charter, and in the same year became the first Lucasian professor of the mathematical sciences. This last post he resigned five years later in favour of his brilliant pupil Isaac Newton; but Barrow was afterwards made Master of Trinity College, the King declaring that he had bestowed the post "on the best scholar in Europe". Three years later, in 1675, he was chosen vice-chancellor of the University, and he died of fever on May 4, 1677, while on a visit to London.

BARROW'S mathematical works included his edition of the "Elements of Euclid", 1655; "Lectiones Mathematicæ", 1683; "Lectiones Opticæ et Geometricæ", 1669; and his edition of the "Conics of Apollonius", 1675. As a divine, Barrow ranked with the greatest of his age. Described as "a person of the lesser size, lean and of extraordinary strength, of a fair and calm complexion", a portrait of Barrow by Lefebre has long been included in the catalogue of the National Portrait Gallery, but this is not now considered genuine. The Gallery, however, possesses a pencil portrait by the contemporary artist Loggan. Barrow's death took place, one account says, "in a mean lodging at a saddler's near Charing Cross"; but Dean Stanley wrote that "He had come, as Master after Master had come, to the election of Westminster Scholars, and was lodged in one of the canonical houses that had a little stair to it out of the cloister, which made him call it 'a man's nest'. He was there struck with high fever, and died from the opium which, by a custom contracted when at Constantinople, he administered to himself." His grave in the Abbey is to be found on the west side of Poets' Corner, opposite to those of Chaucer, Browning, and Tennyson.

AFTER an interval of three years, a second Science Exhibition was held on Oct. 14–18 in the White Rock Pavilion at Hastings. This time the whole building was used, and the committee of local electricians, engineers, medical men, chemists, science teachers, artists, musicians, and others, with the mayor as president and the headmaster of the Grammar School as organising secretary, got together a much more comprehensive collection of working apparatus to illustrate modern scientific discovery and invention. Demonstrations were given every hour on such subjects as television, ultra-violet light, sound vibration, and electric transformers; cinematograph films were

shown to illustrate natural history subjects ; and on successive evenings Sir Leonard Hill, Prof E. N. da C. Andrade, Prof. E. V. Appleton, and Dr. Alexander Wood lectured to considerable audiences on the advances in science with which they are especially familiar. Admission in the mornings was limited to parties of school pupils. It is obvious that in a town such as Hastings some means should be found for giving popular instruction in science, and the crowds that attended and the interest shown have convinced the promoters that the Exhibition has served this purpose. The receipts from admission fees will, it is expected, cover the expenses, so that no call on the guarantors will be necessary. One advantage of the Exhibition is that the scientific talent of the town has been mobilised to carry it out, and an enthusiastic band of workers brought together which will be available for other concerted efforts.

AT a meeting of the Newcomen Society held at the Science Museum on Oct. 15, Mr. H. P. Vowles read a paper entitled "An Inquiry into Origins of the Windmill". Though our Domesday survey, made between 1080 and 1086, mentions between five and six thousand mills, it is presumed these were all water-mills or cattle-mills. The earliest authentic evidence of a windmill in England refers to that erected by Herbert, the Dean at Bury St. Edmunds, about A.D. 1191, the event being recorded in the "Chronicle of Joceylin de Brakelond". The question as to whence England and other western countries obtained their ideas of a windmill Mr. Vowles attempted to answer by recalling the travel and trade of a thousand years ago, when the Vikings sailed the waterways of Russia and a great trade route extended from Asia Minor through Persia to China. Near this trade route, as it passed through Persia, lay Sijistan, now Seistan, a land of almost ceaseless winds, where windmills were apparently in common use by the tenth century, and where innumerable windmills of a primitive type can be seen to-day. Mr. Vowles's paper contained many references to the manuscripts and early works he has examined, and what he calls "a not altogether unreasonable theory" of the origin of windmills is certainly worth pursuing.

THE presidential address of Mr. L. St. L. Pendred to the Institution of Mechanical Engineers, delivered on Oct. 17, was entitled "Random Reflections" and was addressed principally to young engineers—"I mean", Mr. Pendred said, "men under forty". Great inventions have generally been made by men still under middle age, and it is often the ignorance of youth, disregarding any opinion but its own, which carries its will against the inertia age inevitably brings. No doubt it is right schools should say "It is so", but it is to be hoped there will be students with enough folly to try the apparently impossible. In our own time we have seen the theory of gravitation shaken, the theory of light in the melting-pot, and the transmutation of metals brought almost within reach. "It is a glorious age for those who would let their thoughts run free", but reasonable restraint should be used. Breadth of view is also desirable, and, as John Bourne said long ago, "an engineer must be content to believe that there are other things in the world besides cast-iron and steam pressure". The plea for a broader cultivation for engineers is seen in America, Germany, and France, as well as Great Britain. But with all this, while avoiding the evils of specialisation or what Johnson called the "drowsy equilibration of undetermined counsel", the present requires vigorous action, for, as Lytton said, "So much depends upon action, that everything seems to say aloud to every man : 'Do something—do it—do it!'"

AN interesting paper on the operation of overhead power lines at 15,000 volts was read by M. Polack, the engineer of the Nord Lumière Co., at the recent International Union of Power Engineers at Paris. It is printed in the *Electrical Times* for Sept. 18. The overhead lines have a total length of 728 miles and are supported by concrete posts. Glass insulators are generally used, as it is found that they have a large factor of safety. The conductors are stranded and the network is supplied from the huge Gennevilliers Central Station. The principal causes of trouble are tempests, trees, birds, malicious persons, and deposits of conducting materials on the insulators. About 80 per cent of the disturbances are only for a few seconds. Of the remainder, which cause a shut down for a longer period, thunderstorms cause about ten per cent, birds about one per cent, and breakage of posts less than one per cent. Engineers fear thunderstorms most, as they affect the lines over a wide region and interrupt at the same time the telephone service. On wooden posts the lightning discharges make helicoidal grooves, cause arcs to be established between the conductor and distant objects, and destroy apparatus. The breaking of the wires is the most frequent result of a storm. The fall of trees sometimes breaks the wires, and the blowing of branches across the conductors starts arcs which weaken them. Both small and large birds can start an arc between a conductor and 'earth'. Accidents due to this cause are not uncommon in spring and autumn, but are rare in winter and summer. Even such small birds as starlings have been known to start an arc. Malicious and thoughtless people have been known to throw wires or old bicycle rims at the wires to see what would happen.

THE quarterly meeting of the Grand Council of the British Empire Cancer Campaign was held at the new offices at 12 Grosvenor Crescent, Hyde Park Corner, London, S.W.1, on Oct. 13. On the recommendation of the Scientific Advisory Committee, a further grant of £150 was made to Dr. J. C. Mottram, pathologist at the Radium Institute, London ; £300 to Mrs. E. K. Dawson, of Edinburgh, for the continuance of investigations into mammary cancer; and £250 to Mr. E. Nevill Willmer, at the Physiological Laboratory, University of Cambridge. An application for affiliation from the Natal Radium and Anti-Cancer Fund, South Africa, was received and acceded to, thus completing the representation of the British Empire Cancer Campaign either by way of branches or affiliated

bodies in every one of the British Dominions. It was announced that a popular book, entitled "The Truth about Cancer", has been finally approved by all the technical committees of the Campaign and will be published by Messrs. John Murray at a cost of 2*s*. 6*d*. per copy. The Campaign has fixed the price of the book at this figure so as to make it available for all classes of the community. The Campaign has received an intimation that a legacy of more than £20,000 will become available shortly for its research into the causes and cure of cancer.

ON Oct. 19, Wing-Commander Kingsford Smith landed at Darwin, Northern Australia, having completed a flight from England to Australia in just over 10 days. His machine is an Avro Avian Sports model, driven by a 120-h.p. Gipsy engine, and its maximum fuel load is 100 gallons. It is thus a light aeroplane comparable with that used in February 1927 by Mr. Bert Hinkler, whose time for the same journey was 15½ days. Incidentally it may be noted that Kingsford Smith did the same journey last year in a three-engined Fokker, taking about 12 days. The daily stages of his recent flight were as follows: Rome (1000 miles); Athens (700 miles); Aleppo (1100 miles); Bushire (950 miles); Karachi (1050 miles); Allahabad (950 miles); Rangoon (1100 miles); Singapore (1200 miles); Sourabaya (1000 miles); Atambua (900 miles); Darwin (500 miles).

THE Fifth Congress of Polish Physicists, held at Poznań on Sept. 24–27, attracted more than three hundred members. The Congress was divided into two sections, nearly equal in numbers—an educational section and a scientific one. The members of the latter section represented all centres of physical research in Poland, many of which were created after the recovery of the political independence of that country. The Congress was held under the presidency of Prof. M. Wolfke, of the Technical Institute, Warsaw. Seventy-two experimental and nine theoretical papers were presented, showing a considerable increase of scientific activity since the last Congress, held at Wilno in 1928. The Physical Institute of the University of Warsaw, the director of which is Prof. Pieńkowski, contributed more than twenty papers.

IT is interesting to note that some fields of research seem particularly to attract Polish physicists. These are, with the number of papers in each: molecular and atomic spectra (35); dielectric constants (9); electric arc (8); radioactivity (6). Special interest was aroused by papers on association of light quanta, by Wolfke; allotropic modification of liquid ether, by Wolfke and Mazur—the first case of allotropy in the liquid state was discovered in 1928 by Wolfke and Keesom in liquefied helium; X-ray investigation of the structure of wood, by Pieńkowski; resonance spectra of silver and zinc vapours, by Kapuściński, Warsaw; absorption spectra of sulphur, selenium, and tellurium, several papers, University Institute, Warsaw; a mercury arc of extremely high efficiency, by Reczyński, Lwów; isotopic effect in band spectra, by Curtiss and Patkowski, Wilno; dielectric constants, by Zakrzewski, Kraków; Raman effect at critical temperature, by Ziemecki and Narkiewicz, Warsaw; ionisation potential of radon, by Holweck and Wertenstein, Warsaw. The Congress has elected Mme. Curie and Prof. W. Natanson as honorary members of the Polish Physical Society.

LORD D'ABERNON has accepted the office of president of the National Institute of Industrial Psychology, in succession to the late Earl of Balfour, its first president. Lord D'Abernon, like his predecessor, is keenly interested in the activities of the Institutes, both industrial and educational. He is a strong advocate of the value and necessity of the better methods devised and employed by the Institute for giving advice to young persons in their choice of a career.

THE Horace Brown Medal of the Institute of Brewing is awarded by the Council for "eminent services on the scientific or technical side of the fermentation industries, at intervals of not less than three years". The first award was made to Prof. H. E. Armstrong in 1926, and the next recipient of the medal is to be Dr. E. S. Beaven, who, by his individual work, has done more than anyone to add to our knowledge of barley. The presentation will be made by the president, Mr. Percy Gates, in the lecture theatre of the Institution of Electrical Engineers, on Friday, Nov. 21, at 8.15 P.M., when Dr. Beaven will deliver the memorial lecture on "The Culture of Barley for Brewing".

DR. A. W. HILL, director of the Royal Botanic Gardens, Kew, leaves England on Oct. 24 on a visit to South Africa at the invitation of the Government of the Union. Dr. Hill will examine the botanical and allied activities of the Union under the guidance of Dr. I. B. Pole Evans, chief of the Division of Botany, Pretoria. The visit has been made possible by a grant from the Empire Marketing Board to Kew for overseas visits. Dr. Hill expects to leave Beira on Jan. 2 to go to Uganda (where he will be the guest of the governor) and to Kenya; in both colonies he will visit the agricultural and botanical departments. The tour will end with a visit to the East African Agricultural Research Station, Amani, to attend the conference of directors of agriculture at the end of January.

KING EDWARD'S Hospital Fund for London has arranged the following series of demonstration-lectures: "A Hundred Years of Photography", by Dr. Walter Clark, director of the Research Laboratories, Kodak, Ltd., on Oct. 29; "Sound-Reproduction", by Mr. J. H. A. Whitehouse, head of the Technical Publications Department of the Gramophone Co., Ltd., on Nov. 5; "The Miracle of Sound-Photography", by Mr. J. L. Underhill, chief recording engineer of the R.C.A. Photophone, Ltd., on Nov. 10; "Dyes and Dyeing", by Major F. A. Freeth, research manager of Imperial Chemical Industries, Ltd., on Nov. 19; "A Light Talk on Illumination", by Mr. T. E. Ritchie, chief illuminating engineer of the General Electric Co., Ltd. All these demonstrations will be given at the Portland Hall, Regent Street Polytechnic, at 5.30 P.M. A further demonstration, "The Romance of a Lump of Coal", by Sir Francis Goodenough, controller of gas sales of the Gas Light and Coke Co., will be given at 6 P.M. on Dec. 8 at the Caxton Hall, Westminster. The feature of the series

is that prominence is being given to practical demonstrations illustrating the development of the subjects. Tickets can be obtained from the Secretary, King Edward's Hospital Fund for London, 7 Walbrook, E.C.4, or at the doors, prices 2*s*. 6*d*. and 5*s*. (seats numbered and reserved) each demonstration, or 12*s*. 6*d*. and 25*s*. for the series.

IN the article referring to the meeting at Stockholm of the International Union of Geodesy and Geophysics, which appeared in NATURE for Oct. 11, p. 585, a statement appears suggesting that an Auroral Atlas is in preparation. We understand that this Atlas is, in fact, already prepared and published, and its distribution is now being undertaken by Prof. C. Størmer, chairman of the Committee responsible for its preparation.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A lecturer in civil engineering at Armstrong College—The Registrar, Armstrong College, Newcastle-upon-Tyne (Nov. 1). A plant physiologist at the Agricultural and Horticultural Research Station, Long Ashton, Bristol —The Secretary, University, Bristol (Nov. 3). An assistant pathologist at the French Hospital and Dispensary, Shaftesbury Avenue—The Secretary, French Hospital and Dispensary, 172 Shaftesbury Avenue, W.C.2 (Nov. 4). An assistant pathologist to the Pathological, Bacteriological, and Clinical Research Department of the Royal Sussex County Hospital, Brighton—The Secretary-Superintendent, Royal Sussex County Hospital, Brighton (Nov. 10). A senior assistant pathologist at the Auckland Hospital—The Secretary, Auckland Hospital Board, Auckland, New Zealand (Dec. 15). A part-time master for electrical engineering at the Technical Institute, Ponders End, Enfield—F. G. Apthorpe, Education Offices, Gentleman's Row, Enfield.

Our Astronomical Column.

Magnetic Disturbance and Aurora.—A magnetic disturbance, classified as a 'small storm', commenced at 15^h G.M.T. on Oct. 17 and lasted about ten hours. The range in declination at Greenwich was 55′, the oscillations of the needles being most rapid about 17^h and 22^h. There was an accompanying display of the aurora borealis, which seems to have been particularly well seen from the eastern counties of England. Mr. Charles Leaf, 7 Grange Road, Cambridge, states that at "1952 G.M.T. a low arch was visible stretching from north-west through north to north-north-east. This was bright green in colour, the lower edge being quite sharply defined, while the upper edge gradually merged into the clear sky above. At its highest point the arch was perhaps 15° above the horizon, and the extremities did not quite reach it. No streamers were observed." The arch persisted until 2130 G.M.T., when rainclouds finally hid it. Mr. H. W. L. Absalom, 9 Hillside Gardens, Wallington, Surrey, saw an auroral display between 6.30 and 6.45 P.M. (G.M.T.). "The phenomenon was first a comparatively short, thin, and rather diffuse arc of glow a few degrees below the three most westerly stars of the Plough. A few minutes later vertical structure became apparent, there being meanwhile a slow westward drift of the phenomenon, which, in its final form, seemed to consist of a nearly vertical shaft to the north-west. This shaft faded somewhat suddenly a minute or two before 6.45 P.M."

At this time there was a relatively small group of sunspots about two days' travel past the sun's central meridian. This group, seemingly unimportant, was more interesting spectroscopically ; it was surrounded by a conspicuous area of bright hydrogen flocculi, and as another index of activity, small but fairly rapidly moving streams of hydrogen, shown as absorption markings, were associated with the rearmost spot on Oct. 18 and 19. Whilst in these respects alone the group of spots was not unusual, the region may be considered at least as suspect in a possible association with this magnetic disturbance and aurora.

Bright Lines in Long-period Variable Stars.—An examination of the behaviour of bright lines in the spectra of long-period variable stars is made by Merrill and Burwell in the *Astrophysical Journal*, vol. 71, p. 285. The wave-lengths of 58 bright lines are recorded originating in hydrogen, iron (including 'forbidden' lines), magnesium, silicon, manganese, and (doubtfully) strontium and iridium. The forbidden iron lines and a magnesium triplet in the ultra-violet have not previously been recorded. The most interesting results deal with line intensities. Intensity *ratios* rather than absolute values are used, in order to avoid photometric difficulties, and the ratio $H\gamma : H\delta$ shows striking variations throughout the light-period which are common to all the *Me*-type stars examined. It rises rapidly from 1/8 up to 1/2 (reaching the latter value just before the maximum light-phase), then remains nearly constant for more than a fifth of the period, and finally rises rapidly again to about 5/2. Other intensity ratios show similar variations. The results are discussed, and it is shown that the bright lines behave as if they had little dependence upon the photosphere. It is also suggested that the band-producing titanium oxide exists at a higher level than that at which the bright lines are produced.

Pluto.—Mr. Bower has compared the recent observations of Pluto made by Prof. G. van Biesbroeck at the Yerkes Observatory with the ephemeris prepared by himself and Mr. Whipple using the elements that they derived from observations extending from 1919 to 1930. The mean correction to the ephemeris at the beginning of September last is only $-0{\cdot}3''$ in R.A. and $0{\cdot}2''$ in Decl. This is so small that it finally clinches the correct identification of the 1919 images with Pluto. This was really quite certain already, but some astronomers preferred to wait for the autumn observations before accepting them ; these should now be satisfied.

M. F. Quenisset succeeded in photographing Pluto at the Juvisy Observatory on Sept. 25, using a lens of only 5 in. aperture and 24 in. focal length. The exposure was for 2¼ hours. He estimates the magnitude as 15 ; Prof. Wolf thought it somewhat brighter than this ; probably something depends on the type of plate used, as the light of Pluto appears to be yellowish. It is now near its stationary point, and will soon begin to retrograde. Messrs. Bower and Whipple have issued an appeal to all who have access to old plates that might contain images of Pluto to examine them carefully. They gave an ephemeris for past years in *Lick Observatory Bulletin*, No. 427. This is so near the truth that only a small region on each plate would need to be scrutinised. Two plates of each region are needed to distinguish the planet from a star, unless the exposure is so long that the planet has trailed appreciably.

Research Items.

A Survival in Sind.—Mr. Ernest Mackay, in the *Journal of the Royal Anthropological Institute*, vol. 60, pt. 1, in describing the pottery-making industry of Balreji village, two miles south-east of the ancient site of Mohenjo-daro, singles out a number of details in which he sees resemblances to the pottery of the ancient East and particularly to the painted pottery of Sumeria. The wheel is unlike that employed anywhere else in India except in the upper Punjab, having two discs, of which the lower is turned by the foot. The foot wheel is used in the Bahrein Islands and elsewhere in the Persian Gulf, whence it may have reached India either overland or by sea. In making small vessels a tall column is moulded from which the completed vessel is severed by a cord. This leaves a characteristic groove in the base. Similar grooves are to be detected in Sumerian and Mohenjo-daro pottery. Vessels were cut from the wheel by cord in Crete so early as Middle Minoan II. The larger jars are built up in three or four parts on a moulded base. The same method, except for the moulded base, is found in pottery of the pre-Sargonic period of Mesopotamia and in the painted pottery of Jemdet Nasr near Kish, *c.* 3500 B.C. The method of tapping the pottery before quite dry with a block and spatula may have been employed in the manufacture of some of the so-called hand-made pottery of the early East. Specimens of the tapping block have been found at Harappa and various sites in Northern Baluchistan. To decorate the pots, they are placed on a conical stand and a cover with a projecting knob is placed in the mouth of the pot, this being used to revolve the vessel with the palm of the hand. Similar covers are found at Mohenjo-daro and also at Jemdet Nasr. Though the designs show very little resemblance to those of Mohenjo-daro, except that the scale pattern of the Nal pottery may be attributed to the influence of the Indus valley culture, yet the very survival of the art may itself be due to a tradition handed down from the people of Mohenjo-daro rather than to a new introduction. It is certainly not Greek or Arab.

Characteristics of the Peoples of Central Asia.—During a long sojourn in Central Asia (1892–1908) J. Talko-Hryncewicz collected many skulls of the present-day and former inhabitants, which he found by the railways and in fields, forests, and cemeteries. Their abundance was due to the belief of the Buddhists that the most honourable sepulchre was in the interior of wild beasts, and to the consequent scanty burial given to corpses. A study of the skulls shows that the population is composed of two principal types (*Bull. intern. Acad. Polonaise Sc. Lett.*, Ser. B, p. 107, 1930). The first type, Mongolian and contemporaneous, comprises two varieties, an eastern and a western, the latter perhaps mingled with Turks. The second type, represented by a probably pure Turkish race, is extinct at the present day, the remains being found only in tombs. This 'Euro-Asiatic' race, which mixed with others, such as the Mongols, was once very numerous and had several branches. It spread even to the bounds of central Asia on the north-east, and its influence upon the Chinese there is marked by the presence of carriage roads, irrigation canals, and certain agricultural implements, while its rune-like inscriptions remain on the stone tombs of the Khans at Karakoram. The author believes that the characters of the skulls and the size and development of the skeleton indicate that this is the race to which the Huns belonged, and accordingly he does not hesitate to range the Huns as a race with Turkish rather than of Finno-Mongol with Slav affinities.

Birds of the Antarctic Seas.—The British Antarctic Expedition of 1910 on the *Terra Nova* made a collection, amongst other things, of bird skins, but the accidents of death, first of Dr. E. A. Wilson, the naturalist of the Expedition, and then of Mr. Ogilvie-Grant, have delayed the report until now. A casual glance at the report suggests that it is largely due to the pen and pencil of Dr. Wilson, and, indeed, its text and the many drawings in pencil and colour reflect the keen observation and skill of that ill-fated naturalist. But closer reading shows that the authors, Dr. P. R. Lowe and N. B. Kinnear, have contributed a great deal to the scientific value of the work, notably by their long series of measurements of specimens from different regions, and by their remarks on age and locality differences. Forty species and sub-species were observed and obtained during the voyage, and many interesting notes on habits, characteristic attitudes in flight and in feeding were made. One of the most striking was the observation near Cape Crozier that young and adult individuals of the Emperor penguin were frozen into the lower layers of the old bay-ice of the previous winter and dropped into the sea as the ice melted. That and the presence of adults with chicks of different stages, seen at various places from Dec. 19 until Jan. 4, confirmed the suspicions that the chick is very slow in shedding its first plumage and the egg has to be laid and hatched out during the winter months.

Swarming of Bees.—In an article on the phylogeny, physiology, and biology of the swarming of bees (*Biol. Zentralbl.*, Leipzig, Bd. 50, p. 219; 1930), G. Götze discusses the investigations made on this subject at the Institute of Plant Diseases at Landsberg. Swarming, he holds, originates as a rule owing to lack of room, lack of food, or the unsafe condition of the old nest, and not, as Edwards and Latham have stated, as part of the nuptial flight. It is a division of the bee-stock in which the sex-impulse has no part, and most likely arises from an instinct impelling to migration towards favourable conditions of food and colonisation. It is an expression of the social relationship between the queen and her subjects, an election flight which leads to the division of the bee-stock as soon as several females have come to adult state. The social problem amongst bees has found, in different quarters of the globe, three types of solution. In America the stingless *Meliponi* exhibit the flight of young queens with partial swarming; in India the workers of *Apis dorsata* build new nests and this is followed by the swarming of the queen; and in Europe, the old queen of *Apis mellifica* flies off, and later there follow successive swarms with young queens. The author considers that such harmonious procedure as swarming in a state composed of so many castes could not be due to physiological reflexes to particular stimuli, and favours the view that a deep-seated hereditary instinct is involved.

Regeneration and Normal Growth.—Przibram's measurements of *Sphodromantis* and those of Křiženecky on *Tenebrio* reached analogous conclusions that a parallelism exists between regenerative and normal growth. Ubisch, on the other hand, regards differentiation, not growth, as the essential feature of regeneration. E. Godlewski and I. Latinik have attacked the problem afresh by determining during ontogenesis and during regeneration the growth of sectors of the tail of axolotl, the segments being so

far as possible equal and placed behind each other (*Bull. intern. Acad. Polonaise Sc. Lett.*, Ser. B, p. 79, 1930). The authors share neither of the opinions indicated above, for they regard growth and differentiation as complex general notions, indicating the resultant of several very different factors. Growth can indeed be distinguished in the ontogenetic and in the regenerative phase: in the former it is uniform in all the sectors; in the latter, apart from a generally accelerated movement, it shows stronger growth in the anterior than in the posterior sectors. It would appear, therefore, that factors take part in regeneration different from those involved in normal growth, and that a theory which limits regeneration to accelerated growth does not fully meet the facts of the case.

Graft Hybrids.—A valuable account of investigations in this interesting field is given by Prof. F. E. Weiss in *Biological Reviews*, vol. 5, No. 3, 1930. After some discussion of the vexed question of the influence of stock on scion, a very succinct historical account is given of the best known horticultural 'sports' which are now interpreted as graft hybrids, namely, the bizzarria orange, *Cytisus Adami*, and *Crataegomespilus*. In the last case, Weiss and Haberlandt regard the explanation of this plant as a periclinal chimæra as in doubt, because the shape of the epidermal cells, as seen in surface view, does not correspond with that of either of the original plants, from the graft union of which the sport has apparently arisen. It is not clear, however, why the authors should expect an epidermal cell to retain all its original characteristics of shape when it is subjected to a different amount of superficial extension, due to the fact that it is now spread over a core of different growth capacity. Baur's original explanation of some of these graft hybrids as chimæras, in which a skin of one parent is spread over the core of another, has been fully confirmed by the beautiful experiments in the artificial production of such graft hybrids from the region of graft union, which were initiated by Winkler. Prof. Weiss describes these experiments and shows how the further elucidation of the complex phenomena associated with the production of graft hybrids depends upon adequate cytological studies, and upon the developmental studies of the growth processes in the apical meristem. Many cases of graft hybrids have been brought under notice because the tissues from different parents show different capacities in the production of green chloroplasts. Prof. Weiss makes it clear, however, that the interpretation of the genetic and somatic factors involved in the production of variegation is a very complex and involved problem.

Land Mollusca from Caribbean Islands.—Visits during the expedition of the yacht *Mary Pinchet* were paid and land mollusca collected at Grand Cayman, the Swan Islands, Old Providence Island, and St. Andrew Island, the results of which are now described in full by Dr. H. A. Pilsbry (*Proc. Acad. Nat. Sci. Philad.*, vol. 82). Some work had previously been done on the land mollusca of Grand Cayman and the Swan Islands, but no land snails have hitherto been reported from Old Providence or St. Andrew Islands. Of the twenty-nine species collected at Grand Cayman, nineteen are restricted to it, and the author considers that it has existed well back into Tertiary times and has never been connected with Cuba. Its fauna can be most credibly accounted for by a former land connexion with Jamaica. Twenty-two species of land snails are now known from the Swan Islands, of which nine are special thereto. Sceptical as to the ability of land snails to make long sea voyages, Dr. Pilsbry regards their origin as obscure. The ridge on which Old Providence and St. Andrew Islands stand was formerly emergent and connected with the mainland, probably in Pliocene times.

Metamorphism and Geological Structure.—In an important paper by Gertrude L. Elles and C. E. Tilley, published in the *Trans. Roy. Soc. Edinburgh* (Vol. 56, Pt. 3, No. 25, 1930), the results are presented of many years' work on the structure of the Central and South-west Highlands as shown by the metamorphic condition of the beds. In addition to very extensive field work, nearly 3000 rock specimens have been sectioned and examined in order to define with precision the limits of the various metamorphic zones that have been recognised. The distribution of the latter shows very conclusively that the fundamental structure of the entire region was one of large-scale recumbent folding of the type suggested by Bailey. The connexion between this folding and the metamorphism is so close that the two processes must be regarded as having taken place approximately at the same time. The early recumbent folding was followed by a simpler type of folding like that found in the southern uplands. This stage was unaccompanied by constructive metamorphism. The movement seems to have culminated in the development of a series of thrusts with an overdrive to the north-west. The impulse of the earlier folding, however, appears to have come from the north-west. The two sets of trend lines are not exactly parallel. The paper is well illustrated with maps and sections, and is a most valuable contribution to our rapidly growing knowledge of an area and a method in both of which Barrow was the pioneer.

Australian Rainfall.—The Commonwealth Meteorologist has produced the rain map of Australia for 1929. Twelve small maps show the monthly rainfall and a large one the annual rainfall. The maps are based on the record of 1300 stations that are well distributed except for a gap in the interior of the western half of Australia. Only fifteen per cent of the country had rain in excess of normal. This compares with thirteen per cent last year, but this year was really worse, because there were very dry conditions in the pastoral lands of South Australia, north-west of New South Wales, and south-west Queensland. In some of those areas the totals were the lowest on record. The wheat areas of Victoria had a lack of rain during the critical winter and spring months. The total wheat harvest of Australia has been estimated to have dropped from 160 million bushels last year to 126 million bushels. Wool production, however, was high, and the sugar plantations do not appear to have suffered from shortage of rain. Tasmania as usual had a good rainfall.

Ultra-violet Glazing.—In response to the frequent inquiries from the building industry as to the use of window glasses transparent to ultra-violet rays, the Building Research Board of the Department of Scientific and Industrial Research has issued a *Bulletin* of a dozen pages on the subject, prepared by Mr. H. E. Beckett. A number of glasses which, when in sheets of 0·23 cm. thickness, transmit 65 per cent of the therapeutic rays between 0·29 and $0{\cdot}32 \times 10^{-4}$ cm. are now available, but their transparency falls off to 55 per cent in the course of three months' exposure to sunlight, and any dirt which may collect on their surfaces reduces their transmission still more. To get the therapeutic benefit of a window of the glass, it is necessary to sit within a few feet of it, as the available radiation falls off rapidly with increasing distance from the window, and at most points within a room the amount available is small. Copies of the *Bulletin* can be obtained from H.M. Stationery Office (price 4*d.*).

Possibility of Collisions between Light Quanta.—If light has a corpuscular structure, collision phenomena might be expected to occur when two beams cross each other, and it would be possible, for example, for two similar quanta to give rise to a new one of a new frequency. A search for an effect of this nature is described by A. L. Hughes and G. E. M. Jauncey in the second August number of the *Physical Review*. Two beams of sunlight, filtered through red glass, were passed through a pair of large lenses, so that the beams, the axes of which were inclined at 120°, intersected at a common focus. The point of intersection, when examined through a green filter with a dark-adapted eye, showed no detectable light, and it is calculated, from the energy of sunlight and the sensitivity of the eye, that the collision area of the quantum, for an event of this type, is less than 3×10^{-20} cm.[2]

Protecting Transmission Lines from Lightning.—During a severe thunderstorm the engineers of overhead transmission lines have an anxious time. They do not fear that the surges set up in the lines may do damage, as modern lightning arresters are very efficient; but they do fear, however, that direct flashes of lightning may strike the line. In *AEG Progress* for October the methods of protecting transmission lines from direct strokes are discussed. It is suggested that if all the lattice towers are connected with the earth through a suitable resistance and are connected together by an earth wire, then the line will be practically safeguarded. The author states that a lightning flash is non-oscillatory and a cathode ray oscillogram is shown to support this statement. A description is given of experiments carried out in the A.E.G. high tension laboratory to find the nature of the canal through which a high tension discharge takes place in air. Currents were varied from 1500 to 60,000 amperes. The diameter of the spark canal was measured photographically, every precaution being taken to prevent irradiation on the photographic plates. A curve is given to show the relation between the diameter of the spark canal and the maximum current. The record shows that with high discharge currents, the current density in the spark canal approximates to a constant value of ten amperes per square millimetre. A lightning current of 175,000 amperes would thus require a canal of diameter 15 centimetres. The spark canal in the experiments was constricted at the points where it started and finished. Similar constriction should occur when lightning flashes hit the ground. The author considers that a fulgurite of 5 centimetres diameter would be caused by a lightning flash of 175,000 amperes.

A New Distance Finder.—To meet the increasing need for a simple and inexpensive apparatus for measuring distances, Messrs. W. H. Harling, Ltd., of 117 Moorgate, E.C.3, have just introduced a "Popular Distance Finder" (price 27s. 6d. without staff: staff, 7s. 6d. extra), which should be of use to surveyors, engineers, architects, scouts, etc. The size of the instrument when set up is 12½ in. × 10 in., and, without the staff, packs up to 12½ in. × 2½ in. × 2½ in. It consists of a horizontal arm carrying a cross-bar and scale at one end and an eye-piece at the other, mounted on a staff. The scale arm is also provided with eye-pieces for observations along the chosen base-line. Two adjusting slow-motion gears are attached, one to turn the whole instrument about the staff, the other to turn the scale arm only. Each arm is fitted with a spirit level, and the scale is so graduated that, if the length of the base-line is 10 or 100 units, the required range may be read off the scale without calculation. Another feature in the simplicity of the design lies in the fact that there is no restriction as to the direction of the base chosen. Provision is made for reclamping the instrument on the staff in a vertical plane, so that heights may be as readily measured as horizontal ranges. Any distance from 50 feet to 5 miles may be measured; indeed, the range is limited only by visibility and the power of the eye, and, provided the base-line is not less than one-tenth of the distance to be measured, a 99 per cent accuracy is obtainable.

Sodium Vapour.—Measurements of the vapour pressure and density of sodium by Rodebush and Walters are described in the July number of the *Journal of the American Chemical Society*, from which the authors conclude that there can be no question of the existence of an appreciable amount of Na_2 molecules in the vapour. This conclusion is of interest in confirming the results of band spectra, which also indicate the presence of double molecules in the vapours of alkali metals, previously regarded as purely monatomic.

Rapid Estimation of Copper.—In the September issue of the *Berichte der Deutschen Chemischen Gesellschaft*, Prof. Fritz Ephraim describes some remarkable results which he has obtained in estimations of copper both in pure salts and in the presence of many other metals by means of the co-ordinated complex derivative which the metal forms with salicylaldoxime. The sensitiveness of this reagent is said to be greater than that of dimethyl-glyoxime for nickel. Moreover, it gives much more satisfactory results than cupron (benzoïn oxime), since it can be used in the presence of dilute acid, when its action becomes highly selective, the corresponding compounds with all other metals being held in solution. It is important to eliminate by careful washing all traces of excess of the reagent, otherwise the precipitate may decompose on drying. The dry compound contains nearly 19 per cent of copper and can be weighed accurately on a Gooch crucible.

Melting Points of Krypton and Xenon.—The melting points of the inert gases krypton and xenon have been redetermined by Dr. Kurt Peters and Kurt Weil (*Zeitschrift für physikalische Chemie*, Abt. A. Bd. 148, Heft 1/2). The essential part of the apparatus is a glass tube 4 mm. in diameter slightly bulbed at the lower end. Within this slides a glass rod, 2 mm. thick and 10 cm. long; the lower end of the rod has three slight projections. Also included is an iron tube surrounding the glass rod and allowing this rod to be moved up or down with the help of an external electro-magnet. By means of liquid air the inert gas is condensed as a frozen ring in the lower part of the outer tube. With the help of the magnet the lower jagged end of the rod is set into this frozen ring. The whole apparatus is then introduced into an aluminium block thermostat, and the tip of the rod is watched by means of its projection on a screen whilst the slowly rising temperature is determined on a platinum resistance thermometer. The results obtained for the melting points of krypton and xenon are $-157{\cdot}0° \pm 0{\cdot}5°$ C. and $-112{\cdot}0° \pm 0{\cdot}5°$ C. respectively. Since these results differ considerably from those of Ramsay and Travers, it seemed desirable to control the figures by time vapour pressure curves. A bend in the curves confirms the temperatures given. The normal boiling points were also determined by extrapolation. In a separate paper, "Adsorptionsversuche mit schweren Edelgasen" (*Zeitschrift für physikalische Chemie*, Abt. A. 148 Bd. 1/2 Heft), the same authors have described a method for the quantitative separation of argon, krypton, and xenon. The mixed gases can be adsorbed on carbon at −190° C., and then as the temperature rises they can be 'desorbed' through separate successive ranges of temperature by means of a mercury pump.

New Science Buildings at Christ's Hospital, Horsham.

HIS Royal Highness the Prince of Wales, who is the president of Christ's Hospital, visited the school at Horsham, on Oct. 14, to open the new buildings (Fig. 1) which have recently been erected for the purpose of supplying increased facilities for the teaching of science and geography.

The Prince arrived by aeroplane about mid-day and, accompanied by the headmaster and the Bishop of Worcester, he entered the new quadrangle, where he addressed the assembled school. In the course of his speech, he thanked those who had subscribed to the building fund and stressed the importance of biological and geographical studies in furthering the welfare of the Empire.

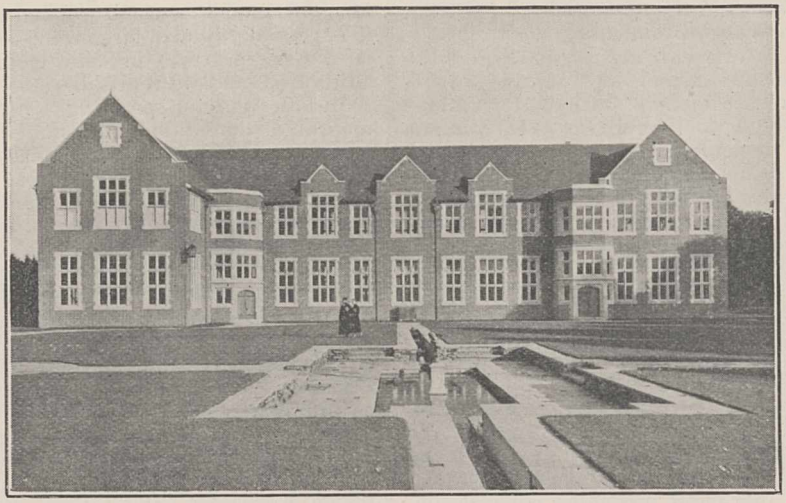

FIG. 1.—New science buildings, Christ's Hospital. West elevation and quadrangle.

"The new building," he said, "which adds so finely to the beauty and usefulness of this great and ancient school, is to be used mainly for the teaching of geography and of natural sciences, among which, I understand, biology will now be able to take its proper place beside chemistry and physics. Knowing as I do the need of scientific investigators to fill posts in outlying parts of the Empire, the teaching of geography and biology has for me a special appeal. They are both Imperial subjects, and they both make for the better understanding of mankind. To appreciate, through a study of biology, both the variety and the unity of all organic life is the surest path to sympathy and sound philosophy." The Prince then declared the building open and made a tour of inspection through it.

The new block of buildings is of red and white stone and forms the east side of a new quadrangle. It is very substantially built: the walls are double and the space between them filled with 'Hygean' rock—a material of bituminous nature—and the floors are of reinforced concrete.

On the ground floor are six large rooms. One is a chemical laboratory for the use of the more advanced students, leading out of which is a science library and reading-room. Two rooms are arranged for the teaching of practical mathematics, and one is a large biological laboratory. This is fitted with working benches and standing benches for aquaria, etc., and is intended for the more elementary work and nature study. It will be available for use out of school hours and will thus help to encourage the intelligent study of outdoor life, which has always been one of the aims of the school.

On the upper floor are two large geography class-rooms. They are lofty and well lighted and have been excellently equipped under the direction of Mr. T. K. M. Booth, who is well known for his work as a teacher of physical geography. On this floor are also two other laboratories for more advanced biological work and a lecture room to accommodate about eighty boys. This is fitted with raised tiers of benches and is well equipped with up-to-date projection apparatus. Communicating with this by means of a hatch is a small preparation room.

Above one of the biological rooms is a flat roof, surrounded by a coping, where many outdoor experiments may be carried out.

The working benches in all the science rooms are of the knee-hole type, and each working space is supplied with gas, water, and both high and low tension electrical points. The constructional work has been carried out by Messrs. Henry Norris and Son, Ltd., of Hertford, under the direction of the architect, Mr. S. Tatchell, F.R.I.B.A.

Native Races of the British Empire.

THE first of the series of popular lectures under the auspices of the Royal Anthropological Institute in the coming winter took place at the Portland Hall of the Regent Street Polytechnic Annexe on Oct. 15, when Prof. John L. Myres, president of the Royal Anthropological Institute, delivered the inaugural lecture, on "Native Races of the Empire: Facts and Problems". He said that it is remarkable, and also natural, that the greater advances in the 'study of man' have occurred during the greater periods of exploration and exploitation. Contact and conflict with alien cultures sharpen men's observation of customs and beliefs, and provoke curiosity about the reasons for them. Political theories have been founded on travellers' tales about men in the 'state of Nature' presupposed by philosophers, and have differed like the customs so described. This has been the contribution of adventurers and administrators to anthropology. What has anthropology to offer in return by way of instruction, advice, or warning to those whose interests or duties involve intercourse with 'native races'?

At first sight, a survey of the native races of the Empire would seem to fall little short of a general survey of mankind, so widespread are the regions included. But the same reasons which explain the special courses taken by colonisation and conquest determined also which races and peoples the pioneers would encounter, the historical order in which they met them, and consequently the fund of previous experience with which each fresh 'native question' was handled. This in turn suggests a natural order in which to group studies of 'native races', according to their geographical backgrounds and economic foundations.

In North America, where intercourse between European settlers and aboriginals occurred first on a large

scale, it was mainly between hunters on both sides in the north, and only further south between hunting natives and immigrant farmers, involving transference of lands and displacement of natives by immigrants, eventually almost complete. Clash between the Plains Indians, already using the horse, and white cattle-ranchers, came later and was more severe; and in turn the discovery that grain could be grown on prairie restricted surviving redskins to a few limited reserves. In the mountain belt, displacement has been slower, as in the austerer north; and on the Pacific coast, fisheries and other local industries permit gradual incorporation of natives into the white community. All through North America, the absence of strong racial contrasts and the high quality of redskin intelligence has made absorption easy.

Contrast the course of events in Australia, where the physical difference was conspicuous, native adaptability was low, and the settlers' outlook, for various reasons, less favourable to tolerant or even humane intercourse. The dependence of Australian settlement on grazing animals emphasised the clash between pastoral and hunting populations; and the early discovery of precious metals introduced severe economic complications, unfavourable (as in South Africa) to aboriginal prosperity.

The natural poverty of aboriginal Australia contrasts alike with the natural wealth of New Zealand and of the Pacific island-world whence the Maori had come; and the higher intellectual endowment of the Polynesian helps to explain both the sturdy resistance of the Maori and the facility with which European intercourse has broken up the receptive culture of the other islanders. In Polynesia, and still more in Indonesia, tropical conditions (especially wealth of forest products) have on one hand precluded colonisation, and on the other led to various ways of utilising the forest-bred aboriginals as mere collectors of raw material, such as rubber or copra, under servile conditions which are disorganising their societies. Quite of a different kind are the problems which occur when the native population has domestic animals and is more or less pastoral and nomad, as in Arabia and Iraq, while the immigrants are agricultural and sedentary, or European needs favour agricultural elements against the pastoral. It makes little difference, moreover, to herdsmen, tenacious though they are of their own traditions, whether their grasslands have always been grazed, as in Arabia and Upper Mesopotamia, or were formerly the granary of great civilisations, as in Babylonia, Syria, Palestine, and Egypt. In northern Nigeria, the same clash of pastorals and cultivators appears in similar open country; and on the north-west frontier of India, too, the men of the plains are cultivators and the hillmen mainly pastoral, though not nomad like the Arabs and other Moslem pastorals.

As the only regions within the Empire or its mandated territories where purely pastoral communities are predominant lie where normal European colonisation is not practicable, contact with nomad peoples would be limited to marginal police work; were it not, with modern agricultural and engineering methods it is possible to farm large tracts of grassland, so that customary pastures are abridged, and nomads raid cultivated lands in reprisal.

In Palestine, for special reasons, political and sentimental, a country long abandoned to immigrants still mainly nomad is being reoccupied by sedentary farming communities, supplying the needs of an even larger tour-population, also immigrant, and imperfectly accustomed to traditional modes of life.

It is necessary to take account of the special problems of contact with pastoral peoples, as well as with hunting tribes and with the simpler cultivators, if we are to understand the peculiarly complicated situation all down eastern and southern Africa, from Sudan to the Kalahari Desert. Here, moreover, mainly because these tribes, so long as they kept to the plateaux, seldom wholly lost their cattle, and consequently kept their mobility, the population is unstable and tends to drift southward, gently or violently, with overlaps, conquests, and race mixture. Into this initial confusion European exploitation, based on the coasts, brings into the interior numerous cross-currents and such complication as former Arab slave-raiding, recent devastation of cattle and peoples by fly-borne and travel-borne diseases, the shift of native labour into gold-fields and diamond-fields, and the wastage of brains and resources in the so-called 'scramble for Africa' between Europeans.

Subsequent lectures will deal, on Nov. 12, with "Spirit Worshippers of the South Seas", by Mr. A. M. Hocart; on Dec. 10 with "Tribes of the Egyptian Sudan", by Lord Raglan; and after Christmas, with other native races, to be announced later.

Photosynthesis of Carbohydrates.*

AS has already been described in previous papers, the photosynthesis of carbohydrates can be achieved by the irradiation of carbonic acid absorbed on a suitable surface in the form of a very fine powder. The material used in the earlier experiments was nickel carbonate, which, however, required previous activation by means of light and was only effective for about two hours.

Considerable advantage is gained by the use of ferric oxide as catalyst, the oxide, containing some thorium oxide as promoter, being deposited on kieselguhr which has previously been coated with aluminium hydroxide. The aluminated kieselguhr is evaporated to dryness with a solution of ferric nitrate, and the product is first ignited in a stream of dry air and afterwards heated at 410° in a vacuum in order to remove any adsorbed nitric oxide. These powders do not require any previous activation.

The activity of the powders in promoting photosynthesis varies in a remarkable way with the amount of thorium oxide present in the ferric oxide, sharp maxima being observed when the thorium oxide content is about 1·31 and 2·12 per cent with minima on either side of these amounts. The maximum yield of carbohydrates is about 0·13 gm. per hour with 100 grams of powder at 18°.

It has been found that photosynthetic activity is proportional to the magnitude of the electropositive charge assumed by the powders when in suspension in water saturated with carbon dioxide. This enables the activity of any powder to be rapidly determined. The most active powders give in the cataphoresis apparatus a velocity of 0·00041 cm. per second along a potential gradient of 1 volt per cm. Cataphoresis measurements made with activated nickel carbonate have shown that the material completely loses its activity in two hours when its suspension in conductivity water is exposed to light. The short-lived activity of this substance as a catalyst for the photosynthetic reaction is thus explained.

Cataphoresis measurements have rendered possible the determination of the rates of the poisoning of the

* Substance of a paper read by Prof. E. C. C. Baly, F.R.S., before Section B (Chemistry) of the British Association at Bristol on Sept. 8.

powders by the oxygen produced in the photosynthetic reaction and of the subsequent de-poisoning by carbonic acid. The ferric oxide powders in suspension in water saturated with carbonic dioxide maintain a constant cataphoretic velocity when kept in the dark. A suspension of a powder, with a stream of carbon dioxide passing through it, becomes less electropositively charged when exposed to light, the decrease in charge depending directly on the intensity of the light. When the intensity of the light exceeds a definite value the powder undergoes complete flocculation and is rapidly deposited on the bottom of the containing vessel. If the irradiation is then stopped, the powder is de-flocculated and the original maximum electropositive charge is restored, the poisoning and de-poisoning being completely reversible. It follows from this that if the intensity of the light be not too great the photosynthetic production of carbohydrates becomes a continuous process.

It has been previously shown that the yield of carbohydrates is linearly proportional to the temperature between 5° and 31°, and that a very rapid decrease in yield takes place when the temperature exceeds 31°. It was suggested that the explanation of this sudden decrease in activity was due to the fact that 31° marks the limit of stability of the adsorption complex of carbonic acid. This suggested explanation has now been verified experimentally. Suspension of the ferric oxide powders in water saturated with carbon dioxide are completely stable in the dark at 31° and at lower temperatures. If the temperature is raised above 31° the suspension is completely flocculated and rapidly settles out.

Measurements have been made of the photosynthetic efficiency of the powders with light of different wavelengths, and it has been found that the efficiency increases from the blue to the red end of the spectrum, the maximum being obtained with light of about wavelength 760 $\mu\mu$. The analogy between the laboratory process and that in the living plant seems therefore to be complete, since the two are similar in the following respects :

(1) The reaction is a photochemical one on a surface.

(2) The energy of activation of the carbonic acid is supplied in two stages, part by the surface and part in the form of light.

(3) The photosynthetic efficiency decreases when the intensity of the light is too great, and is restored in the dark.

(4) The production of photosynthesised material is linearly proportional to the temperature up to a critical temperature, above which the production rapidly falls. In the laboratory this critical temperature is 31° and in the living plant it is 36°.

(5) The photosynthetic efficiency increases from the blue to the red end of the spectrum.

It may be recorded that, although the yields of carbohydrates obtained from carbonic acid have not yet been large enough for the purpose, a systematic analysis has been made of the sugars present in the syrup photosynthesised from an aqueous solution of formaldehyde. This syrup is very similar in its properties to that obtained from carbonic acid. The sugars were oxidised by means of bromine and the resulting acids were separated by fractional crystallisation of their salts with various alkaloids. There were thus obtained pure preparations of *d*-gluconic acid and *d*-erythronic acid, both of which were completely identified. The formation of these acids proves the photosynthesis of glucose and fructose. Evidence was also obtained of the formation of dibasic acids, suggesting the photosynthesis of carbohydrates with larger molecular weights than the hexoses.

Agricultural Field Experiments.*

A FOREWORD explains that the pamphlet referred to below is published primarily for the benefit of officers engaged in field experimentation in the Madras Presidency. It is divided into three parts ; the first introductory, dealing with the general principles underlying the work and with experimental technique ; the second with various methods of grouping plots so as to minimise the disturbing influence of soil heterogeneity ; and the third with the statistical concepts which are utilised in the analysis and interpretation of results. There is a short bibliography and a separate booklet of mathematical tables.

The authors rightly stress the necessity for selecting a uniform piece of land for experimental purposes, and for ensuring that the plant shall be uniform also. Recent advances in field experimental technique, although they may reduce the effects of non-uniformity, do not lessen the desirability of choosing the best possible site for an experiment. A debatable point is raised when it is stated (p. 3) that "no experiment can provide accurate data that is not based on a simple enquiry". Care should certainly be taken to ensure that the questions asked are straightforward and that the answers are therefore unambiguous ; but much information can be gained from a complex experiment which is sought in vain in a simple experiment. Thus two simple experiments, investigating the effect of varying quantities of nitrogen in one case and of phosphate in the other, will not give information, obtainable if the two experiments had been combined, as to the effect of nitrogen at different levels of phosphate and of phosphate at different levels of nitrogen. Where more than two factors are introduced into a single experiment it becomes possible, of course, to calculate interactions of higher order than the first. In this connexion R. A. Fisher has written : "No aphorism is more frequently repeated in connection with field trials, than that we must ask Nature few questions, or, ideally, one question at a time. The writer is convinced that this view is wholly mistaken. Nature, he suggests, will best respond to a logical and carefully thought out questionnaire" ("The Arrangement of Field Experiments" : *Jour. of Min. of Agric.*, 1925).

In the second part Beaven's half drill strip method is described, but without pointing out its two serious but remediable defects : that the continued use of one half of the drill for one variety, and of the other half for the variety with which it is to be compared, may introduce a constant difference the magnitude of which cannot be estimated ; and that the regular alternation of strips of the two varieties does not permit of a valid estimate of experimental error. In this part the method of randomised blocks receives but scanty attention, and the Latin square method, which is by far the most efficient of all experimental arrangements, is not mentioned.

The third part indicates the procedure for calculating the standard deviation of the mean of a set of observations, and explains "Student's" method. A pamphlet published as recently as 1928 should have included an account of Fisher's "Analysis of Variance", that invaluable weapon of the field experimenter.

* "The Conduct of Field Experiments", by R. O. Iliffe and B. Viswa Nath. Bulletin No. 89 of the Department of Agriculture. (Madras : Government Press, Madras, 1928.) 1 rupee 4 annas.

Cyclones of the South Indian Ocean.

MR. R. A. WATSON, when director of the Royal Alfred Observatory, Mauritius, began a series of annual papers dealing with each cyclone season in that part of the South Indian Ocean lying near and to the east of Mauritius. They are published in the *Miscellaneous Publications* of the Royal Alfred Observatory. The second of the series, entitled "The Cyclone Season 1928–1929", shows that the season in question was a normal one in regard to the number of cyclones (8) that were noted. None of these storms caused damage in Mauritius, but Rodrigues suffered severely in January 1929.

The paper contains, in addition to the particulars of this one season, statistical information about the seasonal distribution and the movements of cyclones between the equator, lat. 30° S. and long. 50° and 70° E., based on 77 years' records beginning in 1848 that are not available elsewhere. This information extends and brings more up to date a part of the statistics that appeared in "Hurricanes and Tropical Revolving Storms", by Mrs. E. V. Newnham (*Geophysical Memoir*, No. 19), issued by the Meteorological Office, London, eight years ago. The manuscript records of the Observatory were used in addition to published information. Speaking of the seasonal variation in the number of cyclones recorded on each date, the author says: "The yearly variation is best represented by a slow rise throughout October and November, then a somewhat rapid rise to a maximum about Feb. 4, and a gradual fall to the end of May".

It may be noted that before the publication of the memoir referred to above, the best authority for the seasonal variation in the frequency of storms in the whole of the South Indian Ocean was Meldrum, who found from a consideration of 35 years' observations, also beginning in 1848, that more storms occurred in January than in February—71 as against 61—which implied an earlier date for the maximum than is now indicated. Mrs. Newnham's figures for the wider area accord well, however, with those found by Watson.

Watson also gives statistics in regard to the frequency with which all cyclones that crossed latitudes 10°, 15°, 20°, 25°, and 30° S. moved in the various directions: north, north-north-east, north-east, and so on. His remarks upon these have an important bearing upon the general question of the motion of tropical cyclones. He says, "The table is strongly suggestive of wind diagrams for various heights above the surface at Mauritius, the low latitudes corresponding to small heights and the higher latitudes to heights of 4 or 5 kilometres. . . . Given that the surface of separation between the easterly trades and the westerly 'anti-trades' slopes upwards from the surface about latitude 30° S. to reach very big heights about latitude 10° S., and that a cyclone is carried along by the prevailing current where condensation is taking place most vigorously, we should expect some such similarity." Before, however, this explanation can be accepted, it appears desirable to have direct evidence that the principal rain clouds show the very large variation in height in different latitudes that is implied. The suggestion opens up an interesting line of possible research.

University and Educational Intelligence.

CAMBRIDGE.—The professor of chemistry has, with the consent of the Vice-Chancellor, appointed S. E. Janson, of Gonville and Caius College, to be his assistant for five years as from July 1 last.

The Busk Studentship in aeronautics, founded in memory of E. T. Busk, who lost his life in 1914 whilst flying an experimental aeroplane, has been awarded for the year 1930–31 to R. H. Francis, of the University College of North Wales, Bangor.

N. F. Mott has been elected to an official corporate fellowship at Gonville and Caius College on his appointment as lecturer in mathematics. Mr. Mott was formerly a scholar of St. John's College, gained a first class in the Mathematical Tripos, Pt. I., and was a wrangler with distinction in Pt. II. in 1926. After working in Copenhagen, he was appointed lecturer in theoretical physics in the University of Manchester.

LONDON.—Notice is given that the Rogers prize for 1931, value £100, is offered for an essay on "Filtrable Viruses as a cause of Disease in Man". The competition is open to all persons whose names appear on the Medical Register of the United Kingdom. Copies of the regulations, including information regarding the date in April by which essays must be received, may be obtained on application to the Academic Registrar, University of London, South Kensington, S.W.7.

A SCHOLARSHIP has been founded at University College, Southampton, by friends of the late Dr. Alex Hill, in recognition of the distinguished services rendered by him to the College. The scholarship is of the value of £50 per annum, tenable for three years at the College, and will be awarded annually. The holder will be required to pay tuition fees. Dr. Alex Hill, who died on Feb. 27, 1929, became principal of University College, Southampton, in 1913, and steered the College through the difficult War and post-War years, until he resigned in 1920 to devote his energies to the rapidly developing work of the Universities Bureau of the British Empire. From 1920 until his death he was a vice-president of the College, so that he was actively connected with it for a continuous period of sixteen years.

THE following scholarships have been awarded by the Institution of Electrical Engineers for 1930:—*Ferranti Scholarship* (annual value £250, tenable for two years): E. Wilkinson (University of Liverpool); *Duddell Scholarship* (annual value £150, tenable for three years): T. R. Stretton (Cardiff Technical College); *David Hughes Scholarship* (value £100, tenable for one year): H. A. Wainwright (University of Sheffield); *Salomons Scholarship* (value £100, tenable for one year): E. Bell (Armstrong College, Newcastle-on-Tyne); *War Thanksgiving Education and Research Fund* (No. 1): grants of £50 each to F. J. Clark (East London College) and Miss W. Hackett (University of Birmingham); *Thorrowgood Scholarship* (annual value £25, tenable for two years): J. F. H. Tyler (Southern Railway Company).

THE Mond Nickel Company, Ltd., Imperial Chemical House, London, S.W.1, has arranged three exhibits showing aspects of the nickel industry, which are available, free of charge, to colleges, technical institutions, schools, etc., in connexion with conversaziones or to illustrate class or open lectures. Exhibit No. 1, illustrating "The Versatility of Nickel", was available last year. Exhibit No. 2 illustrates "The Extraction of Nickel by the Mond Process", and consists of flow sheet, photographs, samples of intermediate and fine products, letterpress, and booklets. Exhibit No. 3 illustrates "The Properties and Applications of Nickel and its Alloys", and consists of samples of products made in many different alloys, photographs, letterpress, and booklets. Lectures illustrated by travelling exhibits or lantern slides are also given by members of the firm's staff.

Historic Natural Events.

Oct. 26, 1916. **Whirlwind in Essex.**—A tornado travelled in a north-easterly direction across Essex near Writtle, passing through the centre of that village at 1.7 P.M. The track was only about 100 feet in breadth, and very sharply defined. Damage estimated at several thousand pounds was done to buildings in Writtle, but no lives were lost. An aneroid barometer was observed to fall an inch during the storm, and to recover in eight or ten minutes.

Oct. 27, 1913. **South Wales Tornado.**—This disturbance was first observed in Devonshire shortly after 4 P.M., as a small but intensely black cloud from which fell torrential rain and hail of great quantity and size. It was accompanied by thunder and lightning, but the wind was not especially high. Travelling northwards, the storm crossed the Bristol Channel and appeared as a heavy thunderstorm at Aberthaw, but no material damage was recorded until it had penetrated 12 miles inland. From here onwards a great deal of damage was done along a sharply bounded track several hundred feet in width. Its passage lasted less than a minute, after which torrential rain fell. Trees were uprooted and buildings demolished; several pieces of slate were afterwards found buried to a depth of 1½ inches across the grain of trees. After leaving Wales, the storm passed through Shropshire and Cheshire, reaching the latter at 8.30 P.M. The storm was noteworthy as the nearest approach to the true American tornado which has been scientifically investigated in England, its rotary motion being shown by trees lying in every direction, while others had their tops twisted off.

Oct. 28, 1891. **Earthquake in Central Japan.**—One of Japan's greatest earthquakes desolated the Mino-Owari plain near the centre of the Main Island. Over an area of 4286 square miles, the destruction of property was nearly complete, 197,530 buildings being ruined, while 7279 persons were killed. The earthquake was due to a sudden movement along a great fault, the scarp of which was traced across plain and mountain for 40 miles, and was believed to be nearly 70 miles in length. At the surface, the horizontal shift varied from 3 to 13 feet. The vertical displacement was usually less than 10 feet, but in one place reached nearly 20 feet. The after-shocks of this earthquake were unusually frequent. At Gifu, close to the fault-scarp, 1746 shocks were registered during the first thirty days and 3365 by the end of 1893.

Oct. 28, 1927. **Breakdown of Electrical Transmission through Salt Spray.**—On Oct. 28–29 a deep barometric depression crossed the British Isles, giving rise to a violent gale from south veering to west. At Southport the wind velocity reached 96 miles per hour in a gust and much damage was done. A remarkable feature of the gale was that in the Midlands electrical transmission along overhead power wires broke down from midday on Oct. 29 to early on Oct. 30. The cause of the trouble was afterwards found to be as follows: During the gale great quantities of spray were carried inland by the wind all along the west coast, and coated the insulators of the power lines in South Wales with a layer of salt water which practically short-circuited them. As the spray was carried inland, the water was evaporated owing to the dryness of the air, and by the time the air reached the Midlands the spray was reduced to salt crystals. These stuck on the insulators of the power lines but were too dry to destroy the insulation completely, until the air became damp again on Oct. 29, and they absorbed water. On Oct. 30 general rain washed the insulators clean again.

Oct. 29, 1867. **The Hurricane of San Narciso.**—This was one of the worst hurricanes on record in the West Indies. The storm passed across the Virgin Islands travelling towards the west-north-west, the centre reaching St. Thomas at 12.30 P.M., when the hurricane winds gave place to almost complete calm and darkness. More than six hundred persons were drowned at St. Thomas, mainly crews and passengers of vessels. On shore in St. Thomas and Tortola many deaths were caused by the falling of houses, which were almost all destroyed. Some houses were lifted bodily from their foundations and dropped some distance away. At Santa Cruz an American frigate was carried into the market place. This hurricane and the earthquake which accompanied it put an end to the almost completed negotiations for the purchase of the Danish West Indies by the United States. Continuing towards the west-north-west, the centre travelled diagonally across Porto Rico, where its effects were described in a work entitled "La Memorable Noche de San Narciso", by Don Vicente Fontan y Mera. In the various towns of the island 211 persons were killed, 741 injured, and an enormous amount of damage was done to houses and sugar mills. Owing to the torrential rains, there was much flooding.

Oct. 31, 1840. **Rhone Floods.**—On Oct. 27–30, from the Mediterranean to the Vosges, a general downpour of rain occurred, of unprecedented persistence and intensity. The Upper Rhone ravaged Lyons on Oct. 31; on Nov. 1 the Sâone surpassed all previous levels and all the torrents of the Cevennes were in violent flood. The Rhone had already risen more than 18 feet at Valence and more than 23 feet at Avignon, when a further terrific rainstorm burst over the valley from the evening of Nov. 1 to that of Nov. 3. In seven days, Oct. 27–Nov. 3, 9-10 in. of rain fell in the Rhone basin. The renewed floods fell like an avalanche on the already submerged valley; the Sâone rose 28 feet at Trévoux, inundated the lower parts of Lyons, and destroyed four bridges and several hundred houses. The Rhone at Avignon rose 27 feet above its normal level, and only the rupture of the dykes and consequent spread of the floods over an enormous tract of land prevented it from rising still higher. Near Tarascon the flood was nearly 20 miles across, and many bridges were washed away.

Nov. 1, 1755. **Great Lisbon Earthquake.**—This was one of the greatest of all recorded earthquakes. Coming without warning, the shock lasted six or more minutes, during which time about 60,000 persons were killed. The city of Lisbon was utterly ruined. Large numbers of persons had collected on a newly built stone pier, which sank suddenly with all upon it beneath the water. The epicentre lay about 100 miles west of Lisbon. The sea waves were of great height, about 50 ft. at Lisbon, 60 ft. at Cadiz, 15 ft. at Funchal, and 6-10 ft. along the southern coasts of England and Ireland. They swept across the Atlantic to the shores of Antigua, Barbados, and Martinique. An almost unique feature of this earthquake was the disturbance of lakes and rivers all over Europe and even in North America. In Loch Lomond (1220 miles from the epicentre), the water oscillated for 1½ hours, at first to a height of 2 ft. 4 in. above the normal level. The Elbe at Hamburg (1400 miles), Lake Wener in Sweden (1750 miles), and the great lakes of Canada (nearly 4000 miles) were agitated.

Nov. 1, 1876. **Backergunge Cyclone.**—An intense cyclone travelled northward across the Bay of Bengal towards the delta of the Ganges, and a cyclone wave, ten to forty feet deep, struck the low-lying district of Backergunge in Bengal. In half an hour about 100,000 persons were drowned and all the crops were destroyed, and the disaster was followed by a famine and pestilence which cost a further 100,000 lives.

Societies and Academies.

PARIS.

Academy of Sciences, Sept. 15.—**Paul Helbronner**: The observation of a polar aurora. Observed Sept. 3, between parallels 65° 10′ and 64° 40′, on the occasion of the meeting of the International Congress of Geodesy and Geophysics at Stockholm.—**V. Romanovsky**: The discrete chains of Markoff.—**J. Rey Pastor**: A method of convergence by means.—**L. Bert** and **M. Raynaud**: A synthesis of propenyl benzene. The reaction between ω-chlorallyl benzene and sodium gave unexpected results, propenyl benzene, $C_6H_5.CH:CH.CH_3$, being the main product. The yield is sufficient to make this a good method of preparation of this hydrocarbon.—**Jean Piveteau**: The structural peculiarities of a new type of fossil fish from the Permo-Triassic formations of the north of Madagascar. This fossil has been previously described by Priem, and considered by him as belonging to the genus *Pristisomus*; the author does not agree with this view, and suggests the name of *Australosomus* as the name of a new genus.—**J. Vellard** and **Jarbas Penteado**: The action of ultra-violet rays on venoms. Experiments were made on venoms from *Lachesis atrox*, *L. jararaca*, *Crotalus terrificus*, *Naja tripudians*, and *Bufo marinus*. An account of the changes in physical and chemical properties is given. The physiological action was found to be considerably reduced by exposure to ultra-violet light. With large doses of venoms irradiated for 45 minutes, the authors have been able to protect guinea-pigs and goats against the action of a subsequent injection of fatal doses of fresh venom.

CAPE TOWN.

Royal Society of South Africa, Aug. 20.—**T. Stewart**: Steenbras rainfall. The yield of the catchment area for the wet months might be put at 6000 million gallons. This is the capacity of the reservoir which has recently been constructed. In 1922 observations for a period of seven years were available. These showed that the average amount of rainfall in the main valley for the period was 40·7 inches. The observations taken since, that is, over a period of fourteen years, give 39·3 inches for the main valley. This does not apply to the whole catchment.—**K. H. Barnard**: The Cape alder-flies (Megaloptera). Third report on the fauna of the mountains of the Cape Province. Five species are admitted, comprised in four genera. The egg, larva, and pupa of one species, and the larva and pupa of another, have been discovered.—**H. Zwarenstein**: A note on Bridge's genic balance theory of sex determination. The following modification is suggested: the female determining genes are located not only on chromosome X but also on chromosome IV. The male determining genes are in chromosomes II and III. Assigning arbitrary values to the efficiency of these two interacting components, a series of sex indices is derived.—**L. T. Hogben**: Spinal transection and the chromatic functions in *Xenopus Laevis*. Section of the optic nerves has the same effect as removal of the eyes. Section of the entire peripheral nerve supply of the leg has no effect on colour response. Both the black and white background response can be elicited in toads after section of the cord in front of the first pair of spinal nerves or at any lower level.—**Enid Hogben**: The total oxygen consumption of hypophysectomised toads. The ratio of dermal (Winkler method) to pulmonary (Haldane method) respiration has been determined, and the variation of total respiratory rate with temperature, body weight, and sex has been determined. Removal of the pituitary gland is accompanied by a profound diminution in the oxygen consumption.—**J. Hewitt**: Discoveries in a bushman cave at Tafelberg Hall.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 3, 1930).—**V. Ambarzumian** and **D. Ivanenko**: A note on the problem of the unified theory of the electromagnetic and the gravitational field from the point of view of the quantum mechanics.—**A. Mordvilko**: *Pemphigus bursarius* Tullgren (*pyriformis* Licht.) and its anolocyclic forms. The alate forms of *P. bursarius* migrate from the galls on poplars to roots of grasses, where they give rise to exules which have been described under different names. Galls of *P. bursarius* do not occur on poplars (*P. sauveolens* and *P. maximoviczii*) in eastern Siberia, though the root-forms are present; it is possible that *P. nigra* existed there in the preglacial times.—**D. Smirnov**: Systematics of *Diaptomus fischeri* Rylov and *Diaptomus acutulus* Brian. The two species are extremely close, but differ by a number of characters, which are enumerated and analysed.—**J. Medvedev**: The relation of a diastase to the substratum in a system of carboxylase and pyruvic acid.

Comptes rendus, No. 4, 1930.—**V. Ipatjev** and **A. Frost**: Chemical equilibrium between phosphine, phosphorus, and hydrogen.—**J. Kourbatov**, **N. Karzhavina**, and **N. Samoilo**: Description of a method for the preparation of a solution serving for the determination of ionium in the dispersed masses of Tuia-Mouiun.—**S. Smirnov**: (1) A new species of *Phyllopoda anostraca* from the Ussuri region. Description of *Pristicephalus longicornis* sp. n.—(2) A new species of the genus *Diaptomus* Westw. from the Amur region. A description of *D. rylovi* sp. n., closely allied to some North American species of the genus.—**V. Gromova**: Preliminary communication on the *Bos primigenius* Boj. in Russia. A series of thirteen skulls of *B. primigenius* was studied and great individual variability established; this throws some doubt on the validity of a number of species described by other authors, and only two of these may be retained, namely, *Bos trochoceros* Meyer of the glacial period and the postglacial *B. primigenius* Boj.—**G. Alderberg**: Preliminary synopsis of Russian and Mongolian wild boars. Only one species of *Sus* is recognised, with five subspecies, namely, *S. scrofa scrofa* L. (Germany), *S. s. attila* Thomas (Transylvania, Russia, Caucasus), *S. s. nigripes* Blanford (Turkestan, Tian-Shan), *S. s. raddeanus* sbsp. n. (N. Mongolia), and *S. s. continentalis* Nehring (Amur and Ussuri basins).

SYDNEY.

Royal Society of New South Wales, Aug. 6.—**A. R. Penfold**, **C. B. Radcliffe**, and **F. W. Short**: The essential oil of *Eucalyptus rariflora* (Bailey). The air-dried leaves yielded 2·5 per cent of oil, the principal constituents of which have so far been identified are the terpenes Δ-4 carene, *B.* phellandrene, *l*-a-pinene, *B.* pinene, cymene with cineol (about 10 per cent), sesquiterpenes (principally aromadendrene), sesquiterpene alcohols, with small quantities of the aromatic aldehydes (cuminal, phellandral, and cryptal), alkali soluble bodies (unidentified phenols) and dehydroangustione (*B.* diketone).

VIENNA.

Academy of Sciences, June 26.—**E. Beutel** and **A. Kutzelnigg**: The catalytic action of light on the disintegration of certain salts.—**W. J. Müller**: The theory

of passivity phenomena (12). The passage of a current through anodes which are covered with an insoluble surface layer. A formula is suggested based on assumptions as to the division of the current between the surface-layer and its pores.—J. Zellner and E. Zikmunda: The chemistry of halophytes.—J. Zellner and E. Zikmunda: The chemistry of higher fungi (21). *Polyporus sulfureus* and *Lentinus squamosus*.—N. Fröschl, J. Zellner and E. Zikmunda: The comparative chemistry of plants, chemistry of barks (7). *Morus nigra* and *Alnus incana*.—E. Gebauer-Fülnegg and H. Jarsch: Condensation products from aryl-dithio-glycolic acids.—E. Riess: Organic sulphur-nitrogen linkage.—H. Huber and K. Brunner: The action of ferric chloride on the acyl esters of phenol.—F. Perktold: Para-azobenzol-sulphonic acid and paramononitro-para-azobenzol-sulphonic acid.—F. Raaz: The space-unit of gehlenite. Pure synthetic material was prepared in the Kaiser Wilhelm Institute for silicate research at Berlin-Dahlem and submitted to X-ray analysis in Leipzig. The elementary unit is a tetragonal prism with two molecules of the compound $Ca_2Al_2SiO_7$.—J. Kisser and A. Sesser: Biological researches on dwarf trees (1). The structural relations of the high moor forms of *Picea excelsa*. Trees fifty years old were only 60 cm. high and 2 cm. in diameter. The leaves show a diminution in the number of cells rather than in the size of cells.—W. Laves: Histological researches with buffered stain solutions on the post-mortem breakdown of the nuclear chromatin and of the plasma of liver cells.—O. Taussky: The metrics of groups.—E. Bersa: Culture and nutrient physiology of the genus *Pilobolus*. The favourable and unfavourable nitrogen and carbon sources were determined.—A. Himmelbauer: The crystalline form of cadmium antimonide. Form rhombic, formula CdSb.—H. Gerhart: Alterations of crystalline form in double sulphates. Crystals were obtained from solutions containing additions deliberately introduced. Magnesium, cadmium, and manganese double salts cause deformations of copper, nickel and zinc double salts.—L. Goebel: Radioactive disintegration phenomena in the fluorite of Wölsendorf. Haloes are formed and these have been examined with the ultramicroscope. An explanation of the colours of fluor spar is offered in terms of the size of colloid particles of calcium.—R. Steinmaurer: Observations on the variations of the Hessian cosmic ultra-radiation on the Hohen Sonnblick (3100 metres) in July 1929. Registering apparatus was used, both in half-open and in a completely enclosed 7 cm. thick iron-clad electroscope. The measurements were arranged according to sidereal time. There was also a small barometric effect, and other unexplained irregularities.—T. Pintner: Little known and unknown tapeworms.—A. Zinke and R. Wenger: Perylene and its derivatives (29). The decomposition of perylene to benzanthron.—A. Zinke and O. Benndorf: Perylene (30).—A. Pongratz: Perylene (31).—F. Halla and E. Mehl: The space-lattice of natrolite. The unit contains eight molecules of $Na_2Al_2Si_3O_{10}$, $2H_2O$.—A. Brukl: The hetero-poly acids of germanium. Molybdenum and tungsten unite with germanium to form acids.—K. Vanek: Division properties of curves connected in detail.—Communications of the Radium Research Institute.—(No. 258) B. Karlik: The scintillation faculty of calcium tungstate.—(No. 259) M. Blau: Quantitative research on the photographic action of α- and H-particles.—(No. 260) F. Urbach: The breadth of bands and the dependence of emission bands on temperature in alkalihalide phosphorescence.—(No. 261) F. Urbach: The luminescence of alkali halides. Preface and visual observations (1).—(No. 262) F. Urbach: Luminescence of alkali halides (2).—R. Holzapfel: Chief results of radiation measurements on the Stolzalp in the period November, 1928 to October, 1929.—O. Beran: Conductivities and counter voltages in ion-conducting crystals.—M. Beier: Zoological expedition to the Ionian Islands and the Peloponnesus (13). *Hymenoptera parasitica* by C. Ferrière.—L. Waagen: The geological structure of the highlands between Frohnleiten, Übelbach and Deutsch-Feistritz in Styria.

Official Publications Received.

BRITISH.

The Edinburgh and East of Scotland College of Agriculture. Calendar for 1930–1931. Pp. 96. (Edinburgh.)

Annual Report for the Year 1929 of the South African Institute for Medical Research, Johannesburg. Pp. 84+2 plates. (Johannesburg.)

Observations made at the Royal Observatory, Greenwich, in the Year 1928 in Astronomy, Magnetism and Meteorology, under the direction of Sir Frank Dyson. Pp. viii+A106+B4+C141+D62+E46+17. (London: H.M. Stationery Office.) 37*s*. 6*d*. net.

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 43: The Raised Beaches of the East Coast of Ireland. By C. P. Martin. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Eleventh Annual Report of the Ministry of Health, 1929–1930. (Cmd. 3667.) Pp. xiv+277. (London: H.M. Stationery Office.) 4*s*. 6*d*. net.

Interdepartmental Committee on Crabs and Lobsters. Report on Crabs: Being an Interim Report of the Interdepartmental Committee appointed by the Minister of Agriculture and Fisheries and the Secretary of State for Scotland to enquire into the Crab and Lobster Fisheries. Pp. 94. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.

Aeronautical Research Committee. Report for the Year 1929–30. Pp. 82+5 plates. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 2, No. 1, March. Compiled by Agnes Elisabeth Glennie. Pp. iv+108. (London: H.M. Stationery Office.) 2*s*. net.

Tanganyika Territory: Department of Tsetse Research. Co-ordination Report No. 3, 1st September 1929 to 30th September 1930. Pp. 15. (Dar es Salaam: Government Printer.)

Journal of the Marine Biological Association of the United Kingdom. New Series, Vol. 17, No. 1, September. Pp. 275. (Plymouth.) 12*s*. 6*d*. net.

The Year's Photography, 1930–1931. Pp. 20+lii+88 plates. (London: Royal Photographic Society.) 2*s*. 6*d*. net.

Commonwealth of Australia: Bureau of Meteorology, Melbourne. Paper 1, Extract from Bulletin No. 17: Some Periods in Australian Weather. By Dr. Edward Kitson. Pp. 33. (Melbourne: H. J. Green.)

First Annual Report of the Executive Council of the Imperial Agricultural Bureaux. Pp. 15. (London.)

Report for 1929 on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool. Edited by Prof. James Johnstone and Dr. R. J. Daniel. (No. 38.) Pp. 109. (Liverpool.)

Transactions of the Institute of Marine Engineers, Incorporated. Session 1930, Vol. 42, September. Pp. 567-662+xlii. (London.)

FOREIGN.

Meddelanden från Statens Meteorologisk-Hydrografiska Anstalt. Band 5, No. 6: Sveriges Vattenkrafttillgångan, Sammanfattning av resultaten i "Förteckning över Sveriges Vattenfall" för Norrlands älvar och Dalälven, jämte preliminär beräkning av Vattenkraften i hela landet. Av Ragnar Melin. Pp. 27+12 planscher. (Stockholm.) 5.00 kr.

Abisko Naturvetenskapliga Station. Observations météorologiques à Abisko en 1929. Rédigées par Bruno Rolf. Pp. iv+72. (Stockholm.)

Statens Meteorologisk-Hydrografiska Anstalt. Nr. 279: Climate of Sweden. By Axel Wallén. Pp. 65. (Stockholm.) 2.00 kr.

Estados Unidos Mexicanos: Secretaria de Agricultura y Fomento. Estudios de la Oficina Federal para la Defensa Agricola, Num. 3: El Arsenico, y suo derivados, como insecticidas. Por Pablo Hope y Hope y Manuel de la Lama. Pp. 63. (Tacubaya, D.F.: Secretaria de Agricultura y Fomento.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 265: A Method for the Extension of Balmer Series in Laboratory. By Toshio Takamine and Taro Suga. Pp. 117-122+plate 21. (Tōkyō: Iwanami Shoten.) 15 sen.

Science Reports of the Tokyo Bunrika Daigaku, Section A. No. 1: On the Vapour Pressure of Liquid. Part 1: On the Vapour Pressure, Heat of Vaporization and Chemical Constant of Pure Liquid Substance. By Keiichi Watanabe. Pp. 13. (Tokyo: Maruzen Co., Ltd.) 25 sen.

The Science Reports of the Tōhoku Imperial University, Sendai, Japan. Second Series (Geology), Vol. 13, No. 3. Pp. 35-114+plates 11-40. (Tōkyō and Sendai: Maruzen Co., Ltd.)

State of Arkansas: Arkansas Geological Survey. Bulletin 3: Geology of the Arkansas Paleozoic Area, with Especial Reference to Oil and Gas Possibilities. By Carey Croneis. Pp. xx+457+45 plates. (Little Rock, Ark.)

Technical Books of 1929: a Selection. Compiled by Donald Hendry. Twenty-second Issue. Pp. 28. (Brooklyn, N.Y.: Pratt Institute Free Library.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 92: On a Severe Infection of Dogs in Cairo simulating Rabies. Preliminary Note by Prof. Dr. Matteo Carpano. Translated from the Italian by E. Talarewitch. Pp. 19+2 plates. 5 P.T. Bulletin No. 96: Ratoon Cotton in relation to Insect Pests. By Ibrahim Bishara. Pp. ii+68+24 plates. 5 P.T. (Cairo: Government Press.)

CATALOGUE.

Collections and Apparatus required for the Study of Geology. Pp. 24. (London: Thomas Murby and Co.)

Diary of Societies.

FRIDAY, OCTOBER 24.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Lecture Room, Imperial College of Science and Technology), at 2.30.—M. A. H. Tincker: Growth Studies on Oats.—M. Jones: The Yielding Capacity of Oat Varieties under Different Conditions of Soils and Climate.—Dr. P. S. Hudson: The Differentiation of the Wheat Ear.

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

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Newcastle-upon-Tyne), at 6.—J. McGovern: Presidential Address.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (jointly with Institute of Chemistry) (at Liverpool University), at 6.—Dr. P. Lewis-Dale: Chemistry in the Service of the Railway.

SOCIETY OF DYERS AND COLOURISTS (London Section) (at Dyers' Hall, Dowgate Hill), at 6.45.—Dr. E. F. Armstrong: The Future of the Dyestuff Industry—have we Fought in Vain?

INSTITUTION OF LOCOMOTIVE ENGINEERS (Manchester Centre) (at Manchester Literary and Philosophical Society, Manchester), at 7.—H. K. Bamber: The Effect of Road upon Rail Transport and its Influence on Locomotive Design (Presidential Address).

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—J. L. Hodgson and others: Discussion on What are the Desirable Objectives of the Age of Power?

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers' Club, Manchester), at 7.15.—J. Frith and F. Buckingham: Stored Energy.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—A. P. Morris: Bitumen Emulsions, with Particular Reference to their Use on Indian Roads.

LEICESTER TEXTILE SOCIETY (at Victoria Hall, Leicester), at 7.30.—E. Lomas: Pure Silk Manufacture.

ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8.—Dr. Major Greenwood: Public Health Education (Presidential Address).

INSTITUTION OF CHEMICAL ENGINEERS (Graduates' and Students' Section).—J. E. Duckham: Lubrication as applied to Chemical Engineering.

SATURDAY, OCTOBER 25.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Newcastle-upon-Tyne), at 2.30.—A. L. Ford: Machine Mining in Faulted Ground.—Dr. W. Hopkins: A Record of the Upper Carboniferous Non-Marine Lamellibranchs of Northumberland and Durham, and a Record of their Sequence.—Papers open for further discussion: —The Pitman's Yearly Bond, by Prof. H. Louis; The Surveying of Bore-holes, by J. T. Whetton.

BRITISH PSYCHOLOGICAL SOCIETY (at Bedford College for Women), at 3.30.—Miss Madeline Kerr: Unseen Drama and Imagery; Experimental Observations.—Prof. T. H. Pear: Psychological Problems suggested by Radio-Drama.

MONDAY, OCTOBER 27.

CAMBRIDGE PHILOSOPHICAL SOCIETY (Annual General Meeting) (in Cavendish Laboratory), at 4.30.—H. C. Webster: The Capture of Electrons by α-particles.—Dr. N. A. de Bruyne and H. C. Webster: Note on the Use of the Thyratron with a Geiger Counter.—N. Feather: An Unsuccessful Attempt to Influence the Normal Decay of a Weak Source of Polonium.—Dr. F. L. Arnot: Note on the Angular Scattering of Electrons in Gases.—H. S. W. Massey: The Theory of the Scattering of X-rays by Molecular Hydrogen.—*Papers to be communicated by title only:*—Dr. G. Temple: The Matrix Mechanics of the Spinning Electron. —S. Verblunsky: (*a*) A Property of Continuous Arcs II; (*b*) Note on the Sum of an Oscillating Series II.—W. G. Welchman: The Number of Contact Primes of the Canonical Curve of Genus p.—R. Hargreaves: Wave Forms and a Special Problem.—Prof. L. J. Mordell: Note on Some Linear Diophantine Inequalities.—R. E. A. C. Paley and A. Zygmund: On some Series of Functions (2).—R. E. A. C. Paley: On the Strong Summability of Fourier Series.—H. R. Hassé: The Polarisability of the Helium Atom and the Lithium Ion.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Annual Meeting.

INSTITUTE OF ACTUARIES, at 5.—H. M. Trouncer: Presidential Address.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—C. C. Paterson and others: Discussion on The Link between Sales, Manufacture, and Research.

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (jointly with Fuel Section) (at Hotel Metropole, Leeds), at 7.—Dr. W. H. Blackburn and Prof. J. W. Cobb: The Influence of Furnace Atmosphere upon the Scaling of Steel.—Dr. A. Key and Prof. J. W. Cobb: The Determination of the Reactivity of a Coke to Steam and CO_2.

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—C. Schelling: The Odontological Society in the Last Decade of the 19th Century.

BRITISH PSYCHOLOGICAL SOCIETY (Industrial Section) (at National Institute of Industrial Psychology), at 8.15.—Dr. W. J. Pinard: Perseveration as a Means of Testing Leadership.

TUESDAY, OCTOBER 28.

ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5.—Dr. J. A. Ryle, Prof. H. Moore, Dr. Helen Mackay, and others: Discussion on Research in Clinical Medicine.

INSTITUTE OF METALS (Swansea Local Section) (at Thomas's Café, Swansea), at 6.15.—Dr. W. Rosenhain: Impurities in Copper.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at Technical College, Derby), at 6.30.—H. H. Dyer: Some Applications of Electricity to Railway Signalling.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—H. G. Fraser: Chairman's Address.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Sir William Bragg: X-rays and the New Range of Vision (Hurter and Driffield Memorial Lecture).

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at King's Head Hotel, Coventry), at 7.30.—Sir Herbert Austin: The Future Trend of Automobile Design (Presidential Address).

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Midland Hotel, Manchester), at 7.30.—A. L. Lunn: Chairman's Address.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at 39 Elmbank Crescent, Glasgow), at 7.30.—E. Seddon: Chairman's Address.

SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield), at 7.30.—Dr. W. H. Hatfield: Nitride Hardening.

WEDNESDAY, OCTOBER 29.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—M. Waters: Chairman's Address.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-side Branch, Graduate Section) (at Middlesbrough), at 7.30.—T. D. Richards: Chairman's Address.

THURSDAY, OCTOBER 30.

INSTITUTION OF AUTOMOBILE ENGINEERS (Manchester Centre) (at Engineers' Club, Manchester), at 7.—Sir Herbert Austin: The Future Trend of Automobile Design (Presidential Address).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-side Branch) (at Middlesbrough), at 7.30.—Addresses by J. McGovern and J. R. Dippie.

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7.45.—F. H. Whysall: Chairman's Address.

CHEMICAL SOCIETY, at 8.—N. I. Fisher and F. M. Hamer: A General Method for the Preparation of Thiocyanine Dyes. Some Simple Thiocarbocyanines.—Dr. W. H. Mills and I. G. Nixon: Stereochemical Influences on Aromatic Substitution. Substitution Derivatives of 5-hydroxyhydrindene.—Prof. C. S. Gibson and J. D. A. Johnson: Syntheses with $\beta\beta'$ dichlorodiethylether. Part II. Heterocyclic Compounds containing Two Different Atoms of the Oxygen Group in the Ring. 1:4-selenoxan.

FRIDAY, OCTOBER 31.

INSTITUTION OF ELECTRICAL ENGINEERS (West Wales (Swansea) Sub-Centre) (at Corporation Electricity Showrooms, Swansea), at 6.—Sir A. Whitten Brown: Chairman's Address.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—H. T. Young: Is the Engineer of To-day making the Best Use of his Opportunities in Electrical Development in this Country?

INSTITUTION OF CHEMICAL ENGINEERS (at Institution of Civil Engineers), at 6.30.—Prof. W. A. Bone: High-Pressure Reactions (Lecture).

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—E. T. Westbury: The Two-stroke Engine.

GEOLOGISTS' ASSOCIATION (in Great Hall, University College), at 7.30.—Annual Conversazione.

IMPERIAL COLLEGE CHEMICAL SOCIETY (in Main Chemistry Lecture Theatre, Royal College of Science).—Prof. J. F. Thorpe: The Life and Work of W. H. Perkin, Junr.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at Glasgow).—Dr. S. Miall and others: Discussion on the Journal of the Society.

MEDICAL SOCIETY OF LONDON.—Sir Almroth Wright and others: Discussion on The Prophylatic and Therapeutic Values of Vaccines.

PUBLIC LECTURES.

FRIDAY, OCTOBER 24.

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. A. Penck: The Relations of Europe and Central Asia. (Succeeding Lecture on Oct. 27.)

SATURDAY, OCTOBER 25.

UNIVERSITY OF BRISTOL (in Henry Herbert Wills Physical Laboratory), at 11.45 A.M.—Prof. J. Franck: Relations between Spectroscopy and Chemistry (Henry Herbert Wills Memorial Lecture).

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. C. Ainsworth Mitchell: Stories told by Hairs and Fibres.

MONDAY, OCTOBER 27.

UNIVERSITY OF EDINBURGH (in Greek Class Room, Old Quadrangle, University, Edinburgh), at 8.—Capt. C. W. Hume: The Universities and Animal Welfare.

TUESDAY, OCTOBER 28.

KING'S COLLEGE, LONDON, at 11 A.M.—S. P. Turin: The Economic Geography of U.S.S.R.: Means of Communication and Transport.

WEDNESDAY, OCTOBER 29.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Lt.-Col. J. A. A. Pickard: The Prevention of Street Accidents.

UNIVERSITY OF LIVERPOOL (in Arts Theatre), at 8.—Prof. S. Brodetsky: Ancient Jewish Astronomy.

THURSDAY, OCTOBER 30.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—C. P. Blacker: Sterilisation of the Unfit.

UNIVERSITY OF DUBLIN, at 5.—Dr. F. S. Lavery: Trachoma, with Special Reference to its Sociological Aspect (Montgomery Lecture).

BRITISH MEDICAL ASSOCIATION (Hastings Hall, Tavistock Square), at 5.15.—Dr. G. Slot: Rheumatism in Childhood (Chadwick Lecture).

UNIVERSITY COLLEGE, LONDON, at 5.30.—Miss E. Jeffries Davis: Replannings of London, *c.* 1520–1920. (Succeeding Lectures on Nov. 6, 13, 20, and 27.)

SATURDAY, NOVEMBER 1.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—D. Martin Roberts: London in the Stuart Age.

CONGRESS.

NOVEMBER 1 AND 2.

INSTITUTE OF SOCIOLOGY (at Imperial Institute).—Lectures and Discussions on Sociological and Survey Topics.