NATURE

SATURDAY, AUGUST 18, 1934

No. 3381 Vol. 134

CONTENTS

The Aryan Doctrine

HOWEVER much we may feel assured that ultimately truth will prevail, in the practical affairs of life it often befalls that we must watch the dry light of reason pale and flicker in the hot breath of a theory which, illogical and perversive of fact though it may be, appeals to the emotions, the passions and the interests, of the uninstructed, but socially and politically powerful, elements among mankind. The dogma of the Aryan race, which recently has burst like a shell over an astonished world, though formulated on a view of racial affinities fundamentally obsolete and a biased interpretation of archæological fact, with the aid of the mystic symbols of the swastika, the arm raised in salute and a Messianic leader, has swept Germany off her feet by setting up an ideal, which recalls the ancient glories of the Germanic peoples in a period of political and economic depression, and holds out a promise of their revival through a racial regeneration.

It is unfortunate, but true, that an ideal theory which can mould facts to its purpose holds the superior strategic position. The populace is ever impatient of the impartial attitude of a scientific investigation of fact, which must often, by the qualification and limitation of its conclusions owing to imperfect knowledge, provide a check rather than a spur to immediate action. In the discussion of the population problems of the United States, it is the voice of the facile theorist which has been heard, while the scientific investigator of race, who refrains from dogmatism pending fuller inquiry, is still crying in the wilderness. In Germany, any who in their teaching might have been able to criticise the officially accepted view of the racial origins and character of the German people, have been forbidden to lecture on race on the ground that they are unfitted to meddle in an affair of so great practical moment.

Happily such restrictions do not run outside Germany, and although the anthropologist is not concerned with political propaganda as such, when racial theory is invoked in support of social and political action, the basis of argument must be such as will stand the test of scientific examination. The Aryan race doctrine as now held in Germany rests upon concepts, assumptions and theories hitherto generally regarded as untenable or discredited, and until recently accepted only by a few. Mainly they were familiar as the stock-in-trade of popular writers and semi-journalistic publicists

during and after the War. Notwithstanding their popular vogue and certain repercussions in the political world, scientific opinion had not been disposed to regard these concepts with any great degree of concern until their adoption as one of the main driving forces in the Nazi movement attracted a more widely diffused attention.

But contagion spreads; and when a British Cabinet Minister thinks it desirable to affirm his Aryan extraction, then the doyen of anthropologists, the president of the Royal Society, and a leading exponent of the biological study of race, may well combine to protest against the revival of a scientific heresy. The letter from Dr. A. C. Haddon, Sir F. Gowland Hopkins and Prof. J. B. S. Haldane, which appeared in the *Times* of August 7, is an opportune admonition to others, beside Sir John Simon, that men of science outside Germany cannot accept a political faith in the guise of scientific theory without reference to its relation to scientifically assured fact.

It was disastrous for Germany that the first step she elected to take in national regeneration through racial integration should have assumed a form which alienated liberal opinion throughout the whole world, at a time when the racial theory upon which it was based was neither well nor widely known. The crude statement of Nazi argument for discrimination against the Jews on the ground of racial inferiority appeared absurd and almost carried its refutation with it. Apart from the impossibility of analysing the culture of modern Germany in terms of the racial elements of her population—a task from which even the most rash of racial psychologists might well shrink—it was shown time and again that the unquestioned eminence of Germany in the arts and sciences was due in no inconsiderable measure to her nationals of Jewish extraction and descent. It is difficult for an onlooker to appreciate the attitude of mind which can so far run counter to the logic of facts as to impute racial inferiority to the Jew. It has all the appearance of the crudest race prejudice. Germany, however, with a thoroughness that is characteristic, especially in its lack of humour, justifies her action with an appeal to first principles. The Jewish type and Jewish mentality, with its proclivity to socialism and internationalism, it is argued, is incompatible with the German type. But this German type is an ideal type, evolved, like the camel in Heine's story, from the Teutonic inner consciousness and projected into the past, as so often happens with an ideal. It is, in fact, the familiar illusion of the Golden Age; and race prejudice has been transformed into an inevitable measure of purification in the endeavour to recreate a hypothetical ancient German character and culture.

Needless to say, this is not the German view; and confirmation of the conception of a Germanic type, embodying all the virtues of a superman, is found in the evidence of archæology and racial history. Herr Hitler himself affirms in "Mein Kampf" that the Aryans alone among the peoples of the world have been 'founders of culture', and another prominent official of the Reich, Dr. Frank, is reported to have declared that from the substance of the Germanic race have issued the highest achievements of man, so that it might be considered the duty of the entire human race to safeguard this basic element. This may come as a surprise to those who are not familiar with certain lines of argument in the racial question. It is a view which derives from the middle of the last century and the theories of the Comte de Gobineau, in which the Aryans, the white races *par excellence*, were regarded in their mission to mankind at large as only a little lower than the angels.

An official but popularised version of the basis of present-day German political theory will be found in the translation of the circular issued by Dr. Frick, the Minister of the Interior, which appeared in NATURE of February 24, 1934, p. 298. The attention attracted by the misuse of the linguistic term 'Aryan', as significant of race, and the adoption of the swastika as the Aryan symbol, have tended to an unfortunate concentration of criticism on an obvious appeal to sentiment. Notwithstanding the views which have been expressed by Sir Arthur Keith, there seems no good reason to condone the resuscitation of the 'Aryan race' abandoned by Max Müller under criticism. It is, however, in the exclusiveness of its use as the equivalent of 'Nordic' that lurks the sin against the scientific spirit, for with it comes a whole train of assumptions and interpretations which at times fail to pass the bounds of purely imaginative speculation.

Briefly, the German doctrine of the Aryan race is that the tall, long-headed, fair-complexioned Nordic peoples of northern Europe are the modern representatives of the original Aryans. To this race is due the high standard of culture found throughout the civilised world. Not only is this true in antiquity, in the civilisations of Mesopotamia, Egypt, the Mediterranean and so forth, but

even the contribution to culture of Romance countries in modern times is to be attributed to descendants of the Nordic race. They were endowed with certain bodily characters, which represent the highest evolution of the human form; and in addition they possessed, as a racial inheritance, certain outstanding mental qualities. It was in virtue of these physical and mental characters that they became the ruling classes in most ancient and modern societies. Wherever the Nordic strain is mixed with other breeds, it is said, it deteriorates. The aim of the State, therefore, must be to preserve the purity, integrity and dominance of the Aryan race, biologically, socially and politically.

It would be beyond the present purpose to enter into a detailed examination of these interpretations of ethnological, archæological and historical fact, or to weigh the probabilities that the earliest Aryan-speaking peoples were Proto-Nordics, who carried their tongue to the other races of Europe. That the Nordics were a far wandering people who irrupted into many lands is unquestioned; but as nomads their early culture was crude, and the people they conquered must almost invariably have been of a higher culture than themselves. But whatever their cultural status, a strict anthropometric measure applied to the modern population of Germany would find true Nordics in all their racial purity in an embarrassingly small minority.

That Germany has adopted a highly coloured interpretation of history, which in the greater part of its detail would not stand the test of a moment's impartial examination, is a matter of lesser import beside the fact that, by the forcible imposition of certain views on race and racial history, assumption has been taken as proof; and research and its results, unless 'orthodox', have been banned on a number of questions such as racial heredity, racial admixture, the relation of race, mentality and culture, and the like, upon which science would hesitate to pronounce finally in the light of the evidence available. Such dogmatic assumptions, unfortunately, have their attraction for the political doctrinaire and the agitator; and it is perhaps to be regretted, therefore, that the International Congress of Anthropological and Ethnological Sciences did not see its way to promote investigation into such racial problems on broad lines. The machinery may seem overweighty; but at least the truth would have been made available in authoritative form to all.

Finite Differences

The Calculus of Finite Differences. By Prof. L. M. Milne-Thomson. Pp. xxiii+558. (London: Macmillan and Co., Ltd., 1933.) 30*s*. net.

THE last edition of Boole's "Finite Differences" appeared in 1880, and was in fact a reprint of the edition of 1872. The interval of sixty years has seen in the elementary field Sheppard's introduction of central differences, Thiele's strange invention of reciprocal differences, Everett's discovery of the interpolation formula that bears his name, and the recent development of methods of numerical interpolation which dispense with formulæ altogether; Poincaré's attention to the asymptotic behaviour of solutions suggested new and tractable problems regarding insoluble equations; as a branch of analysis the calculus of finite differences has been revolutionised by Nörlund in the course of the last twelve years; Birkhoff, to add one name which is absent from the book under review, has handled the system of linear difference equations by matrix methods which would have won Boole's heart. The publication of an English treatise on finite differences is therefore something of an event to the student of mathematics in Great Britain.

Not that Prof. Milne-Thomson is everywhere on ground that English authors have left untouched since the days of Boole. He follows precedent in dealing in his early chapters not only with the formal algebra of the elementary operators but also with its application to the problems of numerical interpolation, differentiation and integration. These problems come within the domain which Whittaker happily names the calculus of observation, and the only part of Prof. Milne-Thomson's discussion of them which is not in essence familiar is a clear account of the iterative processes of interpolation that have been devised during the last three or four years; these processes could certainly not be ignored in a treatise on numerical analysis, but since their whole point is that what is required in computation is a process and that the existence of a corresponding general formula is irrelevant, it must be admitted that with their development the problem of interpolation extends beyond the bounds of the calculus of finite differences; that Prof. Milne-Thomson should have felt that an account of interpolation which omitted them would be misleading is all the more significant.

Analytically, the calculus of finite differences

must depend ultimately on a complete understanding of the relation that subsists between two functions $u(x)$, $\varphi(x)$, when $\Delta u = \varphi$. If u is given, φ is determinate, but the converse is not true: for a given φ, two solutions in u may differ by an arbitrary function of unit period. It follows that a solution may have specified values at any finite number of points within a unit range, and cannot be rendered determinate by the assignment of any finite assortment of values; this cannot, however, imply that a solution, if it is to be analytic, may have arbitrary values throughout any interval, since a function u specified throughout an interval would be determinate in virtue of being analytic, independently of the postulated relation to the given function φ. The problem of defining a suitable standard solution with which other solutions are to be compared is thus seen to be by no means simple; Ramanujan's note-books contain some characteristic suggestions, and the problem was at length solved by Nörlund in a paper which appeared in *Acta Mathematica* as recently as 1923. It may be mentioned that Nörlund's definition, when $\varphi(x)$ is $1/x$, leads to the logarithmic derivative of the gamma function; at last the gamma function, too often introduced by "Consider the infinite product . . .", is seen to be inevitable.

The study of difference equations or recurrence relations, like that of differential equations, began long ago with the search for soluble examples. But when this chapter came to an end through exhaustion of material, and the interest in differential equations turned on the existence and nature of solutions, the corresponding line of advance for difference equations was not open. Under Weierstrass's influence, the power series was regarded as in some sense the only genuine expression of an analytic function, and the investigation of the character of the solution of a given equation could mean nothing but the study of the solution by means of power series. Since the substitution of a power series for the dependent variable in even the simplest type of difference equation obviously leads nowhere, progress seemed to depend on comparison with equations of which solutions happened to be known: there was no second chapter, but only a continuation of the chapter which ought to have been closed. But, as has long been known, the formal solution of simple types of difference equation is possible in series not of powers but of factorials or inverse factorials. With the recognition in the theory of numbers of what we may call the right of Dirichlet series to independent existence was bound to come a change in the outlook on difference equations; accepting the appropriate series as the fundamental form of expression of the functions of which he is in want, the mathematician inquires directly into the analytical nature of functions expressible in this way. If it cannot be said that Nörlund was the first to adopt the new point of view, the deliberate investigation and the systematic exposition are both his.

It will now be clear that to say that the second half of Prof. Milne-Thomson's book is to a great extent a reproduction of Nörlund's work is no disparagement; on the contrary, a good treatment of the calculus of finite differences at the present moment can be nothing else. The polyglot mathematician will rely on Nörlund's own memoirs and treatises; to the monoglot who cannot or will not study a subject until it is presented to him in English, Prof. Milne-Thomson has done a real service. He writes clearly, and if the invariable use of the subjective after 'if' be a matter of principle with a writer, he must not be blamed for the practice, even if the habit be one by which some readers are irritated.

There are, of course, serious omissions from this treatise, but the book is so large that one must not say what might have been added without suggesting how room might have been found. Prof. Milne-Thomson is not prolix, and condensation of the present material would not have been satisfactory. Perhaps the pity is that he did not break with precedent and separate the two components of the book into independent volumes; the first seven chapters are complete as a textbook on interpolation, and an additional hundred pages would have made all the difference to the range of the analysis.

A grave flaw in the book is the haphazard nature of the references. To reproduce the bibliography which occupies 68 pages at the end of Nörlund's "Differenzenrechnung" would have been absurd. That the only hint of the existence of Nörlund's book is a casual "See also *Differenzenrechnung*, ch. iii" following the one reference to his *Acta* memoir of 1923 is to go to the other extreme. It is not that Prof. Milne-Thomson is grudging in his acknowledgements. But it is impossible to learn from him which are the substantial contributions to the calculus. The index gives an impression which is wholly misleading, for the names to which the largest numbers of entries are attached are the author's own (18),

Nörlund (16), Whittaker and Watson (11), and Knopp (9); the last two sets are concerned with theorems on analysis or on series, not with work on finite differences, and the first set is swollen by eight references to numerical tables from which extracts are made for purposes of illustration.

Prof. Milne-Thomson suggests two additions to the notation of the calculus. He would have a special symbol for operational equivalence, and when he wishes to represent Σ as an inverse operator, he replaces Σ by P^{-1}. Whether it is necessary, in mature work, to distinguish between different uses of the sign of equality, is doubtful; that the author himself does not succeed in maintaining the distinction he proposes is significant, and on any interpretation chains (pp. 33, 125) in which the same expression is equated on one hand by the usual symbol and on the other hand by the operational symbol are palpably absurd. With regard to P, we are not told, either here or in the paper in which the symbol was introduced, how P is different from Δ. E. H. N.

Science and Values

Science and the Spirit of Man: a New Ordering of Experience. By Julius W. Friend and James Feibleman. Pp. 336. (London: George Allen and Unwin, Ltd., 1933.) 12*s.* 6*d.* net.

IT would seem that the number of stately rebukes of scientific arrogance, insufficiency, muddle-headedness and general aridity is increasing, so that the scientific worker must soon perforce clothe himself in sackcloth and ashes and do penance at the new shrines of a fickle public. It is true that in the present work the authors launch their attack less against science itself than at the weird metaphysical speculations with which so much of scientific (?) literature is now encumbered; but in the absence of louder, clearer and oft-repeated disclaimers, science itself must bear some of the responsibility for the darkening clouds of doubt and disaffection with which its domain is now threatened from many quarters.

This work, like many others, is mainly concerned with values many of which are supposed to be belittled or ignored in what is called the modern scientific cosmology. The world has hitherto followed the scientific worker faithfully, if perhaps a little blindly, in demanding "hard, stubborn facts"; though, strangely enough, it has been content to accept only those which relate to a comparatively small and unimportant part of experience, and has entirely overlooked those which are much more vitally important, thus:

"What, for instance, shall be said of love that surmounts and sometimes even denies sex; of sex that defeats procreation? What shall be said of art which fulfils no useful purpose; of laughter that mocks usefulness? How can the heroism that scorns survival be justified? What kind of a case can be made out for the thirst for knowledge for its own sake, the yearning search for meanings beyond the proximate? What shall be thought of the worship that feeds on an ineffable ecstacy; the peace that passes understanding? These are the major and most imperative aspects of experience, yet the scientific cosmology gives them scant notice."

This is perhaps a little overdrawn, and not quite fair to men of science, many of whom are making the most strenuous efforts to gain some insight into the reality and significance of values. It is also probably grossly unfair to hold the scientific cosmology responsible for all the ills of industrialism, or for the insensate worship of bigness in buildings, skyscrapers, super-dirigibles, etc. Many of these things have been evolved under the stress of modern competition, or on the clearer realisation of the fact that better results from every point of view can be obtained from big things than from small. They are not inherently or necessarily bad; nor are they often worshipped; nor were they deliberately foreseen and designed by the man of science.

Apart, however, from possible overstatement here, and a little obscurity there, the book may be said to offer, in this all-important and difficult search for values, some useful clues both on philosophical and scientific grounds; and it is not perhaps too much to say that it goes far in giving us a line of approach to a reasoned faith and theory of life that may clear up some of our doubts and difficulties. There is some trenchant criticism of the present scientific cosmology, which is held to have been constructed on exceedingly dubious and unverified metaphysical principles, deduced from a misinterpretation of what science has discovered. The authors attack it mercilessly, and substitute in its place their own metaphysic based entirely on human values; and they strenuously deny that science itself is built up on demonstrable fact. Indeed they seek to remove the "absurd halo" from science, put human values back into their rightful place, and remove the curse from matter—an ambitious programme valiantly

attempted, and perhaps, so far as the halo is concerned, achieved.

The book is well written, eminently readable for the most part, though difficult in places, concise rather than diffuse, strong and vigorous in movement, even with flashes of eloquence, and a constant appeal to reality and experience which keeps one fairly steadily on the ground, though mentally some exhilarating flights are taken.

W. G. L. C.

The Vertebral Column

The Evolution of the Vertebral Column: a Contribution to the Study of Vertebrate Phylogeny. By Dr. H. F. Gadow. Edited by J. F. Gaskell and H. L. H. H. Green. Pp. xiv+356. (Cambridge: At the University Press, 1933.) 25*s*. net.

IT is now nearly forty years since Dr. Gadow and Miss Abbott published their well-known paper on "The Evolution of the Vertebral Columns" in the *Philosophical Transactions* of 1895–96, the first attempt at tracing a fundamental plan of structure throughout the Vertebrata. In it they maintained that from fish to man the vertebra is built of four primary paired elements surrounding the notochordal axis. Appearing first as cartilages both in ontogeny and in phylogeny, but later often ossified, these elements give rise to the various types of vertebra characteristic of the different groups, some becoming more important, others dwindling or disappearing. A convenient nomenclature was introduced, since very generally adopted: the four elements or arcualia include the basalia and interbasalia; the former are the basidorsal above (giving rise to neural arch), and the basiventral below (giving rise to hæmal arch, rib and chevron); the interbasalia, which alternate with them, are the interdorsal above and interventral below. But, simple and illuminating as this scheme appears to be, it has not met with general acceptance, perhaps because it was to some extent founded on an erroneous interpretation of the development of the arcualia, of their derivation from the sclerotomes out of which they are formed, and of their relation to the muscle segments with which the vertebræ come to alternate in the adult. Much work has been done since then by palæontologists and embryologists on the vertebral column, and there can be little doubt that, on the whole, it has strengthened the main position taken up by Dr. Gadow and Miss Abbott.

The volume under review contains material unfortunately left unfinished owing to the sudden death of the author in 1928. It has been most ably edited by Messrs. Gaskell and Green, with the help of Mrs. Gadow, who have illustrated it by well-chosen figures from various publications and added useful coloured diagrams.

In this book embodying the author's mature conclusions, Dr. Gadow with admirable frankness corrects his former errors, and brings his scheme into harmony with modern embryology. He thus places his theory on a much firmer basis, and greatly simplifies the account of the relation borne by the arcualia to sclerotomes and myomeres.

It is now generally held that the sclerotome of each original segment becomes divided into anterior (cranial) and posterior (caudal) portions, that in the latter arise the basalia (in front of, and related to, the intermuscular or intersegmental septum), and in the former arise the interbasalia; and, further, that since, in Tetrapods at least, the interbasalia tend to become attached to the basalia of the segment in front, each completed vertebra comes to alternate with the muscular segments.

The book is chiefly concerned with the Tetrapoda or four-footed land vertebrates, and, after the introductory general chapters, there is a useful description of the chief processes developed on their vertebræ, their articulations and nomenclature. Next comes a discussion of the atlas, epistropheus and the illusive 'proatlas' sometimes found between skull and vertebral column. With regard to the proatlas, Gadow concludes, we think rightly, that it represents the interdorsal elements of the atlas sclerotome. Here we may remark that it seems undesirable to apply the term epistropheus to the second vertebra of the Amphibia, where we miss the special modification and combination of the first and second vertebræ so characteristic of the Amniota.

The remainder of the book contains definitions of the various types of vertebra found in Tetrapods, and descriptions of the vertebral columns of the different groups. It may be noticed that Gadow adheres to his former statement that the so-called 'notochordal cartilage' occurring in the middle of the vertebra of certain modern Amphibia and Reptilia is formed by the ingrowth through the sheaths of the notochord of cells from the outer mesoblast. This is a matter about which there has been much controversy, but no convincing evidence has so far been brought forward to prove that in

Tetrapods such an invasion of the sheaths takes place.

Readers will perhaps be most interested in Gadow's interpretation of the composition of the vertebra in the Amniota. To trace the fate of the four primary elements from early fossil Stegocephalia to reptile, bird and mammal is a difficult task, more particularly since some of the arcualia are scarcely recognisable in early stages of development in modern forms. Yet it will be generally admitted that, on the whole, Gadow has succeeded in vindicating his position. His general result is that the neural arch is the basidorsal, while the basiventral dwindles or disappears in the trunk to the so-called intercentrum (hypocentrum) or is lost, and that the body of the vertebra is derived from the interventrals. We venture to think, however, that he has attributed too much importance to the interventral and too little to the interdorsal, and that it would be truer to say that the centrum is formed by the interbasals. For example, Piiper in birds, and Dawes in mammals, have recently shown that interdorsals contribute a considerable part.

The important tail region of the column is somewhat neglected in this book, and there is a strange inconsistency on p. 264 dealing with *Sphenodon*, where the chevrons are said to belong genetically to the interventrals. Whether this statement was made deliberately or was due to a slip of the pen it is difficult to say, but it is inconsistent with other statements elsewhere, and with the author's original view (1896). Few conclusions seem more certain than that the chevrons belong to the basiventrals.

Students of comparative anatomy will be grateful for this useful and interesting work by one whose practical knowledge of the details of the anatomy of vertebrates was so great. The exaggerated importance he attributes to Hæckel's recapitulation theory may be easily forgiven in such an important contribution to our knowledge of the vertebral column. The handsome, well-printed and well-illustrated volume will be welcomed as a fitting memorial to an enthusiastic zoologist who devoted his life to the study of the comparative anatomy of the Vertebrata.

E. S. G.

Short Reviews

Oberflächenspannung in der Biologie und Medizin. Von Dr. Ferdinand Herčík. (Wissenschaftliche Forschungsberichte, Naturwissenschaftliche Reihe, herausgegeben von Dr. Raphael Ed. Liesegang, Band 32.) Pp. xii+220. (Dresden und Leipzig: Theodor Steinkopff, 1934.) 14 gold marks.

THIS book will probably be found disappointing by both physical chemists and biologists. It begins with a few brief notes on the nature of surface tension, too sketchy to give any clear idea of the physical nature of this quantity. The section on measuring surface tension shows the author as a devotee of the unreliable 'ring' method, which is starred so prominently that the three principal illustrations in the book are portraits of different forms of torsion balance for operating the method. Although Harkins's careful studies of its errors, and corrections therefor, are mentioned, they do not appear to be taken seriously. The drop volume and bubble pressure methods are the only others described, and there is no real appreciation of either their possibilities or their errors. There is a rather more satisfactory account of the influence of physical factors on the surface tension of pure liquids and solutions; but the fine structure of surface films, and also electrocapillarity, are mentioned but dismissed with an entirely superficial and out-of-date treatment. There is little understanding of the relation between chemical constitution and surface properties. In this field, the author makes little reference to recent work except that of du Noüy and his co-workers.

The rest of the book contains abstracts of work on the surface tension of various body fluids in physiological and pathological conditions—as the changes noted often amount to only one or two dynes per centimetre, many of them may be accidental errors of measurement; and references to views held or suggested, with more or less foundation, by numerous workers as to the importance of surface tension in cell division, growth, muscular and amœboid movement, narcosis and action of vitamins. This may be useful as a rough introduction to the biological literature; but the book is far from being *au fait* with modern surface chemistry, and still farther from being a trustworthy guide to the application of this science to biology.

N. K. A.

Mineral Deposits. By Prof. Henry Louis. Pp. viii+384+3 plates. (London: Ernest Benn, Ltd., 1934.) 30*s.* net.

IN the preface of this book, the author states that miners are but little concerned with the genesis of mineral deposits, and that as the book is intended for use by miners, he has dealt in only the most perfunctory fashion with the mode of formation of mineral deposits. In chaps. ii to x, however, which make up the greater part of the book, deposits are classified according to their mode of origin, a procedure which requires tha

the reader should have some knowledge of the formation of rocks.

The two main divisions adopted in the above-mentioned chapters are Symphytic (bedded) deposits and Epactic (non-stratified) deposits. The symphytic deposits are grouped as clastic, chemical, organic and stratified. The epactic deposits are grouped as veins, masses (stockworks and igneous disseminations), magmatic masses and masses connected with soluble rocks.

The author makes the claim for this classification that "the names are genetic, but the underlying characteristics are morphological or tectonic . . . that it corresponds reasonably well with the observed facts, that it answers the practical needs of the miner, that it enables a useful view to be obtained of a very involved subject, and that it is not illogical".

An introductory chapter deals with general matters; chap. xi deals with the alterations of mineral deposits; chaps. xii–xv give an economic classification under headings of fuels, ores, salts and gems; and there are two good indexes, one general, the other geographical.

The book contains much useful information on the subject of mineral deposits; but it may be suggested that future editions should make mention of the diamond deposits in West and Central Africa, Peruvian and other vanadium ore deposits, Belgian Congo and other radium mineral deposits and Chinese tungsten ore.

A Comprehensive Treatise on Inorganic and Theoretical Chemistry. By Dr. J. W. Mellor. Vol. 13: *Fe* (Part 2). Pp. ix+948. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1934.) 63*s*. net.

VOL. 13 of Mellor's "Comprehensive Treatise" is devoted exclusively to the element iron, which has already formed the subject of a large part of the preceding volume. The present volume deals first with the mechanical, thermal, optical, electrical and magnetic properties of the metal and of its alloys with carbon. Ample attention is given to slip bands, Smekal cracks, transition temperatures, absorption, emission and X-ray spectra. The chemical properties of iron, the corrosion of iron and steel, and the passivity of iron, form the subjects of the next three sections. A full report is given of modern work on this group of subjects, which has given rise to much controversy in recent years; and the clarifying experiments and theories of U. R. Evans on corrosion and passivity are adequately described.

The section on the valency and atomic weight of iron only covers three pages, with two pages of references. Two structural formulæ, showing the polymerisation of ferrous and ferric chloride to double molecules by means of double bonds between pairs of chlorine atoms, are efforts of pure imagination on the part of the authors from whose works they are cited, and are of no value at all at the present day; and the view that in iron tetracarbonyl and pentacarbonyl "the iron is bivalent, and that the bivalent carbonyl radicals are arranged in closed chains" is equally obsolete and unjustified by experiment.

The longest section in the volume deals with the alloys and intermetallic compounds of iron. The text is in very condensed form, but the references alone cover 33 closely-printed pages. The remaining sections deal with the oxygen compounds of iron—oxides, hydroxides, ferrites, ferrates, etc.

The Electrical Properties of Glass. By J. T. Littleton and G. W. Morey. (National Research Council Committee on Electrical Insulation, Monograph No. 3.) Pp. x+184. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.) 18*s*. 6*d*. net.

THIS monograph is issued under the auspices of the American National Committee on Electrical Insulation and discusses the electrical insulation of glass; the insulation of liquids and gases has been discussed in two other monographs. Very little definite knowledge has been previously published showing the connexion between the electrical properties of glass and its composition. The present volume gives a wide survey of the theoretical progress that has been made and critically reviews the available information. It will prove useful to students of the insulating properties of solid dielectrics, as glass is a very convenient material on which to experiment. It is widely used as an engineering material, and so a knowledge of its limitations will be helpful to engineers. Unfortunately, the results obtained by experimenters do not always agree. Defining the electric strength of glass as the maximum voltage gradient required to puncture the material, it would appear to be a variable depending on the thickness of the test specimen. This point needs further experimental investigation.

I Grandi Problemi della Biologia Generale. Per Camillo Acqua. (Biblioteca di Scienze e Filosofia, N. 6.) Pp. viii+253. (Roma: G. Bardi, 1933.) 18 lire.

THIS book consists of a series of essays on the fundamental problems of biology. The essays, however, form a connected discussion of these problems, in which the basic facts are given and modern ideas and theories are reviewed. The treatment is clear and interesting. There are neither figures nor index, but the general subjects of the various chapters are subdivided, so that the list of contents gives a good idea of the matter treated. The principal problems discussed are the origin of life, the differentiation of the plant and animal kingdoms, sex, parthenogenesis, death, Lamarckism, Darwinism, heredity, Mendelism, the gene, mutations and the evolution of species. The author makes a point of carefully separating the known facts from theories and hypotheses, and the result is an illuminating and suggestive volume.

A 'Nuclear Photo-effect': Disintegration of the Diplon by γ-Rays

By DR. J. CHADWICK, F.R.S., and M. GOLDHABER

BY analogy with the excitation and ionisation of atoms by light, one might expect that any complex nucleus should be excited or 'ionised', that is, disintegrated, by γ-rays of suitable energy. Disintegration would be much easier to detect than excitation. The necessary condition to make disintegration possible is that the energy of the γ-ray must be greater than the binding energy of the emitted particle. The γ-rays of thorium C″ of $h\nu = 2{\cdot}62 \times 10^6$ electron volts are the most energetic which are available in sufficient intensity, and therefore one might expect to produce disintegration with emission of a heavy particle, such as a neutron, proton, etc., only of those nuclei which have a small or negative mass defect; for example, D^2, Be^9, and the radioactive nuclei which emit α-particles. The emission of a positive or negative electron from a nucleus under the influence of γ-rays would be difficult to detect unless the resulting nucleus were radioactive.

Heavy hydrogen was chosen as the element first to be examined, because the diplon has a small mass defect and also because it is the simplest of all nuclear systems and its properties are as important in nuclear theory as the hydrogen atom is in atomic theory. The disintegration to be expected is

$$_1D^2 + h\nu \rightarrow {}_1H^1 + {}_0n^1 \quad \ldots\ldots\ldots \quad (1).$$

Since the momentum of the quantum is small and the masses of the proton and neutron are nearly the same, the available energy, $h\nu - W$, where W is the binding energy of the particles, will be divided nearly equally between the proton and the neutron.

The experiments were as follows. An ionisation chamber was filled with heavy hydrogen of about 95 per cent purity, kindly lent by Dr. Oliphant. The chamber was connected to a linear amplifier and oscillograph in the usual way. When the heavy hydrogen was exposed to the γ-radiation from a source of radiothorium, a number of 'kicks' was recorded by the oscillograph. Tests showed that these kicks must be attributed to protons resulting from the splitting of the diplon. When a radium source of equal γ-ray intensity was employed, very few kicks were observed. From this fact we deduce that the disintegration cannot be produced to any marked degree by γ-rays of energy less than $1{\cdot}8 \times 10^6$ electron volts, for there is a strong line of this energy in the radium C spectrum.

If the nuclear process assumed in (1) is correct, a very reliable estimate of the mass of the neutron can be obtained, for the masses of the atoms of hydrogen and heavy hydrogen are known accurately. They are 1·0078 and 2·0136[1] respectively. Since the diplon is stable and can be disintegrated by a γ-ray of energy $2{\cdot}62 \times 10^6$ electron volts (the strong γ-ray of thorium C″), the mass of the neutron must lie between 1·0058 and 1·0086; if the γ-ray of radium C of $1{\cdot}8 \times 10^6$ electron volts is ineffective, the mass of the neutron must be greater than 1·0077. If the energy of the protons liberated in the disintegration (1) were measured, the mass of the neutron could be fixed very closely. A rough estimate of the energy of the protons was deduced from measurements of the size of the oscillograph kicks in the above experiments. The value obtained was about 250,000 volts. This leads to a binding energy for the diplon of $2{\cdot}1 \times 10^6$ electron volts, and gives a value of 1·0081 for the neutron mass. This estimate of the proton energy is, however, very rough, and for the present we may take for the mass of the neutron the value 1·0080, with extreme errors of ± 0·0005.

Previous estimates of the mass of the neutron have been made from considerations of the energy changes in certain nuclear reactions, and values of 1·007 and 1·010 have been derived in this way[2,3]. These estimates, however, depend not only on assumptions concerning the nuclear processes, but also on certain mass-spectrograph measurements, some of which may be in error by about 0·001 mass units. It is of great importance to fix accurately the mass of the neutron and it is hoped to accomplish this by the new method given here.

Experiments are in preparation to observe the disintegration of the diplon in the expansion chamber. These experiments should confirm the nuclear process which has been assumed, and therewith the assumption that the diplon consists of a proton and a neutron. Both the energy of the protons and their angular distribution should also be obtained.

If, as our experiments suggest, the mass defect of the diplon is about 2×10^6 electron volts, it is at once evident why the diplon cannot be disintegrated by the impact of polonium α-particles[4]. When an α-particle collides with a nucleus of mass number M, only a fraction $M/(M+4)$ of the kinetic energy of the α-particle is available for disintegration, if momentum is to be conserved. In the case of the diplon, therefore, only one third of the kinetic energy of the α-particle is available, and this, for the polonium α-particle, is rather less than $1{\cdot}8 \times 10^6$ electron volts. The more energetic particles of radium C′ should just be able to produce disintegration, and Dunning[5] has in fact observed a small effect when heavy water was enclosed in a radon tube.

Our experiments give a value of about 10^{-28} sq. cm. for the cross-section for disintegration of a diplon by a γ-ray of $2{\cdot}62 \times 10^6$ electron volts. In a paper to be published shortly, H. Bethe and R. Peierls have calculated this cross-section,

assuming the interaction forces between a proton and a neutron which are given by the considerations developed by Heisenberg, Majorana and Wigner. They have obtained the transition probability in the usual quantum-mechanical way, and their result gives a value for the cross-section of the same order as the experimental value, but rather greater, if we take the mass of the neutron as 1·0080. If, however, we take the experimental value for the cross-section, the calculations lead to a neutron mass of 1·0085, which seems rather high. Thus the agreement of theory with experiment may be called satisfactory but not complete.

One further point may be mentioned. Some experiments of Lea[6] have shown that paraffin wax bombarded by neutrons emits a hard γ-radiation greater in intensity and in quantum energy than when carbon alone is bombarded. The explanation suggested was that, in the collisions of neutrons and protons, the particles sometimes combine to form a diplon, with the emission of a γ-ray. This process is the reverse of the one considered here. Now if we assume detailed balancing of all processes occurring in a thermodynamical equilibrium between diplons, protons, neutrons and radiation, we can calculate, without any special assumption about interaction forces, the relative probabilities of the reaction (1) and the reverse process. Using our experimental value for the cross-section for reaction (1), we can calculate the cross-section for the capture of neutrons by protons for the case when the neutrons have a kinetic energy $2(h\nu - W) = 1{\cdot}0 \times 10^6$ electron volts in a co-ordinate system in which the proton is at rest before the collision. In this special case the cross-section σ_c for capture (into the ground state of the diplon—we neglect possible higher states) is much smaller than the cross-section σ_p for the 'photo-effect'. It is unlikely that σ_c will be very much greater for the faster neutrons concerned in Lea's experiments. It therefore seems very difficult to explain the observations of Lea as due to the capture of neutrons by protons, for this effect should be extremely small. A satisfactory explanation is not easy to find and further experiments seem desirable.

[1] K. T. Bainbridge, *Phys. Rev.*, **44**, 57; 1933.
[2] J. Chadwick, *Proc. Roy. Soc.*, A, **142**, 1; 1933.
[3] I. Curie and F. Joliot, NATURE, **133**, 721, May 12, 1934.
[4] Rutherford and A. E. Kempton, *Proc. Roy. Soc.*, A, **143**, 724; 1934.
[5] *Phys. Rev.*, **45**, 586; 1934.
[6] NATURE, **133**, 24, Jan. 6, 1934.

Ancient Indian Iron

By S. C. BRITTON, Salters Fellow, University Metallurgical Laboratories, Cambridge

IT appears certain that iron was known in India at a very early date. Mention of its production in ancient writings puts the earliest time of production earlier than 1,000 B.C. According to Herodotus[1], the Indian contingent of the army of Xerxes were using iron for military purposes about 500 B.C. The description of iron surgical instruments in an ancient medical work, the excavation of iron weapons from burial sites and the presence to this day of masses of iron like the pillars of Delhi and Dhar all indicate that the production of iron steadily increased as the centuries passed.

The methods of production and qualities of Indian iron and steel seem to have early excited the curiosity of the British conquerors and in 1795, Dr. George Pearson[2] published a paper on a kind of steel named 'wootz', then being manufactured in Bombay. The methods of analysis and examination then available only allowed the vague conclusions that the metal was very hard, had about 0·03 per cent carbon, and was believed to have been produced by direct reduction of the ore. Dr. Buchanan's "Travels in the South of India", published in 1807, describes the native Indian processes for iron and steel production then employed, which were believed to be those handed down from previous ages. Numerous other investigations have been made since that time, which increase in thoroughness as methods of examination have improved.

THE DELHI PILLAR

The Delhi pillar has constantly aroused interest. Sir Alexander Cunningham, in the "Archæological Survey of India", published during the years 1862–65, reported the pillar as a solid shaft of wrought iron, upwards of sixteen inches in diameter and twenty-two feet in length; he mentions the curious yellow colour of the upper part of the shaft, which at one time caused the belief that the pillar was of bronze. This appearance has been commented upon by many observers since that time. Inscriptions made on the pillar are said still to be perfectly clear and sharp, and these have allowed the approximate date of its erection to be fixed as A.D. 310.

There seems little doubt that the pillar was built up by welding together discs of iron; it is said that the marks of welding can still plainly be seen[3]. Sir Robert Hadfield examined a small specimen of the pillar in 1911 and afterwards was able to make a fairly detailed investigation of a larger piece[4]. The analysis showed the composition C, 0·08; Si, 0·046; Mn, 0; P, 0·114; N, 0·032; Fe, 99·72; Cu and other elements, 0·034. Hadfield described the iron as an excellent type of wrought iron entirely free from inclusions, being better from the point of view of homogeneity and purity than the best modern Swedish charcoal irons. The structure was found to consist of large grains of ferrite with a very small portion of cementite, sometimes located in the grain boundaries and

occasionally in the ground mass. A smaller grain structure, independent of the large one, was faintly visible, and there were also a large number of small lines in a regular formation which appeared to be related to the small grain structure; this was mentioned as possibly due to an aging effect. A specimen of the pillar rusted in a single night when water was placed on it in Hadfield's laboratory, but the fractured surface suffered no change in four days when merely exposed to the laboratory atmosphere[5]. Hadfield mentions that the part of the pillar below the ground had suffered from corrosion.

The Dhar Pillar

The great iron pillar found at Dhar is described in detail by Cousins[6]. The pillar is in three portions, having apparently been fractured during religious disturbances in the fourteenth and fifteenth centuries A.D. There are no original inscriptions on the pillar itself, or sufficiently definite references elsewhere, to give a basis for any but the vaguest conjecture about the date of manufacture. Its form suggests that it belongs to the Gupta period (A.D. 320–480), and the general belief is that it is approximately contemporaneous with the Delhi pillar.

The original Dhar pillar appears to have been approximately 50 feet long with an average section of 104 square inches and a weight of about 7 tons, and, like the Delhi pillar, it seems to have been constructed by welding together discs of wrought iron. There are a number of holes in the pillar of about $1\frac{1}{4}$ in. diameter and varying from $1\frac{3}{4}$ in. to 3 in. in depth, which Cousins[6] suggests were intended to hold tommy-bars for turning the mass whilst it was being forged; the finding of the broken end of a bar jammed into one of the holes lends some support to this idea. Sir Robert Hadfield has examined a specimen of the pillar[7], and found it to be wrought iron having C, 0·02; P, 0·28; Fe, 99·6. The Brinell ball hardness varied considerably and irregularly over the material, the limits being 240 and 121; the fracture was bright and crystalline, showing laminations. Further analyses and micrographical investigation by C. J. Smithells and by Prof. Cobb have shown no new features in the iron; it is found to rust fairly quickly in a laboratory atmosphere[8].

Ancient Sinhalese Iron

The first thorough investigation of ancient Indian steel was made by Sir Robert Hadfield in 1911–12[9]. He was able to examine a number of ancient implements which had been excavated from the buried cities of Ceylon. Many such implements have been unearthed; they are very heavily rusted and apparently continue to rust in the atmosphere of the Museum of Colombo, unless very carefully protected. Nevertheless, the presence of a considerable quantity of yet unchanged iron shows a marked resistance to corrosion. An ancient Sinhalese chisel, dating back to the fifth century, was found to have the percentage composition, iron, 99·3; phosphorus, 0·28; sulphur, 0·003; silicon, 0·12; no manganese and only traces of carbon with about 0·3 per cent of slag and oxide inclusions. Examination of micro-sections led Hadfield to believe that the chisel had been carburised, had originally been quenched, but had become partially tempered during the long lapse of time. A nail and an ancient billhook of similar age and origin showed a similar analysis. All the specimens contained a large amount of slag in lumpy irregular form. The low sulphur content was held to indicate that the metal was originally produced by charcoal reduction of the ore. The microscopical examination suggested that the specimens were rather similar to modern puddled iron, and this was further borne out to some extent by mechanical tests.

The Iron Beams at Konarak

A number of large iron beams which were apparently used in the construction of the collapsed Black Pagoda at Konarak are still lying amid the ruins of the temple in varying states of preservation. The date most generally accepted for the building of the temple is about 1240 A.D., and it is presumed that the beams were made at that time. Their appearance is fully described by Graves[10].

There are some twenty-nine massive bars, most of them broken in the collapse of the building; the largest two are approximately 35 feet long by about 8 inches square and $25\frac{1}{2}$ feet long by 11 inches square respectively. They show very definite evidence of having been fabricated by welding up small blooms, commonly 2 inches by 1 inch in section and 6 inches long. Many of the broken ends show the existence of irregular and sometimes uniform cavities from which small pieces of cinder can be raked. Some of the beams are very heavily rusted, but many of them are scarcely affected and have a very thin and closely adherent coating. A specimen taken from one of the beams has been examined by Friend and Thornycroft[11]. The presence of many cracks, containing slag inclusions, rendered micrographical investigation difficult. The cracks were found to be bordered by bands of ferrite, the grain boundaries being faintly discernible. Portions of the specimen more distant from the cracks showed a fairly uniform structure, typical of a mild steel containing rather less than 0·15 per cent carbon. The metal was found to be very soft, having a Brinell hardness number of 72. Analysis of a piece chosen as free from slag showed C, 0·110; Si, 0·100; S, 0·024; P, 0·015; Mn, a trace.

An attempt was made to compare the resistance to corrosion of the metal with that of a modern mild steel of unspecified composition. One weighed specimen of each was exposed to alternate wetting by tap-water and drying for one year; reweighing

after removal of rust showed that the ancient iron had suffered a loss amounting to 89 per cent of that of the modern steel. The specimens were then exposed to the action of an artificial sea-water for a year and again the ancient iron lost less weight than the modern steel, losses being in the ratio 75 : 100. However, tests of this kind, made on single specimens, and including only one modern steel, really show very little about the corrosion resistance of the ancient metal.

Miscellaneous Specimens

The so-called Pillar of Heliodorus at Besnagar, which is itself of stone, is supported at its base by iron wedges which are still in a partial state of preservation. It is believed that the pillar was erected about 125 B.C. and that the iron supports were used from the outset. However, there is a possibility that the metal was not native India iron, but was imported from Greece. Hadfield has examined a sample of it and describes it[12] as the only ancient ferrous specimen which can be called steel ; he actually demonstrated that it could be hardened by quenching. The structure was pearlitic, having elongated and irregularly disposed crystals of sorbitic pearlite upon a ferrite ground mass ; after quenching from 850° C. in water, a specimen became martensitic. There were seams of slag in some portions. Analysis showed C, 0·70 ; Si, 0·04 ; S, 0·008 ; P, 0·020 ; Mn, 0·02 ; Cr, a trace ; Fe, 99. The Brinell hardness number was 146.

W. Rosenhain[13] mentions ancient iron chains which assisted pilgrims to climb Adam's Peak, Ceylon. These have been worn round and smooth, but are apparently uncorroded. Rosenhain suggested that the links have corroded down to a cinder layer so that the outside remaining is apparently only a cinder surface protecting the iron below ; specimens cut and brought to London rusted as quickly as any other iron. Graves[14] gives a list of 239 pieces of iron ranging up to 17 feet long and up to 6 inches by 4 inches section used in the construction of the Garden Temple at Puri, which was built not later than the first half of the twelfth century. However, no further information on these is available.

Iron swords and daggers of uncertain date have been unearthed from burial sites in the district of Tinnevelly and specimens of third century iron have been recovered from Buddha Gaya[15] but no examination appears to have been made.

It seems possible that many specimens of iron exist in India of which the date of manufacture cannot be established, but which may well be ancient, and there are no doubt others of ascertainable date yet to be excavated from the earth.

[1] Book VII, chapter 65.
[2] *Phil. Trans.*, **112**, 253.
[3] Turner, *J. Iron and Steel Inst.*, **85**, 184 ; 1912.
[4] *J.I.S.I.*, **122**, 240 ; 1925.
[5] *J. Soc. Chem. Ind.*, **44**, 1029 ; 1925.
[6] "Annual Report of the Archæological Survey of India, 1902–3", p. 205.
[7] Discussion of a paper by T. A. Rickards, *J.I.S.I.*, No. II, 345 ; 1929.
[8] Prof. A. Smithells, private communication, April 1934.
[9] *J.I.S.I.*, No. 1, 312 ; 1912.
[10] *J.I.S.I.*, **85**, 187 ; 1912.
[11] *J.I.S.I.*, No. II, 313 ; 1924.
[12] *Trans. Far. Soc.*, (10), 210 ; 1914.
[13] *Trans. Far. Soc.*, **11**, 236 ; 1916.
[14] *J.I.S.I.*, No. 1, 199 ; 1912.
[15] Friend, "Iron in Antiquity", p. 142.

(*To be continued.*)

Samuel Pierpont Langley (1834–1906)

ON August 22, the centenary of the birth of Samuel Pierpont Langley will be commemorated at the Smithsonian Institution, Washington. Langley was secretary of the Institution from 1887 until 1906 ; it was there he made his valuable investigations in aeronautics and to him was due the inauguration of both the Astrophysical Observatory and the National Zoological Park, which, like the United States National Museum and the Bureau of American Ethnology, are integral parts of the Institution. Much of his experimental apparatus is preserved in the Museum, and it has accordingly been arranged for a special exhibit devoted to his activities and honours to be unveiled on the hundredth anniversary of his birth. The exhibit is being arranged by Mr. T. T. Belote, curator of the Division of American History, and it will ultimately be one of four recalling his own work and that of his two predecessors, Joseph Henry, who was secretary from 1846 until 1878, and Spencer Fullerton Baird, who held the office from 1878 until 1887, and of his successor, Charles Doolittle Walcott, who was secretary from 1907 until 1927. It is also intended to direct attention to Langley's work in the Press, and to publish a special memoir of him containing some extracts from his writings.

Langley was born at Roxbury, Massachusetts, on August 22, 1834, and died at the age of seventy-one years on February 27, 1906, at Aiken, South Carolina. The son of a wholesale merchant of Boston, he came of a family connected with many of the most eminent men in the history of Massachusetts, and grew up in an atmosphere which stimulated his original and inquiring mind. Even as a mere child, he had the use of a telescope, and he once declared that he could not remember when he was not interested in astronomy. Like all the family, he was an omnivorous reader and when, as a youth of seventeen years, he left the Boston High School, he had laid the foundation of his knowledge of English, French and German classics. On leaving school he took up civil engineering and architecture, and at the age of twenty-three years went westward, spending seven years in Chicago and St. Louis. Of this

phase in Langley's career, his biographers say very little.

The turning point in Langley's career came when he was thirty-one years of age. Following a tour in Europe, during which he visited many scientific institutions and observatories, he abandoned practical engineering for astronomy, and although without any academic standing, in 1865 he became an assistant in Harvard Observatory. In the following year he joined the Naval Academy at Annapolis as an assistant professor of mathematics and in 1867 was appointed director of the Allegheny Observatory and professor of physics in the Western University of Pennsylvania, Pittsburgh, where he remained twenty years. To this period belongs his important researches on the sun which brought him fame both at home and abroad. He took part in total solar eclipse expeditions to Kentucky in 1869, to Spain in 1870, and to Pike's Peak in 1878, and a year or two later invented the bolometer, an electrical resistance thermometer of extreme delicacy. With this he was able to explore the infra-red portion of the sun's spectrum, and after experiments at Allegheny, with his assistant James Edward Keeler (1857–1900), afterwards director of Lick Observatory, made an expedition to Mount Whitney, California, where at a height of 14,887 ft. "in the driest and purest air, perhaps in the world . . . the known extent of the solar spectrum was thus at once more than doubled". While at Allegheny he also had a large share in inducing the railway companies to adopt the system of standard time now in use, and likewise became known as a lecturer and writer able to present difficult and abstruse subjects in language at once lucid and entertaining.

Many honours came to Langley through his study of solar radiation, and by the age of fifty years he had gained an international reputation. His connexion with the Smithsonian Institution began in January 1887, when he was appointed assistant secretary and placed in charge of the library and international exchanges. In that year he also served as president of the American Association for the Advancement of Science, and in November, on the death of Baird, was made secretary of the Smithsonian Institution. Though somewhat hampered by want of funds, with money from private sources he was able to establish the Astrophysical Observatory, and after three years of effort on his part, in 1890 Congress made an appropriation of 200,000 dollars for the purchase of 167 acres of land near Washington for a National Zoological Park.

The outstanding feature of Langley's life's work at Washington, however, was his devotion to the infant science of aeronautics, which then had many more sceptics than students. Like the experiments of his contemporaries—Lilienthal in Germany, Hargrave in Australia, Ader in France, and Maxim in England—Langley's investigations were made in comparative isolation and at the time attracted but little attention. Speaking in 1922, long after the aeroplane had become a commonplace, Prof. L. Bairstow referred to Langley's work as "a first rate example of systematic inquiry. . . . Progress was made step by step in the face of formidable difficulties, and no attempts were made to solve the problems of mechanical flight by bursts of brilliance or invention".

Langley's successful experiments with model aeroplanes are now well known, but there is another important aspect of his work. This is referred to in the sketch of Langley given in the "Dictionary of American Biography" now being published under the auspices of the American Council of Learned Societies. "The greatness of his contribution to aviation," the writer says, "depends not only on his pioneering laboratory investigations and successful long-distance flights of large power-driven models, but on the very fact that a man of his reputation should have adventured it in a field at that time so much ridiculed." The development of aviation was largely determined by his efforts, and the Wright brothers wrote that "the knowledge that the head of the most prominent scientific institution of America believed in the possibility of human flight was one of the influences which led us to undertake the preliminary investigations that preceded our active work".

The first fruits of Langley's laboratory investigations were given in his "Experiments in Aerodynamics" published in 1891 and "The Internal Work of the Wind" of 1893. Having discovered some of the fundamental principles underlying the design of heavier-than-air flying machines, he proceeded to construct power-driven models. After using twisted rubber and wound-up springs for driving the propellers, he constructed petrol-heated flash-boiler steam engines weighing about 5 lb. per horse-power. His models he called "aerodromes", and on May 6, 1896, at Quantico on the Potomac, Aerodrome No. 5 flew some 3,000 ft. Six months later, on November 28, No. 6 flew 4,200 ft. These were the first sustained free flights of power-driven heavier-than-air machines ever made. Writing of what he had accomplished, Langley said a year or two later: "I have brought to a close the portion of the work which seemed especially mine—the demonstration of the practicability of mechanical flight—and for the next stage, which is the commercial and practical development of the idea, it is probable that the world may look to others. The world, indeed, would be supine if it does not realise that a new possibility has come to it, and that the great universal highway overhead is now soon to be opened."

It does not appear from Langley's writings that he anticipated constructing a full-size aeroplane, but he was one of those who find themselves "in the river of the thoughts and events, forced onward by the ideas and necessities of his contemporaries". Through the suggestion of some American naval and military officers, the War

Department Board of Ordnance in 1898, during the presidency of Mr. McKinley, secured an appropriation of 50,000 dollars for the building of a man-carrying machine, and Langley at the age of sixty-four years found himself committed to a task which might well have daunted far younger men. As before, the power unit proved one of the greatest difficulties, but this problem was solved by the brilliant young inventor Charles Matthew Manly (1876–1927), who had been recommended to Langley by Prof. Thurston. After several attempts, Manly produced the five-cylinder radial petrol engine, now preserved at Washington, which was used in the abortive trials of 1903. The engine with its accessories weighed 187·47 lb. and developed 52·4 h.p. at 950 r.p.m. Manly was also the pilot on the trials of October 7 and December 8, 1903, and on both occasions narrowly escaped drowning.

The failure of those trials was undoubtedly a great disappointment to Langley, but in the opinion of many well qualified to judge, only a little more good fortune would have secured for the Langley machine the record established a few days later at Kitty Hawk by the machine of Wilbur and Orville Wright. Of the trials of Langley's machine made in 1914 over Lake Keuka, at Hammondsport, New York, by Glenn Curtiss, some observations were made in NATURE of November 3, 1921, January 26, and March 9, 1922, and it is unnecessary to repeat them here. Langley had passed away many years before those trials, leaving behind him a remarkable record of sustained effort and steady achievement, and of undiminished faith in the future of aviation. His record is indelibly inscribed in both the history of the study of the heavens and the story of the conquest of the air.

The Loch Ness "Monster"

SINCE our earlier notes upon this subject were written (NATURE, Jan. 13, 1934, p. 56), the attention of thousands of people has been concentrated upon seeing and adding to the descriptions of this world-famous animal. The situation is without parallel in the records of the observation of Nature, and it is of some interest to analyse the results.

Clearly the recent records are not all of equal value. On July 4, a worker at Glendoe sawmill (as reported in the *Scotsman*, July 7) observed the creature emerge from the loch: as it emerged propelled by flippers, five humps were seen, twelve distinct humps as it wormed its way ashore, head smaller and thicker than a horse's, neck heavily maned, body fully 30 feet long, but not very thick. It was seen to feed upon weeds and water plants growing on the shore (a previous observer had seen it or another carrying a lamb in its mouth) and as the monastery clock struck 10 a.m., it wriggled back into the loch, having been under observation for an hour. A drawing representing this apparition accompanied the newspaper account.

In a different category must be placed the photograph, by Dr. R. K. Wilson, reproduced in the *Daily Mail* of April 21, of a long neck with small head projecting from the loch at a distance of 150–200 yards from the camera. The difficulty in this case is to convince oneself that the object photographed is a head and neck, and is moving—the indications on the water surface suggest rather a stationary object.

Undoubtedly the most thorough series of observations is that due to the organisation of Sir Edward Mountain, who for four weeks, just concluded, has had twenty watchers posted at points of advantage on the shores of Loch Ness. They report having seen the creature twenty-one times and have made five photographs. Three of the photographs, presumably the better ones, have been reproduced in different newspapers. Of these, one shows the wash of an object, probably bulky and moving at considerable speed, but of the object itself nothing. A second shows a very low dark 'hump' or perhaps two, but in the reproduction, lines, less marked, seem to be continued in both directions from the dark object, and a moving object does not make a wash in opposite directions. Even if this represents something animate, the something is indeterminate. The third reproduction (in the *Scotsman*) is more definite, showing something short and fairly massive, low in the water, succeeded by two or three less distinct 'humps'. It is impossible to say what it is, but it suggests to the writer the appearance of the head of a large seal, and the 'humps' water ripples caused by shoulders and hind quarters. Of the twenty-one reports, all that the published accounts (*Times* and *Scotsman*, August 9) say is that "in the main . . . the watchers agree that when on the surface the monster displays a very small head relative to the size of the body, and moves along the water in such a way as to show either two or three humps".

We write with the disadvantage of not having examined the negatives or the actual reports of Sir Edward Mountain's watchers (who presumably are untrained in the observation of animal ways), but keeping in mind that any creature of marine habit transported to fresh water, will lie low in the water and so lose some of its usual appearance, we do not yet find it necessary to depart from our earlier suggestion that the monster may be a large grey seal. The great difficulty is to account for the frequent descriptions of a small head on a long neck, but the reproduction in the *Scotsman* does not suggest a very small head (if the anterior portion showing is the head) and the summary of the observations of Sir Edward Mountain's watchers makes no mention of a long neck.

J. R.

Obituary

PROF. H. F. W. BURSTALL

HENRY FREDERICK WILLIAM BURSTALL, who died on July 15, was born in Aberdeen on September 3, 1865, but he was not of Scottish descent nor had he any Scotch accent. As a boy he was weakly, and in consequence his school life suffered many interruptions. At the age of sixteen years he was apprenticed to John Stewart and Son, marine engineers, of Blackwall, and it was during this period that his mathematical ability began to be evident. On the completion of his indentures he entered University College, London, where he attended the lectures of Prof. M. Hill and won a bursary to St. John's College, Cambridge. Three years later he emerged as sixteenth in Part I of the Tripos, and although in Part II ill-health again hampered him, he succeeded in securing a high place in the second class.

From Cambridge in 1890 Burstall went to the late Sir Alexander Kennedy, serving for a year as an assistant under his own brother, Mr. H. R. J. Burstall, and doing chiefly electrical work. His thoughts, however, were now turning towards the academic side of his profession, and he deliberately chose mechanical rather than electrical engineering, believing that it offered more scope. There was nothing in electrical work but straightforward calculation, he said. He was appointed demonstrator in mechanical engineering at King's College, London, and remained there until 1896, when he was elected to the chair of civil and mechanical engineering at the Mason College, Birmingham.

It was a period of great expansion in Birmingham, and Burstall soon found himself involved in those discussions from which the first of the provincial universities was soon to emerge. The scheme included a great engineering school, and to him was entrusted the duty of outlining its scope and its organisation. Much, it was thought, could be learnt from America, and so Burstall was sent to the United States and to Canada. The essential features of the school as it exists to-day are largely his work. He advised that the Departments of Civil, Mechanical and Electrical Engineering should be separate, and himself became the first holder of the chair established by the late Sir James Chance. A feature of the Mechanical Engineering School (at that time unique) was the use of the power station as a heat laboratory; while the establishment of workshops where, as part of a degree course, practical training could be given right through from pattern-making to fitting, was also an innovation.

Although this work of organisation must have been onerous, Burstall found time also for gas engine research. In 1898 he agreed to act as reporter to the Gas Engine Research Committee which had been established by the Institution of Mechanical Engineers, and the well-known reports of 1898, 1901 and 1908 are largely the work of his hand. From this time onwards, he adopted the internal combustion engine as his special study and became a recognised authority upon its indicator diagram. He wrote little; but his papers on the "Indicating of Gas Engines" (1909) and "The Energy Diagram for Gas" (1911) were regarded as valuable contributions to knowledge.

The outbreak of the War threw new duties upon Burstall. The University became a great hospital, and any work in his department was subservient to the responsibility of keeping the necessary power, heat and light available at all times. Nevertheless, for the Admiralty and for the Air Board he carried out work upon carburation at high altitudes and also upon air-flow. The radiators used upon the 'tanks' in 1918 were the outcome of his investigations. With the advent of peace, he returned to the gas engine and devised his 'optical indicator' (1923), which enabled reliable diagrams to be obtained up to 1,600 revolutions per minute.

In later years, Burstall concerned himself more and more with administrative problems at the University, acting as Dean of the Faculty of Science for five years and for a further five as Vice-principal. His hobby was the cultivation of carnations, in which he was well known as an expert and successful exhibitor. When he retired in 1930, he went to live in a small house at Hopwood, near Alvechurch, where he had a workshop, his beloved carnations and a few sheep. There he acquired a philosophy which led him to declare that engineers had done more harm than good by the development of mechanical processes, and that if he had his time again he would choose a calling less divorced from Nature.

There is no questioning Burstall's intellectual ability. One had only to be in conversation with him for a few minutes to realise his wide interests, his philosophical outlook and his powers of expression. If his life did not seem to fulfil its early promise in the direction of scientific research, we must remember the calls which deflected him from his chosen subject. Not only did these arise at the inauguration of the University, and at the outbreak of War, but domestic sorrow laid upon him also the onus of acting both as father and as mother to the four children who survive him.

W. M. C.

WE regret to record the death on August 10 at the age of fifty-four years of Mr. Edwin Ward, director since 1931 of the Royal Scottish Museum. Mr. Ward was appointed to the Art and Ethnographical Department of the Museum in 1901. For two seasons he excavated with Sir Flinders Petrie in Egypt, and later wrote a complete guide to the Egyptological collection of the Museum. Although his earliest and main interest was in Egyptology, his knowledge of armour, coins and pottery was extensive.

News and Views

Safety in Industry

THE annual report of the Chief Inspector of Factories and Workshops for 1933 provides the usual impressive picture of what is too readily passed over even by scientific workers as one of the routine services which Government renders to the community. Despite this efficient and untiring service, however, industry's toll of accidents is high—113,260 as against 106,164 in 1932 and 688 fatalities as against 602. The increase is not entirely attributed to improved trade. The physical and mental deterioration of workers in prolonged unemployment has untoward results when they are again employed, and, even apart from this, there is a distressingly high proportion of accidents caused by carelessness or contempt of known dangers. The report is in part a record of the watch and ward which is kept over industry to eliminate its dangers and maintain the standards and conditions of employment required by law. It reveals, however, that the inspectorate, in discharge of such responsibilities, is being drawn more and more into educational work, both direct and indirect, perhaps even more among the employees than among employers themselves.

IN such educational work, there is an obvious place for scientific workers, but the report indicates also how important are the services which they can render in the development of safety methods, the investigation of industrial diseases, and the dangers inherent in new processes or products. Examples quoted in the report such as silicosis, cancer of the bladder, or the use of dioxan, sufficiently indicate the wide scope for research in the prevention of industrial disease, and the development of safer operating conditions depends as much upon scientific investigation providing the necessary knowledge as upon mechanical ingenuity in its use. Respirators, fire-extinguishers and the detection of small concentrations of toxic gases are other matters in which research is being conducted, sometimes in co-operation with other bodies such as the Chemical Defence Research Department or the Association of British Chemical Manufacturers. Chapters in the report in which the preparation of reliable accident statistics is discussed or the effect of industrial work on the health of women and girls equally illustrate the claim of the work of the inspectorate to be regarded as a fundamental scientific service which assists to place industrial practice on a basis of carefully ascertained facts.

Coloration of Young Tapirs

ALL who are interested in the problems presented by the coloration of young animals, will probably pay an early visit to the Gardens of the Zoological Society of London, to inspect the young Brazilian tapir born there a few days ago. As with the wild swine, the 'porklings' of tapirs are longitudinally striped with white on a dark background, but after a fashion of their own, differing conspicuously in the two species. For the young Brazilian animal presents evidence of a more primitive stage in the distribution of these markings, inasmuch as the spaces between the continuous stripes are partly filled in by rows of spots and dashes representing once continuous stripes. In the Malayan species of the same age these broken bands have vanished. The adults of the two species are no less striking in regard to their coloration. For the Brazilian animal, a forest-dweller, is of a uniform black, while the Malayan is one of the most remarkable to be found among the mammals, for the forepart of the body, including the fore-legs, and the hind-legs as far as the base of the tail, are jet black, while the rest of the body is greyish-white. Observation on the living animal has shown that this is really a singularly effective form of 'concealing coloration', since the animal spends the heat of the day asleep among the great boulders strewn over the floor of dried-up river-beds. To these it comes to bear a striking resemblance, the black areas of the body simulating the shadows and the greyish-white portion the sunlit surfaces of the surrounding masses of rock.

Iron Age Finds in Berkshire

A SERIES of archæological investigations on the Berkshire Downs has been organised by the Newbury Field Club under a scheme for the relief of unemployment. Some interesting finds have been made, of which the most noteworthy is an interment of two horses. The skeletons, which were found with their legs intertwined, according to a report from the *Times* correspondent in the issue of August 13, belong to the large-headed, short-necked and short-legged type of the Iron Age breed represented in modern times by the Exmoor and New Forest ponies. One of the skeletons is said to be exceedingly well preserved, but the other had lost its head. The burial is compared with the Yorkshire chariot burials, which are generally held to belong to the earliest phase of the later, or La Tène, period of the Iron Age. The Berkshire example did not, however, include harness and chariot as in the Yorkshire burials. A few miles west of the horse interment, a bronze age burial also included the remains of a domesticated animal. In this instance the skeleton of a dog was found in association with a human skeleton in the contracted position. Other finds include a fragment of beaker pottery (c. 1800 B.C.), and a Roman copper bracelet, found on the same site as the horse burial, and iron age pottery and an ornamented fragment of a Saxon shield found at Scutchamore Knob, near East Hendred.

Excavations at Maiden Castle

EXCAVATIONS which have been planned to cover three years' work, have been begun on the prehistoric earthwork of Maiden Castle, near Dorchester. The responsibility for the excavation has been undertaken by the Society of Antiquaries, and the field-director is Dr. R. E. Mortimer Wheeler, of the

London Museum. According to a report of the work to date which appears in the *Times* of August 10, it has now become evident that a building unearthed by Mr. A. Cunnington in 1882 and again brought to light by the present operations is a temple and not a villa as was at first believed. It is a Roman building which can be definitely identified as the type of temple peculiar to the Celtic regions of France, Germany and Great Britain during the Roman period. It was square in plan with a raised central shrine and a surrounding verandah. Behind the temple is a little two-roomed bungalow which probably served as the residence of the priest. Near these buildings an interesting discovery was a pit-dwelling cut into the chalk to a depth of more than 10 ft. The sides curve towards the top and originally it was covered with a lid-like roof. The floors of rammed chalk were inserted at various periods and the pit would seem to have been inhabited in the later stages of its history. By the Roman period it was filled up. In cutting through a crossbank dividing off the eastern third of the fortress, in which the temple is situated, pottery and a quern of prehistoric date have been discovered, proving that the hill was occupied as a village before Maiden Castle at its earliest stage came into existence.

Electric Shut-down in London on July 29

A STATEMENT has now been issued by the Central Electricity Board on the failure of the supply in south-east and east England on Sunday, July 29. In this the Board refers to the joint report of the engineers of the C.E.B. and the London Power Company. The engineers state that they have explored every avenue which might elucidate the general failure, and in their opinion there is only one cause which could fully explain it. It must have been the breakdown of one of the turbines at the Deptford West Station of the London Power Company. The Board states that the system has always, even on Sunday loading, sufficient margin of plant in operation to make good immediately the loss of the largest station's output to the system, and it has also sufficient spare plant ready to be put into operation to maintain that margin against the unlikely contingency of a second station breaking down; but the Board had not considered what would happen if two major stations shut down simultaneously. The Sunday disposition of the generating plant had not allowed for this contingency. If such an abnormal event had happened on a week day, the arrangement of the plant is such that a widespread failure could have been avoided. The Board is satisfied that such a combination of untoward circumstances is not likely to recur and there need be no apprehension of any such general failure in the future.

Statistics in Economic Planning

IN *Planning* of July 17 (16 Queen Anne's Gate, London, S.W.1) emphasis is laid on the importance of settling economic and social problems, so far as possible, by reference to ascertained facts, rather than by the dim light of ancient tradition or with the aid of a flash of alleged inspiration. But if the fact-finding method is to prevail, certain conditions must be first satisfied. It is necessary to have a technique for collecting and publishing accurately and promptly the right information in the right form. Planning essentially consists of organising knowledge, and bringing it effectively to bear on current problems of economics, politics and sociology. Here is one of the most obvious contrasts between planning and *laissez-faire*. *Laissez-faire* assumed a process of automatic and almost unconscious growth. A few inquisitive persons, such as Bagehot, might occasionally inquire how the system worked, and which way it was going; but opinion on the whole was indifferent, if not hostile, to the gathering, publication and use of systematic facts and figures. The intense secrecy and suspicion still so often encountered when such information is required, is a survival of this prejudice. The forces now at work are tending to break down this obscurantism, so that one of the most notable features of the present time is the sudden growth of statistics and information services. In certain directions, however, necessary statistics have barely begun to be provided. There is no adequate index of the huge changes in the structure of society which have occurred in the past twenty years, and are still occurring under our eyes. Large-scale planning demands a vast expansion of statistics and information services. Some expansion is taking place, but it is at present completely unco-ordinated, and there are immense gaps.

Industrial and Agricultural Statistics

THE Industrial and Agricultural Research Section of the Royal Statistical Society, formed by the Council in 1933, has just issued its first publication as a supplement to part 2, vol. 97 of the *Journal of the Royal Statistical Society*. The issue will be bi-annual (price 5*s*. each) and the second number will be published at the same time as part 4 of the current volume of the *Journal*. Some indication of the type of problem considered by the Section is obtained from the titles of the papers comprising the first number, which are as follows: "Application of Statistical Methods to Production and Research in Industry", "Statistics in Agricultural Research", "A New Method of Handling Statistical Data", and "Methods of Estimating from Samples the Population Standard Deviation". In addition, an account is given of the formation of the new section, and a bibliography of papers on agricultural statistics published during 1931–33 is included. The payment of an annual subscription of 10*s*. (excluding postage) secures both numbers of the supplement each year, and also confers the right to attend the meetings as an associate member of the Section. Orders and subscriptions should be addressed to the assistant secretary, Royal Statistical Society, 9 Adelphi Terrace, London, W.C.2, and marked I.A.R.S.

Poland and Germany

IT is not generally realised that Berlin was originally a Slav settlement. In vol. 18 of *Nauka Polska* (Warszawa: Imienia Mianowskiego) Dr. K. Piotrowicz, director of the Library of the Polish Academy

of Sciences, gives a well-documented account of the manuscripts, documents, prints and other Polish works produced in early times on present German territory. It is clear that in the Middle Ages Polish culture played an important rôle in those lands now comprising eastern Germany, for many of the Polish kings and noblemen were patrons of learning. Also many scientific and other works by Polish authors were printed in towns as far west as Strasbourg. In the same volume there is an introductory note on the scientific and cultural relations between Germany and Poland by Prof. Aleksander Brückner, of the University of Berlin.

Science in Poland

VOL. 19 of *Nauka Polska* (issued simultaneously with vol. 18) contains articles on science in ancient times; problems in writing biographies; current scientific work at Lwów; the position of science in Italy, Greece, Rumania and Lithuania; and a full account of recent activities in England of the British Science Guild, the Association of Scientific Workers and the Parliamentary Science Committee. The volume concludes with a comprehensive international bibliography (20 pages) of "works concerning the psychology and sociology of science" for the years 1928–31. From Prof. T. Mańkowski's report on scientific and cultural life in Lwów at the present time it is clear that, in the faculties for pure science and medicine, modern equipment has been installed and everything is being done to encourage research workers and to see that they are not hampered by lack of facilities. Since the establishment of the Polish Republic, Lwów has become an increasingly important scientific centre in south-east Poland. A polytechnic and medical school existed before the War, but all cultural life came to a standstill in 1914 and it was not until 1920 that circumstances were favourable for the re-establishment of a university in this city.

Antarctic Exploration

THE *Penola*, the vessel of Mr. J. Rymill's antarctic expedition, according to the *Times* of August 10, was commissioned at Southampton last week and carried out preliminary trials preparatory to sailing for London, where the stores and scientific instruments will be taken on board. The expedition's aeroplane, a three-seater De Havilland Fox Moth, about sixty tons of stores and some sixty Greenland dogs have already been sent out to the Falkland Islands by cargo-steamer. The *Penola* is due to leave London on September 2 for the Falkland Islands, calling on the way at Monte Video. The staff of the expedition will themselves constitute the crew under command of Lieut. R. E. D. Ryder, R.N. The *Penola* is a three-masted topsail schooner with two 50 H.P. Diesel engines. Most of the members of the expedition have already had arctic or antarctic experience. While the work will be primarily exploratory, attention will be paid to various scientific problems including plankton, the occurrence of 'heavy water', the sociology of penguins and meteorological work. It is hoped to trace the southern extensions of the Antarctic Andes which are known as the Graham Land islands. Although the expedition hopes to be away for more than two years, the total cost is not expected to exceed £15,000, which is considerably lower than that of any other previous expedition. There is also news of Admiral Byrd's antarctic expedition; Admiral Byrd himself has been living alone at an observation hut some 120 miles south of his base camp in the Bay of Whales in order to secure continuous meteorological records. He had recently asked to be relieved owing to illness, and a rescue party succeeded in reaching him on August 13.

American Trans-Antarctic Flight

THE original plan of the Ellsworth Antarctic Expedition for a flight across Antarctica from the Ross Sea to the Weddell Sea and back to the base had to be abandoned last January owing to serious damage to the aeroplane on the pack-ice. Mr. Ellsworth now proposes new plans for the southern summer of 1934–35, and explains them at length in *Natural History* of July–August 1934. His ship, *Wyatt Earp*, will reach Deception Island about November 1. From there, Messrs. Ellsworth and Balchen propose to fly southward along the unknown western edge of the Weddell Sea to the ice-barrier at its head and then straight across Antarctica to the Bay of Whales on the Ross Sea, a total distance of 2,800 miles over virtually unexplored areas. The ship will go round to the Ross Sea to pick up the expedition, which will no doubt have the use of Byrd's base in the Bay of Whales. The plane has a maximum speed of 210 miles an hour, and it is proposed to fly at 150 miles an hour. Fully loaded, with pontoons in place of ski, its cruising radius is 3,200 miles. The use of pontoons, which materially increases the weight, is necessary because Deception Island does not offer a land surface sufficiently extensive for a 'take off' for this heavy machine.

American Indian Land-Tenure

A MOVEMENT has been initiated in the United States for the reform of the terms of land-tenure among the Indians. Under the law of 1887, lands were allotted to the Indians on individual tenure, a system of which they had had no experience under tribal institutions. No sooner had allotment been made than land dealers began to acquire holdings from the Indians, in many instances in exchange for a few bottles of whisky or other articles of little or no value. It is estimated that in less than fifty years the Indians have lost two thirds of their lands, and whole tribes have been reduced to pauperism. A conference has been summoned, it is announced by Science Service, Washington, to discuss this situation, as well as other problems affecting the Indians. It will be attended by representatives of the Indian Rights Association, the National Association on Indian Affairs and many other bodies interested in the welfare of the Indian. The Commissioner of Indian Affairs, Mr. John Collier, will also attend. Special attention will be given to drafting proposals

for the amendment of the land laws. Among the reforms it is intended to propose is the reintroduction of the system of tribal tenure. It is understood that this proposal has the approval of the Indian Office. Suggestions are also to be considered for the establishment of a system of credit for the Indians in order to enable them to equip and stock their farms, as they are not otherwise in a position to work any land which may be assigned to them. It is certainly desirable that something should be done to establish on an economic basis the half-detribalised Indians who at present are largely parasitic on the fringes of white communities. The passing of a revised land-law which would restore the Indian to the land without the power of alienation would probably prove a substantial advance in that direction.

Grading of Empire Hardwoods

A SMALL brochure has been prepared by the Imperial Institute Advisory Committee on Timbers entitled "Grading Rules and Standard Sizes for Empire Hardwoods" (Imperial Institute, South Kensington, Oct. 1933). The Sub-Committee, appointed by the Advisory Committee, decided that these inquiries should be confined to overseas Empire square-edged hardwoods. The grading rules and memorandum on sizes recommended by it will be subject to amendment from time to time, as further experience is gained. The grading rules for Empire hardwoods (square-edged) intended for shipment to the United Kingdom are considered under: A. Hardwoods from Countries other than Canada and New Zealand, I Standard Grades. II Wormy Grades. III Grades for shorts, squares, strips, quarter-sawn stock. B. Canadian Hardwoods. C. New Zealand Hardwoods; and appendixes. This piece of work was overdue and should prove of great value to all concerned in this matter of hardwood imports. The danger of laying down hard and fast grading rules for any particular item of imports may result, however, in great waste at the source of origin—a waste which has to be seen on the spot to be fully realised. For example, under "Squares" it is stated, "*First Quality or Prime Squares* must be free from all defects, except that, when squares are sold specifically for turning, slight defects on one or more corners which will turn off will be admitted". In the case of mahogany, to obtain the flawless squares, sections of logs of 2–4 ft. will be cut off and left to waste in the forest owing to some small flaw which the manager on the spot will not risk sending home since he will be censured by the management. The latter will not have this type of material sent home since they know it will be objected to by the buyers. Is it necessary to waste annually thousands of cubic feet of so magnificent a timber as mahogany because the specification of import laid down by the purchaser approaches an ideal?

Wireless Communication at Mount Everest

A paper entitled "Wireless Communications with the Mount Everest Expedition, 1933", read before the Royal Society of Arts by Mr. D. S. Richards, has now been published (*J. Roy. Soc. Arts*, May 11). The plans provided for the installation of a main fixed station at Darjeeling, the starting point of the expedition, and two mobile transmitting and receiving stations to be erected at the Base Camp and Camp III at altitudes of 16,800 ft. and 21,000 ft. respectively. The distance from Darjeeling to the Base Camp was about 111 miles, with a further 10 miles to Camp III, from which a telephone line was to be laid to Camp IV about 1½ miles distant and at a height of 22,800 ft. Communication was carried out by telephony when possible, with recourse to Morse telegraphy when conditions were less favourable. Wave-lengths in the region 40–60 metres were found to be the most successful, and the best time for communication was in the early morning when fading and interference from atmospherics were reduced to a minimum. On the whole, the wireless equipment worked satisfactorily, and the service provided was of great value to the climbers. Weather reports were delivered to Camp IV within an hour or two of their being originated in Calcutta. Radio-telephony proved a great success on occasions, notably when H.E. the Governor of Bengal spoke to some members of the expedition from Government House, Darjeeling, and also when the Civil Surgeon in Darjeeling was consulted about some medical cases. Dr. Greene also carried out a diagnosis by radio between Base Camp and Camp III when there was no doctor in the latter Camp. Not least among the advantages provided was that of the reception at Base Camp of broadcasting programmes and news bulletins.

Road Construction in New Germany

IF we leave the United States out of account, it is at first sight curious that countries overburdened with financial liabilities take the leading part in promoting road construction. During a period of great prosperity, the United States built a gigantic network of highways. Yet when unemployment increased, further energetic steps were taken to increase the road work being done. During the former period, maximum use was made of machinery, but now the tendency is to employ manual labour as much as possible. In *Roads and Road Construction* of April, there is an interesting paper by Prof. K. Krüger, of the Technical High School, Charlottenburg, describing the latest German *autobahn* (super-highway) scheme. At the motor exhibition in March at Berlin, Herr Hitler urged the encouragement of motor-vehicle traffic as this would provide work for hundreds of thousands of men. The *autobahn* project has been fostered, and the construction of powerful high-speed vehicles—almost semi-aircraft—is being encouraged. It is intended that the high-speed traffic should be collected on the *autobahn*. The ordinary roads not built for the present dense heavy and rapid traffic would be saved from the necessity of constant repairs and efforts would be made to improve them. The super highway will enable the motorist to speed up to at least 90 miles per hour. A lorry driver will be able to travel between two distant cities twice a week instead of making only one return trip. The deterioration of

the lorry and the general transport costs will be considerably reduced. The new roadways will open up many new picturesque places which will attract foreign visitors. According to the law of June 27, 1933, the German State railways have been authorised to create a subsidiary company to build and manage an efficient network of super highways as a monopoly.

Ceralumin

MESSRS. J. STONE AND CO., LTD., of Deptford, have introduced a new light alloy to which they have given the name of "Ceralumin C". This alloy contains copper 2·5, nickel 1·5, magnesium 0·8, iron 1·2, silicon 1·2 and cerium 0·15 per cent. It thus belongs to a well-known class of light alloys, but contains cerium in addition to the more usual elements. It is claimed that cerium refines the microstructure, and also suppresses the formation of the brittle iron–aluminium constituent. The alloy is used in the heat-treated condition, being heated to 515°–535° C. for four to six hours in order to bring the constituents into solid solution, and then quenched. Ageing is effected in 16 hours at 175°, after which the alloy is again quenched. Chill castings after heat treatment have a tensile strength of 23–27 tons/in.^{2}, a proof stress of 21–24 tons/in.^{2}, an elongation of 1 per cent, and a Brinell hardness of 130–140. A fatigue range at 20 million reversals of $\pm 8{\cdot}25$ tons/in.^{2} has been obtained, which is high for alloys of this class. When the ageing at 175° is replaced by ageing at room temperature for five days, the tensile strength is lowered, but an elongation of 4–6 per cent has been obtained. This modified alloy is called "Ceralumin D". Sand castings give rather lower figures. The new alloy is claimed to give smooth castings, and to be suitable for many kinds of aeronautical and automobile purposes.

A 'Perfect' Musical Scale

IN Chap. viii of his forthcoming work on "Some Questions of Musical Theory" ("From Seven to Seventeen". Pp. 137–166. Cambridge: W. Heffer and Sons, Ltd., 1934. 2*s*. 6*d*. net), Dr. W. Perrett divides the octave into 171 intervals which he calls 'hepts'. One sixth of a hept is the least difference of pitch which can be detected by a trained ear and Dr. Perrett shows that if the eleventh, thirteenth and nineteenth harmonics can be dispensed with, 50 of the intervals best known in music can be represented by integral numbers of hepts with errors of less than one seventh of a hept. Thus the fifth is 100, the fourth 71, the major third 55, the minor third 45. With an instrument constructed on these lines, modulation into any key would be possible, but if it were played by hand four players would be necessary. As an instrument with Bosanquet's 84 keys per octave was constructed at a moderate price half a century ago, the author considers that one with 171 is quite within the bounds of possibility at the present time.

Land Utilisation Survey

THE third annual report of this survey of Great Britain shows a growing rate of progress towards the completion of the work. With a total of 15,000 finished six-inch sheets, three-quarters of the field work has now been accomplished. Thirty-six counties are completed and twenty-five more are nearly complete. Parts of Norfolk, West Suffolk, the West Riding, Westmoreland, Cornwall, Carmarthen and Somerset still call for more workers. In southern Scotland there are large areas still to be done. A year ago two sheets, reduced to a one-inch scale from the six-inch sheets, were published by the Ordnance Survey. Eight sheets in all have now been published and four more are in the press. Work is proceeding on the reduction and preparation for press of twenty-nine further sheets. It is proposed to publish a series of explanatory memoirs on certain of the sheets and several of these are now in preparation. The report summarises the extent of work done in each county and contains a map of Great Britain showing completed areas.

The Imperial Institute

THE annual report of the Imperial Institute contains the last report of the retiring director of the Institute, Lieut.-Gen. Sir William Furse, to the Board of Governors. Sir William there affirms his belief that the threefold activities of the Institute—(1) intelligence, (2) investigations and (3) education—are of immense importance and essential to the economic development of the Empire. He adds that the Imperial Institute is still not sufficiently known and is left overmuch to carry on as best it can. It has never been financed adequately, but from time to time an outside Committee is appointed to investigate the Institute, usually when bankruptcy appears to be impending. Its own resources, from its original endowment and from the letting of rooms, amount to less than £10,000 per annum: Sir William estimates that it requires an income four to five times this figure. He points out that the Institute has only been kept alive for the past ten years by the munificence of private donors and adds: "In no spirit of ingratitude to these gentlemen, I venture to suggest that this method of carrying on our essential Imperial service is unworthy of our great Empire."

The Cooling of Boulder Dam

THE Boulder Dam forms a huge concrete plug between the walls of the Black Canyon on the Colorado river. According to Science Service of Washington, D.C., it weighs six million five hundred thousand tons. As this concrete sets, the slow chemical reaction that takes place gives off heat. Researches by the U.S. Bureau of Reclamation have shown that in the Boulder Dam sufficient heat would be generated to melt a cube of ice as high as a 24-story building. If no means were adopted to keep cool this great block much damage might be done, as during the protracted cooling and shrinking period there would be a serious risk of dangerous cracks occurring. To obviate this risk, as each section of the concrete is poured it is riddled with coils of pipe. About 560 miles of tubing will be used, and this will be kept in place permanently as the cement hardens.

Administrative Measures in Puerperal Fever

INVESTIGATIONS carried out for the Departmental Committee on Maternal Mortality have shown the importance of strains of the micro-organism known as the hæmolytic streptococcus, and of carriers of this organism, in the causation of puerperal fever. The Ministry of Health, in a circular recently issued to Medical Officers of Health, therefore recommends on the occurrence of fever in a lying-in woman the isolation and separate nursing of the patient, and investigations to determine the nature of the infecting organism and possible sources of infection. The last-named include bacteriological investigation of the patient and of those who may have been in contact with her during labour and for 48 hours afterwards. As contact with hands and instruments is the most likely mode of infection of the genital tract, attention should be directed to infections or abrasions of the skin of anyone who has had contact with the patient.

Swedish Meteorology

AMONG recent publications of the Swedish Meteorological and Hydrographical Office are the detailed observations from the observatory at Riksgränsen on Vässijaure in Swedish Lapland for the year 1931 (*Årsbok*, 13, 1931). Full records are given for every hour on each day of the year, with additional notes on the freezing of the lake, aurora borealis and other matters. Another publication (*Årsbok*, 15, 1933) records the rainfall of Sweden. Monthly figures are given for each station with summaries for various districts and comparisons with the mean average figures. There are also rainfall maps for each month and for the year. It is noticeable that the year under review showed nearly everywhere in Sweden a considerable deficiency compared with the normal rainfall. A third publication treats of the weather of 1933 (*Årsbok*, 15, 1933) in a series of monthly surveys with comparisons with the means.

Plant Pathology at the Seale-Hayne Agricultural College

THE tenth annual report of the Department of Plant Pathology of the Seale-Hayne Agricultural College, Newton Abbot, Devon, contains several interesting articles by the entomologist (Mr. L. N. Staniland) and the mycologist (Mr. A. Beaumont). The general activities of the Department are reviewed, and reveal a very efficient and progressive organisation. Short articles appear on "The Spread of Potato Eelworm in Consignments of Seed Potatoes", "The Alternative Host Plants of the Violet Aphis", "Violet Eelworm" and "Notes on Hot Water Treatment of Strawberry Runners" together with several paragraphs describing its effects on various pests. A useful article on "Narcissus Disease and Pest Control Calendar" guides the grower in the general treatment of his bulbs (a study which is somewhat neglected by many home gardeners) in addition to discussing the control of pests and diseases. More general notes on insect and fungus maladies which have occurred during the year, and lists of those found in Devon and Cornwall, are also given.

'Insulin-Boots'

WE have received from Messrs. Boots Pure Drug Co., Ltd., Nottingham, an illustrated booklet describing the preparation and uses of Insulin-Boots. The insulin is extracted from frozen pancreas glands by mincing into an alcoholic solvent; further treatment of the solution is necessary to remove the bulk of the inactive protein. The resulting clear solution is concentrated at low temperature by vacuum distillation. After removal of fat the insulin is precipitated by addition of salt and further purified by fractional precipitation in the iso-electric range and from various solvents. The booklet describes the tests to which each batch is submitted, the properties of insulin and its use in diabetes and in non-diabetic conditions. A useful section is a detailed account of the technique of subcutaneous injection. Insulin-Boots is issued in three strengths, 20, 40 and 80 units per c.c.

Announcements

THE RIGHT HON. THE EARL OF MALMESBURY has consented to become president of the next Health Congress of the Royal Sanitary Institute, which is to be held at Bournemouth on July 15–20, 1935.

THE B.B.C. announces that the public experiment with the 24-hour system of timing, which began in April, will end on August 18. It is stated that the system has been effectively introduced to the public, but there has been no evidence of either widespread support or opposition for it.

THE Autumn Meeting of the Iron and Steel Institute will be held in Belgium and Luxemburg on September 10–14. The programme includes visits to the principal iron and steel manufacturing and engineering works of the two countries. Advance copies of papers to be read can be obtained from the secretary of the Institute.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Junior technical assistants (temporary) under the Director of Ordnance Factories—Under-Secretary of State (C.5), War Office, London, S.W.1 (Aug. 22). A county dairy instructor (male) to the Wilts County Council—Clerk of the Council, County Offices, Trowbridge, marked "County Dairy Instructor" (Aug. 27). An engineer sub-lieutenant in the Royal Indian Marine—Secretary, Military Department, India Office, Whitehall, S.W.1, marked "Royal Indian Marine Recruitment" (Aug. 31). An adviser in agricultural zoology at University College, Cardiff—The Registrar (Sept. 1). A head of the Engineering Department, St. Helens Municipal Technical School—The Secretary for Education, Education Office, St. Helens. A public analyst for the Boroughs of Kensington and Hammersmith—Town Clerk, Kensington, W.8. (Sept. 7). University readerships at the British Post-Graduate Medical School in medicine, surgery, obstetrics and gynæcology, pathological chemistry and bacteriology—Academic Registrar, University of London, S.W.7 (Sept. 17).

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 *J*-type and the *S*-type among Mathematicians

MATHEMATICIANS in England and America have been recently intrigued by reports of a lecture delivered by Prof. L. Bieberbach, of the University of Berlin, to the Verein zur Förderung des mathematisch-naturwissenschaftlichen Unterrichts. They have, however, found difficulty in judging the lecture fairly from secondhand reports. It is now possible to form a more reasoned estimate, Prof. Bieberbach having published a considerable extract, under the title "Persönlichkeitsstruktur und mathematisches Schaffen", in the issue of *Forschungen und Fortschritte* of June 20.

Prof. Bieberbach begins by explaining that his exposition will make clear by examples the influence of nationality, blood and race upon the creative style. For a National Socialist, the importance of this influence requires no proof. Rather is it intuitive that all our actions and thoughts are rooted in blood and race and receive their character from them. Every mathematician can recognise such influences in different mathematical styles. Blood and race determine our choice of problems, and so influence even the assured content of science (den Bestand der Wissenschaften an gesicherten Ergebnissen); but naturally do not go so far as to affect the value of π or the validity of Pythagoras' theorem in Euclidean geometry. . . .

Our nature becomes conscious of itself in the malaise (in dem Unbehagen) produced by alien ways. There is an example in the manly rejection (mannhafte Ablehnung) of a great mathematician, Edmund Landau, by the students of Göttingen. The un-German style of this man in teaching and research proved intolerable to German sensibilities. A people which has understood how alien lust for dominance has gnawed into its vitals . . . must reject teachers of an alien type. . . .

Prof. Bieberbach proceeds to distinguish between the '*J*-type' and the '*S*-type' among mathematicians. Broadly, the *J*-type are Germans, the *S*-type Frenchmen and Jews. The differences of type appear quite clearly in the varying treatments by different mathematicians of the theory of imaginary numbers. For example, in Gauss (an outstanding instance of the *J*-type) one finds above all insistence on the 'anschauliche Bedeutung von $\sqrt{-1}$'. . . . On the other hand, there are expositions of the theory by mathematicians of the *S*-type (for example, Cauchy) which produce a malaise (die Unbehagen verursachen) in one belonging to the *J*-type. . . . Technical virtuosity and juggling with conceptions are signs betraying the *S*-type, hostile to life and inorganic (dem Lebensfeindlichen unorganischen *S*-typus). . . .

Typical of the *J*-type are the 'nordisch-falische' Gauss, the 'nordisch-dinarische' Klein, and the 'ostbaltisch-nordische' Hilbert. . . . One of the crowning achievements of the *J*-type is Hilbert's work on axiomatics, and it is particularly regrettable that abstract Jewish thinkers of the *S*-type should have succeeded in distorting it into an intellectual variety performance (intellektuelles Variété). . . .

But perhaps I have quoted enough; and I feel disposed to add one comment only. It is not reasonable to criticise too closely the utterances, even of men of science, in times of intense political or national excitement. There are many of us, many Englishmen and many Germans, who said things during the War which we scarcely meant and are sorry to remember now. Anxiety for one's own position, dread of falling behind the rising torrent of folly, determination at all costs not to be outdone, may be natural if not particularly heroic excuses. Prof. Bieberbach's reputation excludes such explanations of his utterances; and I find myself driven to the more uncharitable conclusion that he really believes them true.

G. H. HARDY.

New College, Oxford.
July 20.

Crystal Structure of the Low Temperature Modification of Ammonium Bromide

IN continuation of the accurate dilatometric investigation of ammonium chloride carried out by Prof. A. Smits and Miss C. H. MacGillavry[1] in the neighbourhood of the well-known transition point at $-30°$, ammonium bromide has been studied by them and by the present writer in the neighbourhood of the analogous transition point at $-39°$. In connexion with these experiments, which have not yet been finished, these ammonium salts, especially ammonium bromide, have been investigated with X-rays by me. By arrangement with Prof. Smits, the results of these latter experiments are described here.

In the case of the corresponding chloride, F. Simon and Miss Cl. von Simson[2] failed to detect a difference in the X-ray diagrams taken below and above the analogous transition point, which I can wholly confirm. I have now found, however, that Debye-Scherrer diagrams of pure ammonium bromide with copper $K\alpha$-rays taken at $-100°$ did show besides the ordinary reflections of NH_4Br a number of faint and very faint lines not present in diagrams of the same preparation at room temperature. As volatile impurities such as water and carbon dioxide were excluded, these extra lines reveal the occurrence of a superlattice in the crystal structure of the low temperature modification, afterwards to be designated as γ-NH_4Br.

From the observed reflections, two possible elementary cells could be deduced. First, a body-centred cubic cell with an edge $a = 2a'$ (a' representing the edge of the elementary cube of the ordinary $CsCl_2$-structure of the β-modification, stable from $-39°$ to $138°$) and containing eight molecules; secondly, a tetragonal elementary cell with $a = a'\sqrt{2}$ and $c = a'$, containing two molecules. From a discussion of the possible atomic arrangements in both cases in connexion with the observed and calculated intensities, the first alternative could be excluded. In this way we arrive at the conclusion, that at low temperatures NH_4Br has a tetragonal lattice with the dimensions at $-100°$: $a = 6{\cdot}007 \pm 0{\cdot}006$ A.; $c = 4{\cdot}035 \pm 0{\cdot}004$ A.; $c/a = 1/\sqrt{2} = 0{\cdot}707$. This conclusion is in remarkable accordance with

the observation of Hettich[3], who found the γ-modification to show double refraction.

An exhaustive examination of the tetragonal space-groups reveals that only the space-groups D_{4h}^7, D_4^2 and V_d^3 are possible. The bromine and nitrogen atoms occupy in all three groups the same places;

Br : 0 ½ u, ½ 0 $\bar{u}$; with $u \simeq 0$ (or $\simeq$ ½).
N : 0 0 ½, ½ ½ ½ ; (or 0 0 0 , ½ ½ 0).

With a value $u = 0{\cdot}030 \pm 0{\cdot}005$ for the only parameter, the intensities can be calculated in excellent agreement with those observed. As Hettich failed to observe piezoelectricity of the γ-modification of NH_4Br, it may be concluded that D_{4h}^7 will be the correct space-group. Assuming that in the γ-modification the ammonium radical only oscillates about fixed positions, the protons will be arranged in tetrahedrons round the nitrogen atoms. They will then occupy an 8-fold position : 8(i) in the designation of Wyckoff with two parameters.

Ammonium iodide shows the same behaviour as the bromide but to a minor degree. The parameter value u is here $0{\cdot}01 \pm 0{\cdot}005$; only some very faint lines were detected corresponding with the strongest extra-lines of ammonium bromide.

J. A. A. KETELAAR.

Laboratory for General and
Inorganic Chemistry,
University of Amsterdam.
July 8.

[1] *Z. phys. Chem.*, A, **166**, 97 ; 1933.
[2] *Naturw.*, **14**, 880 ; 1926.
[3] *Z. phys. Chem.*, A, **168**, 353 ; 1934.

Refractive Index of Gaseous "Heavy Water"

IT may be of interest to record that preliminary measurements of the refractive index of a specimen of gaseous heavy water give a value of $\mu = 1{\cdot}000256$ for $\lambda = 5462{\cdot}23$. The specimen, which was supplied by I.C.I., had a relative density of 1·0324 at 23·3° C., and a concentration estimated at 30 per cent D_2O on the assumption that the density of pure D_2O is 1·1079[1]. The standard density of the vapour was taken as that of hydrogen at 0° and 76 cm., multiplied, as to 70 per cent, by 9 and as to 30 per cent by 10 ; thus :

$$0{\cdot}08995 \left(\frac{70 \times 9}{100} + \frac{30 \times 10}{100}\right) = 0{\cdot}83653 \text{ gm. per litre.}$$

The refractive index of ordinary gaseous water was found in 1914 to be 1·0002527[2] and recent unpublished determinations have given 1·000255. This latter value is so near that of heavy water that it is doubtful whether there is, in reality, any difference between the two. I hope to complete measurements of the refraction and dispersion and to publish the results before November.

If the density of pure liquid D_2O is 1·1079, while the molecular weight is 20, against 18 in the case of water, the molecular volume of D_2O has increased, relative to that of water, in the proportion of 1·1079 to 1·111 or ½ per cent ; and, on the assumption that the abnormality of the D atom has no effect, or a very small effect, on the refractive index, we should expect a slightly lowered index for D_2O, but not so great a difference as that actually found by Taylor and Selwood, who give the difference of indices of pure D_2O as − 0·00462 at 20° C.

If it should prove correct that the index of gaseous D_2O is slightly higher than that of H_2O the discrepancy becomes greater.

CLIVE CUTHBERTSON.

July 26.

[1] H. Taylor and P. W. Selwood, *J. Amer. Chem. Soc.*, 998 ; 1934.
[2] C. and M. Cuthbertson, *Phil. Trans.*, 213, 1.

J. F. Campbell, 1822–85, and his Refracting Quadrant

LAST year I purchased at auction a well-made piece of optical apparatus which intrigued me because I could not divine its purpose. It looked like a sphere of glass with circles etched upon it, set in a block of wood. After cleaning, some writing and the initials 'J. F. C.' appeared on the box which, to make a long story short, turn out to be those of J. F. Campbell. But although his name as applied to the Campbell-Stokes Sunshine Recorder is a household word, none of the physicists or meteorologists to whom I applied for information knew anything about the man. Nor have I been able to find that any obituary notice of him appeared in NATURE or in the usual journals.

Campbell of Islay, as he liked to call himself, was born on December 29, 1822, and died at Cannes on February 17, 1885. He was educated at Eton and Edinburgh. His published works show his genius to have been of no ordinary kind. The best-known of these is perhaps his "Frost and Fire", in two volumes, with a picture of Hecla and Strokr on the title-page, but no author's name either there or at the end of the preface, dated London, April 1865. Only in a postscript does he add the modest note : "My name will not help this comrade in his journey through the world ; but my friends the publishers, to whom I am indebted for many favours, request me to sign this letter of introduction for their nursling 'FROST AND FIRE'. I have then to ask indulgence for my rude work, and for myself. J. F. Campbell" ; then follows a "Table of Contents" which is in tabular form in 8 columns. In the text symbols are used :— $\wedge$ for cone, L = river mark, Δ = ice mark, S = river curves, $\smile\wedge$ = ice mark and weathering, , = current. Large portions of his diary of 1850 are intercalated. So imbued was Campbell with the importance of making Nature print its own records that even the blue cloth binding of these volumes is embellished with an impression of glacial scratchings taken from a glaciated slate-rock surface—a veritable geological Nature-print.

In August 1879, when residing at Niddry Lodge, Kensington, Campbell prepared for the press a small work on "Time Scales : horizontal and vertical" which he had contrived for "numerical picture-writing and reading". He was also busy elaborating the details of the Sunshine Recorder.

"In order to work with radiation and new materials, apparatus had to be chosen or invented and made. The Instruments chiefly used since 1853, have been transparent spheres. In 1853, the only solid spherical lenses that could be found, were bottle stoppers and glass marbles. They were not clear, and they were ill-shaped and small. They served to show what was wanted, and they were used to learn something about the refraction of heat. Cast glass spheres, and spheres

worked hot with pincers by hand and eye, were got and used.

"In 1860 Messrs. Chance of Birmingham made a glass sphere for the writer, cast, ground and polished. It is at Greenwich Observatory. In 1880 Messrs. Chance made a second lens for the writer, which now is at the same station, having done good work. At last, in 1881 Monsieur Feil of Paris made a good glass sphere of homogeneous optical glass, carefully worked. It is the thing wanted and vainly sought during 29 years; and it might be still better."

"Thermography", from which these notes are taken, appeared in 1883, and has also supplied a clue to my box-sphere. It was Campbell's Refracting Quadrant invented in 1853 and made in 1864 as an instrument for drawing to scale in true perspective, and for measuring angles when travelling. It is not a sphere, but a lens with a hemispherical upper surface of radius 2 inches, and a hemispherical lower surface at 3 inches distance. It was intended to be set in gimbals for taking the sun's zenith distance at sea. With a suitable reflector the direction of movement of clouds overhead is well seen, and their rate of angular velocity can be measured on a scale. The description ends: "This invention has not been published so one instrument only exists" ("Thermography", p. 140); and this has now been rescued from oblivion.

Campbell's name was well known to scholars of Gaelic literature, for he collected a number of folk tales in the Highlands and Isles between January 1856 and 1861, some of which were published in his Popular Tales of the West Highlands 1860–62, of which a new edition in four volumes appeared in 1890–93. Legends about the Dragon attracted him. So early as 1862 he had taken incidents from three versions and had compared them with other stories which he had collected on travels to Japan, China and Ceylon. In the East he made sketches of dragons, and on his return, lectured on them. "I take the story," he wrote, "from the Gaelic and tell it in my own words, generally where the scribe's language is prosy. But when passages occur which seem worth preservation—bits of recitation and quaint phrases—I have translated carefully. This is work honestly done while my head was full of the subject." Some of his manuscripts are preserved in the Advocates Library in Edinburgh.

R. T. GUNTHER.

Sensitivity of Dividing and Non-Dividing Cells to Radiation

DR. J. C. MOTTRAM has recently[1] described experiments in which he irradiated the root tip of broad beans and claimed to have confirmed the conclusion, arrived at by him in 1913, namely, that the dividing cell is more sensitive to radiation than the non-dividing cell.

This hypothesis was, in fact, advanced as early as 1906, to account for the fact that the fastest proliferating tissues are the most radio-sensitive, but, as pointed out by me elsewhere[2], it is not the only possible interpretation of this now very well-known principle. If the sensitive state was pre-mitotic we would still find the most rapidly proliferating tissues to be most sensitive to radiation. It is surprising to find that the above hypothesis, or assumption, unsupported by any further evidence, has been accepted by a certain school of radio-biologists as the only possible, and therefore the logical, interpretation of an experimental fact.

The object of this note is to show that, while Mottram's conclusion is consistent with his observations, it is not a logical interpretation, because of the possibility of one or more, other explanations.

In brief, Mottram found that: (*a*) during the middle of the day, fewer cells in the normal bean root are undergoing mitosis than early in the morning or late in the afternoon; (*b*) the effect of a given dose of radiation on the growth rate of the bean root, irradiated during the middle of the day, is less than that on a similar bean root irradiated early in the morning or late in the afternoon.

From these results, he concluded that the dividing cell must therefore be more radio-sensitive than the non-dividing or pre-mitotic cell. That this conclusion is clearly illogical, will appear from the following simple considerations: from the two above experimental facts, it follows that the greater biological effect is related in some way with the higher mitotic activity, but when due consideration is taken of the further fact that a high mitotic activity must necessarily be associated with a high pre-mitotic activity it is manifestly impossible from Mottram's experiments to determine which of the two states, the mitotic or the pre-mitotic, is more radio-sensitive. The situation, so far as Mottram's experiments are concerned, remains unresolved.

Some three years ago, working in the Strangeways Laboratory, Cambridge, I undertook a quantitative investigation[2] into the phenomena involved in the disappearance of the mitotic phases from irradiated tissue cultures, and during the course of the research obtained definite evidence of the fact that the pre-mitotic cell is more radio-sensitive than the mitotic cell. This result is the same as that obtained by Spear[3] and by Strangeways and Hopwood[4] and others, from the same laboratory. WM. H. LOVE.

Department of Cancer Research,
The University,
Sydney.

[1] Mottram, J. C., *Brit. J. Radiol.*, **6**, No. 70, 615; 1933.
[2] Love, W. H., *Archiv. Exper. Zellforsch.*, **11**, 463; 1931; and *Proc. Roy. Soc. N.S.W.*, **66**, 56; 1932.
[3] Spear, F. G., *Proc. Roy. Soc.*, B, **108**, 190; 1931. **110**, 224; 1932.
[4] Strangeways, T. S. P., and Hopwood, F. L., *Proc. Roy. Soc.*, B, **100**, 283; 1926.

IN my paper of 1913[1] the conclusion that the dividing cell is more sensitive to radiation than the non-dividing was arrived at from experiments on the ova of *Ascaris megalocephala*, in which the exact ratio of dividing to non-dividing cells was determined.

For example, when the percentage of the non-dividing cells was 100 under a certain condition of exposure, none were killed in three repeated experiments, whereas when the percentages of dividing cells were 100, 94, 97, then 56 per cent, 48 per cent, 50 per cent of the eggs were killed under the same conditions of exposure. In the first case there may have been some cells in the sensitive (according to Love and Spear) pre-mitotic stage, but they did not die. In the second case either none, six, or three cells could alone have been in the sensitive pre-mitotic stage, and these small numbers could not account for the striking difference in mortality obtained.

As regards my experiments with beans, they fell into line with the above; in this respect they conformed, though alone they could not be conclusive.

I agree with Love and Spear that they have shown that of the various stages through which the non-dividing cell passes between mitosis and mitosis, the pre-mitotic stage is the most sensitive. On the other hand, I know of no experiments of theirs where they have shown that the cell in the pre-mitotic stage (shortly before the disappearance of the nuclear membrane) is more sensitive to radiation than the cell during mitosis. It is known that a cell irradiated during mitosis continues to divide, and that daughter cells result; whereas a non-dividing cell may for a time be inhibited from division under the same conditions of radiation. But one cannot conclude that therefore one cell is more sensitive than the other, because the same measuring rod was not used in the two cases. In one case mitosis already begun was observed, and in the other the passage from the resting to the dividing state—two very different phenomena. In my own experiments the same measuring rod was used, either death of the cell in the case of *Ascaris* ova, or interference with growth of the cell in the case of bean roots.

Many radiologists would, I am sure, be grateful to Dr. Love or to Dr. Spear if they would describe in detail an experiment which proves that a cell about to divide is more sensitive to radiation than a dividing cell; and especially an experiment in which is clearly defined what was the measure of the sensitivity employed.

J. C. MOTTRAM.

Mount Vernon Hospital and
Radium Institute,
London.

[1] *Archives Middlesex Hospital*, **30**.

Infectivity of Summer Sporangia of Potato Wart Disease in Incipient Infections on Varieties Immune in the Field

IT is known that a number of potato varieties which appear immune to wart disease (*Synchytrium endobioticum*) in the field develop incipient and transitory infections under the more intensive infection conditions in the laboratory. Investigation has shown that summer sporangia, and less often winter sporangia, are developed apparently normally until necrotic areas produced in the host interfere with the nutrition of the fungal parasite and cause it to be sloughed off, so that signs of infection disappear within a few weeks.

It is a question of some interest whether the sporangia developed under these conditions are viable and capable of infecting susceptible potato varieties. A number of attempts have been made to infect Arran Chief, a very susceptible variety, from incipient infections bearing summer sporangia. A few developed on Snowdrop, Bishop and Ben Cruachan, varieties which appear immune in the field, have given positive results producing normal warts in Arran Chief, showing that summer sporangia on these varieties produced normal zoospores capable of carrying infection. No infection was obtained from two other varieties tested, but such negative results may be due to the technical difficulty of preparing sufficient material with incipient infections bearing summer sporangia at the right stage for infection.

MARY D. GLYNNE.

Rothamsted Experimental Station,
Harpenden, Herts.
July 19.

Inheritance of Habits

AT this time of the day to try to prove qualitatively that some acquired habits are inherited is to linger in the atmosphere of an old-time controversy. I wish to press forward. I would like to see the problem transferred to another sphere of investigation. What is the kind of physical change that is heritable? Can it be correlated with an easily observable fact; so that knowing it we can predict whether a particular habit would be inherited or not?

What is habit? Consider the following: (1) When under the stress of a parasite some tissues of an organism react or are made to react in order to restore the original balance, they continue in their particular activity when the cause of the disturbance is overthrown. This is continuity of reaction when the stimulus is no longer present. (2) An expert driver of a motor-car reacts when he is in the car surrounded by his particular stimulus, that is, the environment of traffic, etc. When he is not in his environment his reaction is not called forth. This is continuity of reaction only in the presence of the stimulus. (3) Tissues composing the organism have their own habits. How far are these expressed in the behaviour of the organism as a whole? (4) The organism as a whole has recognisable habits. How far are these expressed in the behaviour of the various tissues composing the organism? (5) A stimulus may have been administered only once to which the organism has reacted. Then after many years the particular reaction would be called forth when the stimulus is again administered. This is continuity of reaction after a considerable lapse of time. (6) The creases of a garment are also a continuity of reaction. (7) The idealism that a body given an initial impetus in a certain direction will continue to move in that direction if there were no environment to absorb the energy, involves the idea of an acquired habit.

In these examples the continuity of reaction implies the idea of duration. What should be the duration to constitute a habit? A habit may be acquired and inherited, and after a few generations the habit may cease to appear in the offspring. A habit once inherited may not always remain in the heritable condition.

Some animals are more easily domesticated than others. Man has this property of educability in a pre-eminent degree. If this is an advantage to society it has also its disadvantages. Education is giving a direction to the available energy of the organism. It is always difficult to change the direction of an already strongly directed stream of energy. A fanatic is a person in whom the available energy is very strongly directed but the direction is not in his own hands. Others control and use him. In man, habit is an expression of experience, and no habit can be formed without surrounding it with emotional accretions.

If it is known what physical change has taken place, the control by other people of one's habits can be counteracted by having, for example, an injection.

All this may seem rather fanciful, but will, I believe, fall within the range of possible worlds.

S. MAULIK.

Department of Entomology,
British Museum (Natural History),
South Kensington, S.W.7.
July 18.

Distribution of Chromosome Numbers in a Progeny of Triploid *Allium Schoenoprasum*

A CROSS between a tetraploid giant form of *Allium Schoenoprasum*, L. ($2n = 32$) and common diploid chive ($2n = 16$) gave a triploid F_1 ($2n = 24$). These F_1 plants were all completely self-sterile; but in free flowering a rather large number of seeds was obtained which gave rise to an F_2 generation of about 700 plants. These were derived from crosses within the triploid material; some of them may possibly have been the result of back-crossings with diploid types of chive flowering in the vicinity.

In this F_2 generation there occurred among the 620 plants examined all chromosome numbers between 16 and 34 except the number 20. In addition, there were 3 plants having the chromosome numbers of 38, 39 and 45 respectively. The frequency of the different chromosome numbers is interesting. The average of the entire F_2 generation is as high as $2n = 29$. The numerically highest class represented is $2n = 30$ with 185 individuals or 29·8 per cent of the entire progeny. The classes $2n = 29$–31 amounted to 65·8 per cent, while plants with a lower number of chromosomes than 24 did not amount to more than 6·7 per cent. The euploid chromosome numbers were formed in the following frequency: diploid in 7 cases, triploid in 21 cases and tetraploid in 38 cases. 9 trisomic plants occurred.

Examinations of the chromosome numbers in the first pollen division in triploids show that gametes are formed with different chromosome numbers in expected frequency, that is, all numbers between 8 and 16 occur, the number 12 being the commonest. The distribution of chromosome numbers observed in F_2 should thus be due to zygotic selection. Of the expected zygotes, those with a chromosome number of about $2n = 30$ are evidently the ones most easily formed and those of about $2n = 20$ the most difficult. The few plants observed to have a greater number of chromosomes than 32 originate from gametes with doubled chromosome numbers or (the numbers 33 and 34) possibly from non-disjunction gametes.

A detailed account of the morphology and cytology of the various forms of chive will be published shortly.

ALBERT LEVAN.

Sugar-beet Research Station,
Hilleshög, Landskrona,
Sweden.
July 17.

Effect of 2:6-Dichlorophenol-Indophenol on Tumour and Kidney Respiration

IT has recently been shown[1] that 2:6 dichlorophenol-indophenol, among other oxidising agents, inhibits reversibly glycolysis in muscle extract. It was of interest, therefore, to try the effect of this substance on tumour tissue. Though inhibition of glycolysis was not found, the effects on respiration were striking. The experiments were carried out with the Dixon-Keilin apparatus[2] and the concentration of dichlorophenol-indophenol in the bicarbonate-containing medium was $1{\cdot}3 \times 10^{-3}$ M.

It was found that in the absence of glucose in the medium, the respiration of cancer tissue (Philadelphia No. 1 Rat Sarcoma[3]) was practically completely inhibited, while with glucose there was no great effect —in one case a stimulation and in another a slight inhibition of respiration was found, and in each case a diminution in the respiratory quotient. With kidney cortical tissue, however, inhibition was practically complete whether glucose was present or not.

The accompanying table summarises the results.

Tumour Tissue	$-Qo_2$	R. Q.	$Q_G^{O_2}$	$-Qo_2$	R. Q.	$Q_G^{O_2}$
Glucose present						
Normal	7·7	0·82	12·0	11·6	0·92	19·5
With dye	12·2	0·66	13·4	9·1	0·73	10·8
Glucose absent						
Normal	11·2	0·74		11·4	0·81	
With dye	1·3	—		1·2	—	

Rabbit Kidney Cortex	$-Qo_2$	R. Q.
Glucose present		
Normal	11·8	0·88
With dye	0·9	—
Glucose absent		
Normal	13·1	0·74
With dye	0	—

Kidney is a normal tissue which is comparable to tumour tissue in that its rate of respiration is not greatly affected by the presence or absence of glucose, and further experiments showed that addition of lactate was without effect on the inhibition. It would appear that the cancer tissue is able to produce from glucose a substance which counteracts the activity of the indophenol. It may be that this has some relation to the substance in cancer other than vitamin C which is capable of reducing dichlorophenol-indophenol[4,5]. The explanation of this phenomenon is being sought, and experiments with brain and other tissues will be made.

K. A. C. ELLIOTT.

Cancer Research Laboratories,
Graduate School of Medicine,
University of Pennsylvania,
Philadelphia, Pa.
June 21.

[1] Lipmann, *Biochem. Z.*, **265**, 133; 1933.
[2] *Biochem. J.*, **27**, 86; 1933.
[3] Waldschmidt-Leitz, McDonald, *et al.*, *Z. physiol. Chem.*, **219**, 115; 1933.
[4] Harris, NATURE, **132**, 27, July 1, 1933.
[5] Harris, NATURE, **132**, 605, Oct. 14, 1933.

Limits of the Energy Spectra of Positrons and Electrons from Artificial Radio-Elements

USING a method of coincidences in two Geiger-Müller counters, slightly modified in comparison with that previously described[1], we have investigated the energy spectrum of RaN, RaP and RaAl.

In the following table, only values for the end-points of the spectra are given.

Bombarded element	Radioactive element	Particle emitted	End point of the energy spectrum	Range of the incident α-particles
B	RaN	$\varepsilon+$	1450	5·5 cm.
Al	RaP	$\varepsilon+$	3700	6·1 cm.
Al	RaP	$\varepsilon+$	3700	5·2 cm.
Mg	RaAl	$\varepsilon-$	3050	6·1 cm.
	Th (C+C″)	$\varepsilon-$	2200	

To test and to calibrate the apparatus, the well-known spectrum of thorium (B + C + C″) was used. The end point of the thorium (B + C + C″) spectrum obtained is in good accord with data by other investigators. The spectrum of positrons from radio-phosphorus was measured for α-particles of ranges of 6·1 and 5·2 cm. The shape of the spectral curve and the end point value remain unaltered for both ranges. The value which was obtained for the

spectrum limit for positrons is higher than that reported by I. Curie and F. Joliot[2] but differs considerably (by 1,300 kv.) from that of L. Meitner[3].

We investigated also the dependence of the electron yield, and hence the yield of radio-aluminium atoms, on the range of the incident α-particles. In the case of magnesium, a mixture of radio-aluminium and radio-silicon appears, corresponding to the transformation of different magnesium isotopes; it seemed therefore reasonable to carry out this investigation separately for electrons and for positrons. The same apparatus was used and the number of electrons having energies exceeding 1,500 kv. counted, as a function of the thickness of mica sheets inserted between the source and the magnesium foil (thickness ca. 30–40 microns). The results obtained are shown below:

Number of electrons	Range of particles
1700	5·90 cm.
1100	5·60
620	5·40
340	5·00
270	4·55
120	3·80

In the range interval from 5 cm. to 3·8 cm., we observed a distinct step corresponding obviously to resonance penetration of α-particles in the magnesium nucleus.

Similar results were also obtained in the case of capture of α-particles by an aluminium nucleus.

A. J. ALICHANOW.
A. J. ALICHANIAN.
B. S. DŽELEPOW.

Physico-Technical Institute,
Leningrad.
July 4.

[1] A. J. Alichanow, NATURE, **133**, 581, April 14, 1934.
[2] I. Curie and F. Joliot, *J. Phys.*, **5**, 153.
[3] L. Meitner, *Naturwissen.*, H. 22/24, 388; 1934.

The Second Spark Spectrum of Tellurium

THE arc and the spark spectra of tellurium, extending over the wide region between λ7000 and λ450 have been under investigation by me for the last two years under varying experimental conditions. Very useful data of the spectrum, especially in the vacuum region, have also been kindly made available to me by Dr. K. R. Rao and Prof. R. J. Lang. With the aid of these, the analysis of the very complicated second spark spectrum of tellurium has been elucidated. It is found that the fundamental intervals $5p^3P_0 - 5p^3P_1$, $5p^3P_1 - 5p^3P_2$, and $5p^3P_2 - 5pD^1_2$ are respectively 4,751, 3,410 and 9,198 cm.$^{-1}$. The terms ms^3P having a total separation of 7,952 cm. in the first number are gradually tending to their limiting value 9,227 cm.$^{-1}$ of Te IV[1]. The terms of the $6p$ state are generally in consonance with the corresponding terms of Se III[2]. The third ionisation potential of tellurium, as calculated from the above analysis, is about 29·5 volts. The complete analysis is being communicated to the Royal Society of London.

S. G. KRISHNAMURTY.

Science College,
Andhra University,
Waltair, India.
June 28.

[1] K. R. Rao, *Proc. Roy. Soc.*, A, **133**, 220; 1931.
[2] K. R. Rao and S. G. Krishnamurty, *Proc. Roy. Soc.*, A (in press).

Activities of Life and the Second Law of Thermodynamics

IN his last letter[1], Sir James Jeans writes: "It is a well-known, and indeed obvious, fact that entropy has different values according as it is measured with reference to atoms or molecules or other units." If by entropy he means the *absolute entropy* of a given *state* of a system, his remark, though true, has no bearing whatever on the point at issue. If, on the other hand, he means the *entropy change* in some definite *process*, such as the sorting out of trucks, then we suggest that he is unique amongst physicists in holding this opinion.

We have consistently maintained[2], and still maintain, that the entropy change associated with the sorting of trucks is of the order of magnitude (to within a few powers of ten) Nk, where k is Boltzmann's constant and N is the number of trucks sorted. Sir James Jeans, on the other hand, recently expressed the opinion[3] that N should denote the number of molecules in the trucks. He now apparently suggests that it is merely a question of convention. Though we have discussed the matter with several authorities, including one of the most eminent theoretical physicists of the world, we have failed to find anyone, other than Sir James Jeans, who disagrees with us. We are content, therefore, to leave the matter in dispute to the judgment of the readers of NATURE.

F. G. DONNAN.
University College, London.
E. A. GUGGENHEIM.
University of Reading.
April 21.

[1] NATURE, **133**, 986, June 30, 1934.
[2] NATURE, **133**, 530, April 7, 1934. **133**, 869, June 9, 1934.
[3] NATURE, **133**, 612, April 21, 1934.

Photodissociation of Molecules in the Schumann Ultra-Violet

LARGE energy quanta are needed to disrupt a bond in an organic molecule with simultaneous excitation of the radical set free to the emission of its characteristic spectrum. In some cases, however, this process may be produced in the Schumann ultra-violet.

While studying photochemical reactions induced in gases by light in this region of the spectrum, we were also able to observe the emission of the diatomic radicals OH and CN accompanying the photodissociation of more complex molecules.

The processes observed are:

$$h\nu + H_2O \rightarrow H + OH^*$$
$$h\nu + CH_3OH \rightarrow CH_3 + OH^*$$
$$h\nu + CH_3CN \rightarrow CH_3 + CN^*$$

where OH* and CN* are excited radicals emitting the bands at 3062A. and 3883A. respectively.

The work is now being extended to some other organic molecules.

A. TERENIN.
H. NEUJMIN.

Photochemical Laboratory,
Optical Institute,
Leningrad.
June 29.

Research Items

Possession among the VaNdau. M. H. Ph. Junod describes in *Africa*, 7, 3, a case of VaNdau possession. The VaNdau established themselves among the Bathonga, well known from the description of them written by the late father of M. Junod, as a result of the reduction of the tribes of southern Mozambique in the course of last century. For a long time considered an inferior race and reduced to slavery, they, or rather the spirits of their deceased, have become a terror of the Bathonga, whom they seize in possession. The spirits of the dead VaNdau roam about seeking vengeance on those who have ill-treated them during life. They enter the living and torment them to such a degree that they are prepared to do anything that the spirit wills. Hence the Thonga have devoted themselves to the study of the means whereby these spirits may be propitiated. Many classes of the Ndau ancestral spirits are recognised, to each of which an appropriate chant or song is addressed. Many of these are full of obscene terms. This shows that the state of possession is assimilated to certain periods of life when the ordinary restraints are relaxed. There is no hesitation in abusing the spirit, as for example, in one chant, in which the daughter of a chief is addressed as a prostitute. The exorcist, an office which is not easy of attainment, is either 'called' or may be initiated officially. The period of initiation is six days, on the last of which the real ceremony takes place. It is an introduction to a spiritual knowledge and to a mystic state comparable to that of the mysteries of the beginning of the Christian era. The exorcist may be a man or a woman ; and it is evident that they are well versed in taking advantage of the weaknesses of the people.

Bird Migration and Light Periodicity. Following upon the results of Rowan's experiments which suggest that light periodicity, through its influence upon activity, has a bearing upon the development of the gonads of birds, and so upon their migratory habits, L. J. Cole has tested light effects upon the mourning dove, *Zenaidura macroura carolinensis* (*Auk*, 50, 284 ; 1933). The normal reproductive cycles of mourning doves, or mourning doves with ring dove mates, kept in captivity in naturally lit rooms was found, over a period of years, to be similar to that of wild birds in the region where the captives were taken. Two pairs whose egg-laying dates were well established were placed in each of two separate artificially lit rooms, in one of which the diurnal light period was kept constant at 10½ hours, while in the other the period was increased by 45 minutes weekly up to a 'day' of 19½ hours. The result was that in the latter room one female mourning dove which for five previous seasons had not laid in spring until early in April, laid on February 4 and 5 and again on February 24 and 25, while the other, a ring dove mated with a mourning dove, laid fertile eggs on January 20 although no fertile egg had been laid by her since the preceding July, showing that the male mourning dove had also attained precocious reproductive activity. Of the females in the 'short day' room none had laid up to March 15. The numbers used in these experiments are small, but so far as they go they support the findings of Rowan and Bissonnette that reproductive activity is advanced by lengthening daily light.

Fossil Fishes from Wyoming. Mr. William L. Bryant, in his paper "The Fish Fauna of Beartooth Butte, Wyoming", Parts 2 and 3 (*Proc. Amer. Phil. Soc.*, 73, No. 3, Feb. 1934), describes numerous remains of acanthaspid fishes consisting of detached head roofs and trunk plates. The discovery and exploration of the beartooth fish lens opened a new chapter in our knowledge of vertebrate evolution, revealing another locality where, in Lower Devonian times, lay a body of water teeming with fishes. The author is of the opinion that we still lack sufficient details of these rare members of the *Arthrodira* and know too little of their evolutionary history to warrant their removal from the class Pisces as is suggested by Heintz. No traces of the jaws or dentition have ever been found in the acanthaspids. Basing his opinions on the study of the teeth of the later arthrodires, Mr. Bryant assumes that the most primitive members were equipped with functional teeth similar in origin to those of the gnathostome, and presumes, until more evidence is forthcoming, that the *Arthrodira* including the *Acanthaspida* were true, if highly specialised, fishes, perhaps, in the remote past, having branched off from the Elasmobranch stem. In an appendix, Mr. Rudolph Ruedemann describes eurypterids from the same locality.

Gape-worm in Chickens. P. A. Clapham (*Proc. Roy. Soc. Lond.*, B, 115 ; 1934) records the results of experiments on the transmission of gape-worm, *Syngamus trachea*, by earthworms. Examples of *Syngamus trachea*, obtained from the trachea of partridges, pheasants, chickens and rooks, were dissected and the eggs so liberated were cultivated in Petri-dishes in the laboratory until, in 10–14 days, they reached the infective stage. The earthworms, *Lumbricus terrestris* and *Eisenia fœtida*, employed in the investigation were obtained from soil which could not have been contaminated with larvæ of *Syngamus*. These earthworms were kept in sterilised soil in large Petri-dishes in the laboratory for a week to give them time to void the soil in the gut together with any free eggs or larvæ of helminths. They were then transferred to fresh soil and the eggs containing infective larvæ of *Syngamus* were added to the soil. At the end of 14 days or more the earthworms were washed and brushed with a camel-hair brush to remove soil particles and any adhering larvæ and were fed to chicks which had been reared in incubators. As an intermediate host of *Syngamus*, *Lumbricus terrestris* is much less important than *Eisenia fœtida* ; the latter earthworm lives in soil containing decaying organic matter and hence can be found in large numbers on land over which stock is being raised intensively, for example, poultry runs, and hence this worm is a source of danger when young chickens are reared year after year on old land. All the chickens fed with infected *Eisenia* became infected with *Syngamus* and usually died with the trachea completely blocked. The number of *Syngamus* present varied from 6 to 51 pairs. About 50 per cent of the chickens fed with infected *Lumbricus* proved to have *Syngamus* in the trachea but the infestations were not fatal. Examinations of the infected *Eisenia* showed that the larvæ of *Syngamus* were third-stage larvæ and were encysted in the muscles of the body wall ; they were not present in the intestine as previously reported by Walker.

It has been generally stated that infection with *Syngamus* could be established only in very young chickens but experiments recorded in this paper indicate that, using *Eisenia* as intermediate host, it is possible to transmit *Syngamus* to chickens about three months old, which are under-nourished.

Acceleration of Flower and Fruit Formation. Experiments carried on in the laboratories of Schering-Kahlbaum in Berlin by Prof. W. Schoeller and Dr. H. Goebel have furnished the result that progynon can accelerate the formation of flowers and fruits in hyacinths, tomatoes, lilies-of-the-valley, etc., when progynon is given in very small quantities to the roots either in watery solutions or in the earth ("Die Bedeutung des Follikelhormons für die Pflanze". Von Prof. W. Schoeller und Dr. H. Goebel, Berlin. Medizinische Abhandlungen. Jahrg. 5, Heft 2. Schering-Kahlbaum. A.G. Berlin.) The quantity for hyacinths was 200 units progynon a week. Although the progynon was not absolutely pure, it is thought improbable that this phenomenon may be caused by an impurity. In these experiments there is no question of an influence on the formation of flowers, but only of an acceleration of the development of primordia which were already present. It is well known that such an acceleration can be brought about by many other stimuli, such as ether, ethylene, hot water, cooling at a certain time, etc. It certainly is interesting if among these stimulants progynon also plays a rôle. It will be interesting to see whether these preliminary investigations are confirmed when they are carried out on a larger scale. It may be important to emphasise that this action of progynon is very different from the *blütenbildende Stoffe* of Sachs or root-producing substance of Went, Jr., where indeed new primordia are formed.

Formation of Urease by *Aspergillus*. An interesting study of the conditions necessary for urease formation by *Aspergillus niger* has been made by T. Miwa and S. Yoshii (*Sci. Reports Tokyo Bunrika Daigaku*, 1, 243; 1934). They find that the formation of this enzyme, as measured by its activity, depends chiefly upon the age of the culture and the acidity of the medium. Thus with increasing age, the apparent urease content rapidly decreases, while production is high in cultures below *p*H 4 and is at a maximum at *p*H 1·6–1·8. The addition of glucose or fat to peptone media also apparently favours production of the enzyme. The use of various sources of nitrogen, other than urea, has little effect upon the amount produced.

The Central Core of the Earth. Until about two years ago, no trace of distortional waves has been found on seismograms at great distances from the origin, and this absence has led to the conclusion that the earth contains a central core about 4,400 miles in diameter and composed of a material very different from that outside. Two earthquakes occurring in 1929 have recently led to a revision of this inference. The South Atlantic earthquake of June 27 was registered at Tokyo, 160·4° from the origin, and, according to Prof. A. Imamura (*Tokyo Imp. Acad. Proc.*, 8, 354–357; 1932), the *S′* phase was clearly defined. Mr. L. Bastings has recently studied about fifty European records of the Buller (N.Z.) earthquake of June 17, and these have provided further evidence of the penetration of the central core by the shear or distortional waves. In a paper read before the Wellington Philosophical Society (reported in the *Dominion* of May 16, 1934), Mr. Bastings shows that the waves had travel-times that indicated a rigidity in the core agreeing remarkably with that of the extra-nuclear structure.

Some Properties of Positive Electrons. The *Physical Review* of June 1 contains an account in English of work by J. Thibaud on the positive electron. The positive electrons were produced by a lead foil wrapped round a γ-ray source, and were subjected to a new kind of focusing by an inhomogeneous magnetic field. The field is that lying round the periphery of the circular pole pieces of an electromagnet—it has a large radial gradient, and the paths of the particles are trochoidal. Particles from a small source are collected over nearly a hemisphere and guided round the pole-pieces. The focusing is not selective for velocity. The application of a suitable electric field shifts the spiralling beam of electrons. This electrostatic deflection, combined with measurements of the diameter of the trochoidal beam in a known magnetic field, allow a rough determination of e/m for the positive electrons which shows that e/m lies between half and double the value for negative electrons, and that the two values of e/m are probably identical within much closer limits. When thin absorbing screens are introduced, the scattering and slowing down of the positrons is similar to that of electrons, but with thicker screens the results are complicated by a process which appears to consist in the annihilation of the positive electrons with production of true quanta of energy about 0·5 m.e.v. The free path of a positron before this conversion takes place seems to correspond to a stratum of matter containing about 600 mgm. per sq. cm. Since similar figures are obtained for this quantity in air and in platinum the process must certainly be ascribed to encounters of the positrons with electrons. In addition to the production of positrons in lead, there seems to be a large 'natural' production of positrons from several radioactive elements.

Polarisation of Long Radio Waves. Although the propagation of long radio waves has been studied for some time, there are certain anomalous features, particularly in short-distance transmission. There are peculiar directional effects and a striking result of Hollingsworth shows that there is a pronounced rotation of the plane of polarisation of the down-coming waves at a receiving station during the sunrise and sunset periods. A. L. Green and G. Builder (*Proc. Roy. Soc.*, A, June) have applied the magneto-ionic ray theory to the propagation of these long waves. The calculations show that for propagation of waves along the earth's magnetic field the ordinary (electric vector vertical) and extraordinary rays are received with comparable intensities. When the propagation is across the magnetic field, the attenuation of the ordinary ray due to collisions of electrons in the upper ionosphere may be much greater than for the extraordinary ray, but the attenuations become nearly equal again if the frequency of collisions is very high. The rotation of the plane of polarisation observed by Hollingsworth is therefore to be explained as due to a transference of the reflection at daybreak to a region of the ionosphere about 50 km. above the earth's surface, where the collision frequency is high. The theory gives also a qualitative exploration of the directional anomalies in long-wave propagation.

Aberdeen Meeting of the British Association

In previous articles reference was made to the suitability of Aberdeen as a centre for excursions and to the arrangements the Local General Committee have made whereby practical effect has been given to this feature of the forthcoming meeting of the British Association there. In the present article it is proposed to outline in brief some of the other local arrangements made for the convenience and enjoyment of visiting members.

The Committee has prepared for issue to members a Local Handbook, containing (1) information as to local arrangements, (2) descriptive articles on the general excursions, and (3) a guide to the City of Aberdeen and environs. These descriptive articles, written by such well-known Scottish authors as J. J. Bell, Evan M. Barron, H. B. Mackintosh and W. Douglas Simpson, should enhance the pleasure derived from participating in the general excursions. In addition, the Committee is issuing a map of the region, a plan of the City and a brochure on the works, etc., which may be visited.

Aberdeen is a city of many industrial interests, and although known as the "Granite City", its chief industry is not concerned with granite. The works to be visited have been chosen with care so as to ensure that a representative panorama of industrial Aberdeen is available for inspection. They include paper mills, a tweed mill, a granite yard, fish works, a fish meal factory, engineering works, a dairy plant, a paint and colour works and an envelope factory.

A feature of special interest has been provided through the courtesy of the Fishery Board for Scotland. The research vessel *Explorer* belonging to that Department will be berthed in Aberdeen Harbour during the week of the meeting and may be visited by members of the Association. Officials of the department will be aboard and will explain the nature of the work carried out. Weather permitting, a practical demonstration at sea will be given.

As one would expect, the municipal institutions of Aberdeen are operated in a manner which demonstrates at the same time both efficiency and economy in working. Visits to representative departments of municipal activity have been arranged.

Another item of interest is the display of practically all the exhibits shown at the recent Telford Centenary Exhibition in the Institution of Civil Engineers in London. This has been arranged through the courtesy of the owners of these exhibits and the good offices of Sir Alexander Gibb. While an adjunct of Section G (Engineering), the exhibition will be open to all visiting members and a curator will be in attendance to give information relative to the numerous exhibits.

The entertainments include a reception by the Lord Provost, Magistrates and Town Council on the Thursday evening, and in this connexion the civic authorities are arranging a welcome in accord with the traditional hospitality of the City.

On the afternoon of Tuesday, the University of Aberdeen is holding a garden party in the grounds of King's College in Old Aberdeen—a section of the City apart and still retaining in essence the main features of a medieval university town.

During the week commencing Monday, September 10, the students of the University are producing a play entitled "Town and Gown" in His Majesty's Theatre, and Monday and Tuesday performances will be 'British Association performances'. A brochure on the play is being prepared and will be circulated to visiting members; the play is a cavalcade—of great beauty in parts and uproarious fun in other parts. A "British Association" dance has also been arranged to take place in the Beach Ballroom on Tuesday evening. The Beach Ballroom is a beautiful building on the sea front with a dance floor reputed to be the best in Scotland. Various social and golf clubs in the City will be open to visiting members during the week of the meeting. These include the well-known Royal Aberdeen Golf Club at Balgownie—a seaside course among the best in Scotland.

A wide variety of sectional excursions has been arranged, but it is thought scarcely appropriate to refer to these in this article. Full information may be had in the Local Handbook and the Programme and Daily Time Table.

As to accommodation, practically all hotels in Aberdeen have already been booked up, particularly single bedrooms, but there is an ample supply of good class lodgings at reasonable rates. A large number of persons who do not usually let rooms have indicated their willingness to accommodate members of the Association for the week of the meeting.

Apart from these outward indications of the willingness of all interested in the City to ensure to members a happy and profitable visit of the Association to Aberdeen, it should be emphasised that there also awaits members a personal welcome of great cordiality and warmth. The cultural aspect of the Association's activities and the catholicity of interests represented by the thirteen sections make a special appeal to the Aberdonian. The welcome to the Association may be well summed up in the City's famous toast—"Happy to meet, sorry to part, happy to meet again."

The Waite Agricultural Research Institute

An account of the history and development of the Waite Agricultural Research Institute from the year 1925, when its activities first started, up to 1932 has been issued by the University of Adelaide. Although the chief objective of the Institute is to conduct research on plant and soil problems, it also provides an advisory service to the Department of Agriculture in plant pathology and entomology and gives specialised courses of instruction for the agricultural degrees in the University of Adelaide.

The scope of the scientific work undertaken at the Institute covers a wide field. As might be expected, the limited rainfall and the development of a system of cereal and grassland management to suit such conditions, forms one of the major problems, and a study of the water requirements of plants under various manurial treatments and the differences exhibited by improved varieties of cereals and leguminous plants in this respect, has led both to increases in yield being obtained and also to the

extension of the area capable of supporting the crop. Pasture problems are being investigated both from the agricultural and the chemical point of view, special attention being paid to their mineral content and improvement by means of the introduction of superior species and strains.

Survey and classification of the various soil types in Australia forms a further branch of the work in the chemical section, and fertility problems, particularly in the irrigation settlements, are also being investigated. Entomological work has only been in progress since 1929, but already much valuable information has been obtained with regard to various pests of pasture, cereal and orchard crops. Diseases of agricultural crops inevitably form an important branch of the work of the Institute, and deficiency diseases due to a lack of some mineral element have also been successfully investigated. Breeding experiments with the view of securing varieties with improved resistance to fungus diseases form a natural corollary to the work of the plant pathology section.

Besides the land devoted to agricultural experiments, a certain area is reserved as a permanent park. Advantage has been taken of this to plant a portion as an arboretum, one section being used for indigenous, and another for introduced, species. The report includes a list, with abstracts, of the 141 papers published from the Institute during the years under review, reference to which will indicate the important results on widely different subjects which have already been obtained.

The British Pharmaceutical Codex

THE Codex Revision Committee of the Pharmaceutical Society of Great Britain is issuing in the form of small monographs the reports of its sub-committees* which have been considering different aspects of the Codex in view of its revision this year. The next issue will contain about 300 monographs on crude drugs of vegetable origin of which less than seventy are included in the British Pharmacopœia.

The report of the Pharmacognosy Sub-Committee gives a summary of the principal standards for crude vegetable drugs, which have been accepted provisionally for inclusion in the new edition of the Codex: the standards of purity are based on determinations of foreign matter, alkaloid content, ash, extractive, etc., carried out in a manner similar to the corresponding tests of purity for the drugs in the Pharmacopœia. The report does not deal with the larger part of the sub-committee's work which is concerned with the revision of the descriptions, characters, constituents and commercial varieties of crude vegetable drugs.

The report of the Action and Uses Sub-Committee supplies descriptive portions for about fifty drugs, mostly of animal origin, including antitoxins, toxins and gland products. Among the substances described are scarlet fever toxin and antitoxin, new tuberculin, antimeningococcal, antipneumococcal and antistreptococcal sera, gonococcal, pneumococcal and staphylococcal vaccines, rennet, extracts of parathyroid and suprarenal cortex, œstrin, desiccated stomach and vitamin A, B, C and D concentrates. Standards are suggested for the different preparations. In addition, the sub-committee has revised the "actions and uses" sections of about 1,000 monographs, although their recommendations are not included in this report.

The report of the Pharmacy Sub-Committee includes the principal new and revised formulæ, expressed in both metric and imperial systems, suggested for the formulary section of the Codex. In addition, according to the introduction to the report by the editor, Mr. C. E. Corfield, the sub-committee has worked out tests which it has recommended should be included to form B.P.C. standards for the different preparations. It has also recommended the inclusion of alcohol limits for the concentrated infusions, spirits and tinctures, as well as formulæ for a number of preparations from earlier pharmacopœias which are not included in the British Pharmacopœia 1932, but are still in more or less frequent demand. The reports are issued in the hope that useful comments on the suggested revisions will be received.

* The Pharmaceutical Society of Great Britain: Codex Revision Committee. Reports of Pharmacognosy Subcommittee (pp. 20: 2*s*.), of Action and Uses Subcommittee (pp. 14: 1*s*. 6*d*.) and of Pharmacy Subcommittee (pp. 49: 2*s*. 6*d*.). The Pharmaceutical Press, 23 Bloomsbury Square, London, W.C.1.

Valve Conditions in the Internal Combustion Engine

MAINTENANCE of the automobile engine of to-day is little more than a process of periodic adjustment and replacement, necessitated by wear in component parts. Accordingly any systematic study of the factors causing or influencing such wear will be followed with interest by users and manufacturers alike. In recent years, the Research Committee of the Institution of Automobile Engineers, Watergate House, York Buildings, Adelphi, W.C.2, has undertaken the investigation of wear occurring in various parts subjected to the trying temperature conditions existing in and about the combustion zone. This work has been particularly fruitful. Last year the Committee issued a report on "Cylinder Wear" which attracted considerable attention, and now it has published the results of its work on "Valve Seat Wear".

The first part of the present report deals directly with valve seat wear and describes the experimental technique adopted to discriminate between actual wear in the valve seat and distortion of the valve. Two types of valve material were used. With both, the rate of valve sinkage increased rapidly with increase in tappet clearance and, within the practical temperature range, with rise in temperature. In the one case, however, the valve sinkage was mainly due to seat wear, whereas in the other, it was almost entirely attributable to distortion or 'dishing' of the valve head. Tests with different widths of valve seat bring out the fact that wear is quite independent of seat area.

The important effect of temperature prompted an investigation of the factors influencing exhaust valve and seat temperatures. The results obtained are set out in the second part of the report, and show the influence upon valve and seat tempera-

tures of engine speed, length of valve guide, diameter of valve stem, width of seat, fuel and mixture strength, ignition setting, and cooling water outlet temperature. These results are all interesting and some should prove of real practical use. One point to be particularly noticed is the statement that maximum engine temperatures were obtained when using normal mixtures with optimum ignition advance, a result quite contrary to the common belief that retarded ignition and weak mixtures give rise to overheating.

Sound Recording for the Cinematograph

THE improvement in the quality of recorded sound during the past five or six years has been very rapid. During that time the silent film has been almost entirely superseded by the 'talkie' in the cinema. Dr. C. E. K. Mees, in the Sir Henry Trueman Wood Memorial Lecture delivered before the Royal Society of Arts on May 16, said that the introduction of sound recording to the cinema has influenced every part of the motion picture industry. While it will be readily appreciated that the various developments of the mechanisms for recording and reproducing pictures and sound have in themselves been very extensive, striking changes have also been made in other things, such as the design of theatres and the kind of play which may successfully be filmed.

The detail of sound recording and reproduction for the cinematograph may be divided into several sections : (1) Conversion of sound to electrical pulses ; (2) modulation of light intensity by the electrical pulses ; (3) photographic recording of the light fluctuations ; (4) light fluctuations reconverted to electrical pulses ; (5) electrical operation of the loud speaker. Much of this long chain of operations is concerned with electrical apparatus, but the photographic part differs in no essential way from the ordinary procedure of taking a snapshot, making and projecting a lantern slide. Each of the photographic processes calls, however, for very much more accurate control than is necessary for mere picture-making. Very extensive investigations have been made of the whole subject. These have covered many points already broadly understood, but the new work has been necessarily much more thorough.

The influence of the new knowledge gained is manifest in the improved quality of the sound in the theatres : there is less distortion and less 'ground noise'. Of the first of these it can only be said that constant research on the problems of making and matching negative and positive, and studying wave form reproduction, are gradually pushing the quality beyond its already high level. It seems, however, that little reduction in ground noise is to be expected from diminishing the grainy quality of the photographic material ; the presence of minute scratches, dirt particles, etc., which are inevitably formed when the film is handled, is generally more than enough to counterbalance any decrease in graininess. The reduction of ground noise is being accomplished by modifying the recording apparatus so that the influence of flaws on the film is allowed to operate fully only when the sound to be recorded is loudest : the true sound record then masks the trouble.

The researches already carried out have necessitated the construction of much special apparatus and the development of special technique. Now that these are available, progress is likely to be even more rapid.

University and Educational Intelligence

LONDON.—The following degrees have recently been awarded : D.Sc. in chemistry on H. Martin (Imperial College—Royal College of Science) for thirty-one published works on the "Elucidation of the Mechanism of the Toxic Action of Insecticides and Fungicides used for the Control of Crop Pests and Diseases" ; D.Sc. in physiology on Dame Anne Louise McIlroy (University professor of obstetrics and gynæcology at the London (R.F.H.) School of Medicine for Women) for a thesis entitled "Researches upon the Prevention and Treatment of Asphyxia in the New-born" (*Med. J. and Record*, Nov. and Dec. 1933) ; D.Sc. in zoology on Ethelwynn Trewavas (private study) for published works entitled (1) "The Hyoid and Larynx of the Anura", (2) "Enteropneusta", (3) "A Revision of the Cichlid Fishes of the genus *Lethrinops*, Regan", (4) "Scientific Results of the Cambridge Expedition to the East African Lakes, 1930–31. II. The Cichlid Fishes", (5) "A Contribution to the Classification of the Fishes of the order Apodes, based on the Osteology of some rare Eels", (6) "On the Structure of two Oceanic Fishes, *Cyema atrum*, Gunther, and *Opisthoproctus soleatus*, Vaillant", together with three conjoint subsidiary contributions.

THE American system of radio broadcasting was criticised in an address to the Ohio Radio Institute on May 2 by Levering Tyson, director of the National Advisory Council on Radio in Education. The actual situation is that while, from the engineering point of view, there has been remarkable progress, the programmes have no greater cultural value than before 1927 when a licensing authority was established. This authority has tended to crystallise the *status quo* so that the fundamental concept of broadcasting as a public service has been side-tracked and it remains an individualistic enterprise for private gain. The problems of educational broadcasting are no nearer solution than in 1929 when Secretary Wilbur appointed a committee to investigate them, and the number of educational stations has decreased steadily until to-day there are only a few dozen. Mr. Tyson anticipates that an effort will be made by the industry to put its house in order but that advertisement will continue to be its financial basis. He looks for a gradual assumption by the State of responsibility for establishing certain public services within or parallel to the industry but he holds that "you can't force intellectuality down democracy's throat unless it opens wide its mouth. So far its teeth have been tightly clenched". The address is reproduced in *School and Society* of June 30.

EDUCATION in Kent, 1928–1933, is reviewed by the director, Mr. E. Salter Davies, in a report recently published by the County Education Committee. The administrative machinery was subjected to a severe strain in 1931, when expenditure had to be drastically restricted, and withstood the strain well, thanks to the elasticity and resiliency produced by a happy co-operation of its component parts and broad-minded and vigorous leadership. There was a notable *rapprochement* between the educational system and the requirements of industry. One of many instances of this is to be found in the ample provision for

practical work of all kinds now made in the central schools, recently established under the Hadow re-organisation scheme. In these, science teaching has developed on lines that represent a marked improvement on the traditional method of teaching in elementary schools. It is based on the study of every-day phenomena and is therefore influenced more and more by the nature of the occupations of the local community. This method of approach from practice to theory, from the qualitative to the quantitative, is found to vitalise the teaching. Adaptation to local conditions is facilitated by the schools not having to prepare for any set form of examination, efficiency being assessed "by inspection which envisages individual initiative and free development rather than by an examination which would tend to stereotype the instruction given throughout the county". Conditions in the central schools provide, of course, increased opportunity for specialisation accompanied by the assumption by teachers of increased responsibility. So far the results have been wholly satisfactory, especially in attracting teachers of comparatively high qualifications. Among changes in secondary education is the almost complete displacement of botany in girls' schools by biology, which has moreover found a place as part of the general science course in many boys' schools. Thirty pages of the report are devoted to agricultural education, in which Kent is pre-eminent.

Science News a Century Ago

Death of General Paixhans (1783–1834)

On August 19, 1834, General Henri Joseph Paixhans, the distinguished French artillery officer, died near Metz. Born at Metz on January 22, 1783, he passed through the École Polytechnique and, entering the army, eventually rose to the rank of general. He was an experimenter and inventor, and he improved both guns and projectiles, while his views on the armament of men-of-war had a profound influence on the development of the French navy. He was one of the first to explore the possibility of protecting ships with iron armour plates. He wrote several technical works, among the most important of which were his "Nouvelle Force Maritime et Artillerie", 1822, and "Expériences faites sur une Arme Nouvelle", 1825. As a member of the French Chamber of Deputies, he made several important speeches which were afterwards collected and published.

Caledonian Horticultural Society

"The Society intended so to have arranged their annual dinner, as that the competition fruit might have been partaken of by the members of the British Association, who are to meet in Edinburgh on Sept. 7. On mature consideration, however, they found that they could not deviate from the day fixed in their prize list, which had been widely circulated six months before. This day is the 4th of September, and if any of the learned strangers should happen to be in Edinburgh by that time, there is every reason to believe that they will be invited to be present at the Society's dinner. All the gardeners in the neighbourhood are exerting themselves to make a fine display by the time the Association arrive in Edinburgh." (*Edinburgh Advertiser*, Aug. 22, 1834.)

Steam Carriages and Steam Boats

The *Mechanic's Magazine* of August 23, 1834, said: "Mr. Hancock commenced on Monday last running two steam-carriages regularly between the City and Paddington, and they have been plying regularly throughout the week with uninterrupted success. One of Mr. Russell's steam-carriages between Glasgow and Paisley, having been overset by the breaking of a wheel, the boiler burst, and five persons were killed. The Court of Session has, in consequence of this, interdicted the whole set of carriages from running—for the present at least. A fine specimen this of Caledonian wisdom! Why do they not clear the Clyde of the whole of its steamers, since certain it is that steam-boats have met with accidents as well as steam carriages, and are as likely to meet with them again. It is impossible so absurd an edict can stand."

Airy and Greenwich Observatory

In his autobiography Airy says: "On Aug. 25th Mr. Spring Rice [Lord Monteagle] wrote to me to enquire whether I would accept the office of Astronomer Royal if it were vacant. I replied (from Keswick) on Aug. 30th expressing my general willingness, stipulating for my freedom of vote, etc., and referring to my letter to the Duke of Sussex. On Oct. 8th Lord Auckland, First Lord of the Admiralty, wrote: and on Oct. 10th I provisionally accepted the office. On Oct. 30th I wrote to ask for leave to give a course of lectures at Cambridge in case that my successor at Cambridge should find difficulty in doing it in his first year: and to this Lord Auckland assented on Oct. 31st. All this arrangement was for a time upset by the change of Ministry which shortly followed." At Keswick, between August 22 and August 29, Airy records also that he wrote his paper "On the Calculation of Perturbations" for the Nautical Almanac.

The 'Magneto-Electric' Spark

On August 25, 1834, Faraday wrote in his Diary: "To-day procured the Electric spark from a Magnet directly, i.e. used no soft iron lifter or intermediate magnet". He described an experiment with a cylindrical bar magnet and a coil of wire wound on to part of a pasteboard tube, in which a wire from one end of the coil made contact against a small amalgamated metal plate attached to the other end, and the magnet, on being driven through the tube, separated the wire from the plate and a spark resulted. "The Electricity here is much more directly from the magnet than in the usual way of procuring a spark."

The entry needs some explanation. Faraday depended greatly on the spark as a means of showing that the induced currents he had discovered in 1831 really were electricity, having the same properties as that from a voltaic battery or frictional machine. At the time of reading of the First Series of the Experimental Researches in November 1831, he had succeeded in obtaining the spark by induction only with the iron ring and wire coils used in his original experiment of August 29. It was not until February 1832 that he found a way of producing it with a permanent magnet, by bringing the ends of an iron core, surrounded by a wire coil the ends of which were touching, down on to the poles, when a spark resulted at the contact of the wires. Now, in August 1834, he had eliminated the iron core and obtained his spark with magnet and coil alone.

Societies and Academies

DUBLIN

Royal Irish Academy, June 25. SEÁN P. O. RIORDÁIN: Recent acquisitions from Co. Donegal in the National Museum. The paper deals with more than one hundred acquisitions obtained from Co. Donegal by the National Museum of Ireland during a period of about five years. Many of the Donegal finds were shown to be of unusual types in Irish archæology and gave evidence of interesting connexions with other lands, the relationships with Scotland being particularly close. Several new burial-finds were described, and in a résumé of bronze age burials a total of eight hitherto unpublished finds of food-vessels was brought to notice. Other discoveries of outstanding interest were a find of 108 amber beads (some with double perforation for use as 'spacers'); a socketed bronze axe with an arrangement of circle and pellet ornament similar to Scottish examples; an unusual type of flat bronze dagger, and a remarkable large stone axe. From the later period a find of three silver bracelets of Norse workmanship was dealt with in connexion with similar finds from Great Britain and the Continent and with regard to the evidence of ancient silver mining in Ireland. JOSEPH ALGAR and K. J. HANWAY: Further studies in the synthesis of diflavones. β-Diketones derived from diaceto-resorcinol-dimethyl ether may be prepared by condensing the latter substance with aromatic aldehydes in the presence of alcoholic sodium hydroxide to form dichalkones, such as dibenzylidene-diacetore-sorcinol dimethyl ether. These dichalkones, by addition of bromine, form tetrabromides and the latter, when heated with methyl alcoholic sodium methylate followed by treatment with hot aqueous hydrochloric acid, are converted into β-diketones of the type dibenzoylaceto-resorcinol dimethyl ether. While the procedure described affords a convenient route for the synthesis of β-diketones from diacetore-sorcinol dimethyl ether, attempts to prepare diflavones from the diketones by the action of hot concentrated hydriodic acid, were not uniformly successful. In some cases the analytical results appeared to indicate that ring closure had occurred on one side only of the central nucleus and that the action of the hydriodic acid had resulted in ketonic hydrolysis of the second diketone grouping with the production of a mono-flavone of the type 4′·7 dihydroxy-6-acetyl-flavone.

PARIS

Academy of Sciences, June 25 (*C.R.*, 198, 2217–2312). V. GRIGNARD: The method *par entraînement* for the preparation of mixed organomagnesium compounds. Experimental evidence is given proving that the functional exchange discovered by Prévost and studied more recently by Urion is quite insufficient to explain the phenomenon recently described by the author and named by him the method *par entraînement*. PAUL LANGEVIN was elected a member of the Section of Physics in succession to the late P. Villard. J. GERONIMUS: Some extremal properties of trigonometric polynomials. M. LÉVY: Selective transformations. Application to the analysis of mixtures of sinusoids. CAÏUS JACOB: Some generalised problems of Dirichlet-Neumann for multiply connected areas. RENATO CACCIOPPOLI: Double integrals of Cauchy, and generalised monogenic functions. PIERRE VERNOTTE: The control of the regularity of graduation of a thermometer. The method is based on the determination of the rate of cooling of a calorimeter vessel surrounded by a water jacket of constant temperature. MARCEL SCHWOB: The dispersion and thermal variation of the electrical double refraction of some optically active liquids. Ethyl and butyl tartrate were examined. These liquids have zones of abnormally rapid variation of the electric double refraction with temperature. In the case of ethyl tartrate, Langevin's law does not appear to be obeyed between 4° C. and 15° C. HENRY DE LASZLO: The determination of the structure of the free molecules of tetrabromo- and tetraiodo-pentaerythrite by the diffraction of electrons. L. ABONNENC: The diamagnetism of the ions. B. DECAUX and J. B. GALLÉ: Fluctuations in the time of propagation of short radio-electric waves. In the experimental arrangement described any variation in time over the journey Paris to Algiers and back was shown by a variation of the Lissajous figure on the screen of an oscillograph. During the day this figure remained stable, but at night the Lissajous figures continually changed in shape, sometimes so rapidly that it was impossible to follow them. The variations indicated a difference of time of more than 0·001 sec. over a total time for the double journey of 0·01 sec. ANGLA: Citronnellol-rhodinol. JEAN JAFFRAY: The origin of the high-frequency oscillations produced by high-tension magnetos. W. SWIETOSLAWSKI: The degree of dehydration of binary azeotropes. This can be measured by determining the difference between the temperatures of boiling and condensation. Quantities of water not exceeding 10^{-6} gm. per gm. of mixture can be detected in this way. AUGUSTIN BOUTARIC: The mechanism of the ascent of colloidal solutions in porous bodies. GUY GIRE and ALFRED MOTAIS DE NARBONNE: The action of magnesium on solutions of nickel chloride. E. VELLINGER and G. MULLER: The oxidation of mineral oils by atmospheric oxygen at moderate temperatures. The quantity of asphaltic products formed from mineral oils during the heating in presence of copper is proportional to the time of heating and to the quantity of copper dissolved in the oil. MLLE. BLANCHE GREDY: The study of some acetylene ether oxides. Study of Raman spectra of compounds of the type $R.C \equiv C.CH_2OCH_3$. MARCEL SOMMELET and ISRAËL MARSZAK: Chlormethyl compounds derived from the phenols. OCTAVE BAILLY and JACQUES GAUMÉ: The migration of the phosphoric radical in the course of the hydrolysis of the α-methylglycerophosphoric diester. The passage from α- to β-glycerophosphates. CH. COURTOT: Study in the diphenylene sulphide series. WIEMANN: The hydrogenation of a mixture of two α-ethylenic aldehydes. CHARLES PRÉVOST and RENÉ LUTZ: The reaction of the iodo-argento-benzoic complex on the erythrenic hydrocarbons. V. AGAFONOFF: The question of the buried soils of Alsace. J. JUNG: The position of the rhyolitic tufas of the Sioule (Puy-de-Dôme) valley and the ante-Hercynian age of the gneiss and granites of the north-west part of the Central Plateau. L. CLARIOND: The Palæozoic series of the territories of Tafilalelt (Morocco). CH. POISSON: The evolution of tropical tempests. Discussion of the laws governing tropical storms and the possibility of their prediction. CH. CHABROLIN: The germination of the seeds of *Orobanche*. J. GIAJA and S. GELINEO: Nutrition and resistance to cold. MLLE. A. ARVANITAKI and H.

CARDOT : The interpretation on a common base of myocardic electrograms. ET. RABAUD and MLLE. M. L. VERRIER : Retinal excitability and reflex immobilisation in birds. W. KOPACZEWSKI : Lactogelification of the seric proteins. MLLE. A. MICHAUX : The proportions of calcium and magnesium in the brain of guinea-pigs either normal or attacked with acute scurvy and chronic scurvy. G. DELAMARE : Numerical values of some primary sinusoids with unequal loops of the body of the Spirochetideæ. HENRI B. REITLINGER : A phenomenon of supersaturation of warm water.

LENINGRAD

Academy of Sciences (*C.R.*, n.s., **2**, No. 1). A. GELFOND : On the seventh problem of D. Hilbert. B. DELONE : Fermat's theorem for $n = 3$. A. I. POPOV : On some definite integrals with cylindrical functions. V. D. KUZNETSOV and V. A. ZOLOTOV : On the mechanical formation of twins during recrystallisation of deformed zinc single crystals. V. M. CHULANOVSKIJ and M. P. MOKHNATKIN : Fine structure of the triplet $(2s^2)\ (2p)\ 3s^3\ \varphi \rightarrow (2s^2)\ (2p^2)^3\ \varphi$ of the carbon atom. M. M. KATZNELSON and M. S. KONDAKOVA : 1-Ethyl-2-methyl-valerian acid. Description of properties of the acid. A. KHARIT and N. KHAUSTOV : Oxidation and reduction processes in a working muscle (3). Glutathione in a working muscle. During work, a muscle retains the glutathione which becomes reduced, while it is dispersed by a resting muscle. The oxidised glutathione is carried away by blood both from a working and from a resting muscle. E. HASRATIAN : The influence of an unconditioned food reflex upon the corresponding conditioned reflexes. The unconditioned reflex exerts an inhibitory influence upon conditioned reflexes during a certain period after it has ceased to act ; this inhibition is apparently of the nature of induction. A. SEREBROVSKIJ : The properties of Mendelian equations. Since the equations widely used in genetical literature have no algebraical meaning, the author suggests a new scheme for expressing genetic processes by formulæ constructed according to algebraic rules. The equations formed in this way may be solved algebraically, which would assist materially in the solution of various genetical problems. N. POTAPOV and N. STANKOV : Periodicity of mineral nutrition within the twenty-four hours. The rate of absorption of nitrates by Indian corn is determined by the intensity of the internal processes in the root system, particularly by the breathing activity of the root cells. During the night, the energy of breathing and the absorption of mineral substances increases, by day it decreases. N. UDOLSKAJA : Contribution to the study of the elements of mineral nutrition as factors altering the drought resistance of plants. The action of phosphorus on plants consists largely in increasing the water-retaining capacity of the plasma, thus ensuring a normal course of assimilation under conditions of deficient moisture. G. MOLOTKOVSKIJ : A gelatin chamber for a porometer. G. NADSON and E. STERN : The action of ultra-violet rays of a quartz mercury lamp on the cell of *Bacillus mycoides*, Fl. The rate of development is increased, and a rapid ageing of the cells results. P. MURZAJEV : Mineralogical and geochemical prognoses. The basis of a prognosis concerning the industrial value of a mineral deposit is formed by studying the type of the deposit, the paragenesis of the mineral concerned, and the chief temperature moment in the formation of the mineral body. N. A. GLADKOV : The distribution of ornithological stations on a lake in the plains. The following four stations should be distinguished : water area ; waterside shallows ; shore waterside thickets ; and shore itself.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, **20**, 145–219, March 15, 1934). A. J. WATERMAN : Survival of young rabbit embryos on artificial media. A limited amount of growth and differentiation of embryos of the late primitive streak and two somite stages was obtained by incubation on two culture media, one containing nutrient gelatin and the other Loeffler's coagulated blood serum. CHARLES E. ALLEN : A diploid female gametophyte of *Sphærocarpos*. The involucres of a specimen of *Sphærocarpos* bore an unusually large number of appendages. The spore-tetrads produced, instead of the usual two males and two females, three or even four female-producing spores. This line is diploid, with 2 *X*-chromosomes and 14 autosomes. CHESTER STOCK : A second Eocene primate from California. Parts of jaw bones and teeth belonging to a primate allied to *Washakius* have been found in the Upper Eocene in the Scope deposits of southern California. MORTON D. SCHWEITZER : Coincidence and interference in *Drosophila melanogaster*. C. W. METZ : The rôle of the 'chromosome sheath' in mitosis, and its possible relation to phenomena of mutation. Under favourable conditions, chromosomes are seen to be surrounded by a transparent and apparently gelatinous sheath. The author believes that this sheath is a characteristic structural component of all chromosomes. It is suggested that its function is to 'insulate' the chromosome proper and to prevent it from coming into direct contact with other formed bodies in the cell, including other chromosomes. Irradiation, which increases the rate of mutation, may act by modifying the sheath in such a way as to permit intimate contacts between chromosomes. D. C. COOPER : Development of the embryo sac of *Lilium Henryi*. RICHARD M. BADGER and ROBERT C. BARTON : The ultra-violet absorption spectrum of carbon suboxide gas. In a perfectly clean quartz vessel the gas keeps well especially at low temperatures. Keeping the absorption cell at room temperature, carbon suboxide shows relatively strong absorption bands between $\lambda 3200$ and $\lambda 2500$, and a continuum overlying the bands. The bands are due to transverse oscillations of the molecule and their complexity indicates several vibrational levels of nearly the same energy. RICHARD C. TOLMAN : Effect of inhomogeneity on cosmological models. A theoretical discussion of very simple models composed of dust (nebulæ) exerting negligible pressure and distributed non-uniformly but with spherical symmetry around some particular origin. The discussion may be valid in our own neighbourhood (out to, say, 10^8 light years) and over a limited range of time (say, 10^8 years) but does not necessarily apply to the universe as a whole. R. B. LINDSAY : Elastic wave analogies to the motion of electrons in force fields. HENRY BORSOOK and GEOFFREY KEIGHLEY : A theory of protein metabolism in man. Even in a state of nitrogen equilibrium, most of the protein metabolised in a day is drawn from 'stores' in the body. The specific dynamic action of protein is composed of two factors : (*a*) metabolism of the

nitrogen, a constant which is observable at temperatures below 20° C. when 'chemical' heat regulation mechanism is in operation; and (*b*) metabolism of deaminised residues, a variable factor which comes into operation above 20° C., when body temperature is governed by 'physical' heat regulating mechanisms. NORMAN C. WETZEL: On the motion of growth. (8) The connexion between growth and heat production in the amphibian *Bufo vulgaris* from fertilisation to metamorphosis. Gayda's observations (1921) on growth and heat production of this animal lead to a differential equation of growth similar to that obtained for a human being from early fœtal to adult life and for bacteria. It is claimed that this form of equation can be used quite generally to determine the relationship of growth to metabolism in any organism. EDWIN B. WILSON and JANE WORCESTER: The resolution of four tests. EDWIN B. WILSON: On resolution into generals and specifics. M. H. STONE: Boolean algebras and their application to topology. A Boolean algebra is defined by a set of postulates in terms of (logical) addition and (logical) multiplication as undefined operations. Various theorems are developed and it is shown that there is complete mathematical equivalence between the theories of Hausdorff topology and Boolean algebras. G. A. MILLER: Groups whose squares constitute cyclic subgroups. S. BOCHNER: Average distribution of arbitrary masses under group translations. G. VALIRON: Entire functions and Borel's directions. TRACY YERKES THOMAS: The reduction of degenerate quadratic differential forms.

Official Publications Received

GREAT BRITAIN AND IRELAND

The Botanical Society and Exchange Club of the British Isles. Report for 1933 (with Balance Sheet for 1933) by the Secretary, William Harrison Pearsall. Vol. 10, Part 3. Pp. 461–745. 10*s*. Report for 1933 of the Botanical Exchange Club, by the Editor and Distributor, F. Rilstone. Vol. 10, Part 4. Pp. 747–780. 4*s*. (Arbroath: T. Buncle and Co.)

City of Leicester. Science and its Applications: a Select List of Books in the Central Reference and Lending Libraries, Leicester. Pp. vi+65. (Leicester.)

Quarterly Journal of the Royal Meteorological Society. Vol. 60, No. 255: The Phenological Report, 1933. Pp. 197–250. (London: Royal Meteorological Society.) 3*s*.

Rothamsted Conferences. 17: Modern Changes in the Treatment of Light Soils; being the Report of a Conference held at Rothamsted on March 20th, 1934, under the Chairmanship of Sir E. J. Russell. With Contributions by Sir E. J. Russell, A. J. Hosier, W. Parker, A. W. Oldershaw and Dr. H. H. Mann. Pp. 34. (Harpenden: Rothamsted Experimental Station.) 2*s*.

The Hannah Dairy Research Institute. Annual Report for the Year ending 31st March 1934. Pp. 19+2 plates. (Kirkhill, Ayr.)

The National Central Library. 18th Annual Report of the Executive Committee, 1933–34. Pp. 53. (London: National Central Library.)

Board of Education. Report of the Advisory Council of the Science Museum for the Year 1933. Pp. 47+1 plate. (London: H.M. Stationery Office.) 9*d*. net.

Proceedings of the Royal Society of Edinburgh, Session 1933–1934. Vol. 54, Part 2, No. 10: Note on the Electron Configurations p^2s, p^4s. By Dr. Robert Schlapp. Pp. 109–114. 6*d*. Vol. 54, Part 2, Nos. 11, 12: Graphical Classification of Carbonaceous Minerals—The Mineral Oils; Products of the Natural Development of Coal and Oil. By Prof. Henry Briggs. Pp. 115–134. 1*s*. 9*d*. Vol. 54, Part 2, No. 13: Some Integrals, with Respect to their Degrees, of Associated Legendre Functions. By Prof. T. M. MacRobert. Pp. 135–144. 1*s*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

British Scientific Instrument Research Association. Sixteenth Annual Report for the Year April 1, 1933–March 31, 1934. Pp. 20. (London.)

OTHER COUNTRIES

British Honduras. Report of the Forest Trust for the Biennial Period ending March 31st, 1933. Pp. 22. (Belize.)

Journal of the Indian Institute of Science. Vol. 17A, Part 5: Utilisation of Non-edible Seeds and Seed-Cakes, 1: Vegetable Casein from *Pongamia glabra* and its Applications. By N. Srinivasan and V. Subrahmanyan. Pp. 49–74. (Bangalore.) 12 annas.

Nyasaland Protectorate: Geological Survey Department: Colonial Development. Water Supply Investigation: Progress Report (No. 3) for the Year 1933. Pp. 28+8 plates. (Zomba: Government Printer.) 2*s*. 6*d*.

Report of the Director of the Royal Observatory, Hong Kong, for the Year 1933. Pp. 11. (Hong Kong.)

Veröffentlichungen des Preussischen Meteorologischen Instituts. Nr. 404: Die Wärmeübertragung durch Leitung und Konvektion, Verdunstung und Strahlung in Bioklimatologie und Meteorologie. Von K. Büttner. Pp. 37. (Berlin: Julius Springer.) 5 gold marks.

Canada: Department of Mines: Mines Branch. Limestones of Canada: their Occurrence and Characteristics. Part 2: Maritime Provinces. By M. F. Goudge. (No. 742.) Pp. x+186. (Ottawa: Government Printer.) 50 cents.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 80: The Establishment, Persistency and Productivity of Selected Pasture Species on an Irrigated Reclaimed Swamp. By H. C. Trumble and Dr. J. Griffiths Davies. Pp. 32. (Melbourne: Government Printer.)

The Indian Forest Records. Vol. 20, Part 4: Entomological Investigations on the Spike Disease of Sandal, (21), Thysanoptera. By Dr. T. V. Ramakrishna Ayyar. Pp. ii+12+1 plate. (Delhi: Manager of Publications.) 6 annas; 8*d*.

Survey of India. Geodetic Report, 1933. Pp. xii+117+20 plates. (Dehra Dun.) 3 rupees; 5*s*. 3*d*.

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 33, Part 3: Die japanischen Hylobiinen (Col. Curc.). By Hiromichi Kono. Pp. 223–248+plates 5–6. Vol. 33, Part 4: A Study on the Development of the Tusser Worm, *Antheræa pernyi* Guér. By Saburo Saito. Pp. 249–266+plates 7–11. (Tokyo: Maruzen Co., Ltd.)

Science Reports of the Tokyo Bunrika Daigaku, Section A. No. 30: Über die Untersuchungen der organischen Schwefelverbindungen, Mitteilung 2: Über die Wirkung von Ozon auf Thiamiden und Thianiliden. Von Seiichi Ishikawa und Yohzoh Katoh. Pp. 17–26+1 plate. 20 sen. Nos. 31–22: Über die Verteilung der Primzahlen, von Heihachiro Ishikawa; Some Remarks on the Univalency and Multivalency of Functions, by Shigeo Ozaki. Pp. 27–55. 50 sen. (Tokyo: Maruzen Co. Ltd.)

Sudan Government: Wellcome Tropical Research Laboratories, Khartoum. Report of the Government Chemist for the Year 1933. (Chemical Section, Publication No. 67.) Pp. 16. (Khartoum.)

Reports of the Cancer Research Laboratories of the University of Pennsylvania Graduate School of Medicine. Vol. 2, 1932–1933. 34 papers. (Philadelphia.)

Smithsonian Miscellaneous Collections. Vol. 92, No. 4: A New Original Version of Boscana's Historical Account of the San Juan Capistrano Indians of Southern California. By John P. Harrington. (Publication 3255.) Pp. 62+2 plates. (Washington, D.C.: Smithsonian Institution.)

U.S. Department of the Interior: Geological Survey. Circular 9: Geology and Ore Deposits of the Elk City, Orogrande, Buffalo Hump and Tenmile Districts, Idaho County, Idaho. By P. J. Shenon and J. C. Reed. Pp. v+89+1 plate. Bulletin 849–D: The Mount Eielson District, Alaska. By John C. Reed. (Investigations in Alaska Railroad Belt, 1931.) Pp. viii+231–287+plates 21–24. 25 cents. (Washington, D.C.: Government Printing Office.)

The University of Colorado Studies. Vol. 21, No. 3: A Bibliography of Indium, 1863–1933. By Herbert A. Potratz and Prof. John B. Ekeley. Pp. 151–187. (Boulder, Colo.) 1 dollar.

Publications of the Observatory of the University of Michigan. Vol. 6, No. 2: Spectrographic Studies of Eclipsing Binaries. By Dean B. McLaughlin. Pp. 3–35. Vol. 6, No. 3: Atmospheric Motion in Delta Cephei. By R. M. Petrie. Pp. 37–42. (Ann Arbor, Mich.)

Memoirs of the Commonwealth Solar Observatory, Mount Stromlo, Canberra, Australia. Memoir No. 3: Measurements of Atmospheric Ozone made at the Commonwealth Solar Observatory, Mount Stromlo, Canberra, during the Years 1929 to 1932. By A. J. Higgs. Pp. 29. (Canberra: Commonwealth Government Printer.)

The New Zealand Astronomical Society, Inc. Bulletin No. 22: In Starry Skies. Part 12: Some Present Day Problems. By A. C. Gifford. Pp. 135. (Wellington, N.Z.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 127: A Record of Wheat Breeding, 1921–1931. By G. P. Morris. Mohammad Eff. El Dib and Ahmed Eff. Munir. Pp. iii+127. 15 P.T. Bulletin No. 128: Genetic Basis of Selection Procedure with Cotton Wilt Disease. By Dr. Tewfik Fahmy. Pp. iv+35. 10 P.T. Bulletin No. 130: The Selection of Wilt Immune Strains of Long Staple Cotton (Sakha 4 Gidid). By Dr. Tewfik Fahmy. Pp. vii+25+63 plates. 7 P.T. Bulletin No. 132: Fruit Growing on Sandy Soils. By Dr. Yousif Milad. Pp. 20+6 plates. 4 P.T. Bulletin No. 135: Ulcerous Dermatitis of Ruminants and its relation to Diphtheria of Man. First Paper by Prof. Dr. M. Carpano. Translated from the Italian by E. Talarewitch. Pp. 48+12 plates. 7 P.T. Bulletin No. 140: Fowl-Plague in Egypt. By Dr. Ahmad Mohammed Rachad. Pp. 22. 25 mills. (Cairo: Government Press.)

CATALOGUES

Catalogue of Chemical Apparatus, Chemicals and General Laboratory Equipment. 25th edition. Pp. xvi+856. (London: F. E. Becker and Co.)

Mercury-in-Steel Thermometers. (List No. T/30.) Pp. 48. (London: Negretti and Zambra.)

A Catalogue of Books, including Americana, Australiana, Bibles, Liturgies, etc., Bibliography and Palæography. Early Printed Books, English Literature, Fine Arts, Natural History, Oriental History and Literature, Periodicals, and a small Selection of Works on Tobacco. (No. 493.) Pp. 108. (London: Bernard Quaritch, Ltd.)

"Rotolex" Electric Decorating Kiln. Pp. 4. (London: G. W. B. Electric Furnaces, Ltd.)

Alloy Steels To-day. By Prof. D. Hanson. (Nickel, A22.) Pp. 8. (London: The Mond Nickel Co., Ltd.)

Editorial and Publishing Offices:

MACMILLAN & CO., LTD.
ST. MARTIN'S STREET, LONDON, W.C.2

Telephone Number: WHITEHALL 8831
Telegraphic Address: PHUSIS, LESQUARE, LONDON