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Co-operation in Industrial Research

THE stimulating lecture on fundamental scientific problems in the food industry delivered by Dr. L. M. Lampitt before the Liverpool and the Edinburgh Sections of the Society of Chemical Industry early this year directed attention to a number of problems in research which are of interest far beyond the bounds of the food industry. Dr. Lampitt, for example, was emphatic on the importance of the co-ordination of research, not merely of that financed or directed by the State but also of that carried out by academic or private institutions or by industry itself. Through lack of such co-ordination, not merely in the food industry but in other industries as well, there is overlapping and waste of effort, and also failure to undertake some of the more fundamental work upon which progress finally depends.

Dr. Lampitt suggested that one of our most urgent problems is to explore the possibilities of effective co-operation between the research stations, research associations, the universities and the industrial research organisations. A survey of extra-university research in pure and applied science has already been undertaken by the Association of Scientific Workers, and should provide much useful data for the study of the possibilities of co-operation. The existence of duplication and the neglect of fundamental problems constitute powerful and sufficient reasons for an attempt to formulate a definite policy which would enable the greatest use to be made of each type of activity. Such a policy in itself would ensure closer contact between the scientific investigator and the industrial world, and would tend to eliminate any tendency for the former to work on problems which he considers to be of practical importance but which a representative of industry would easily demonstrate to be of no appreciable utility.

The elimination of duplication and waste of effort, even with existing resources, should tend to liberate funds for fundamental scientific research, the position of which has already been seriously threatened by the restriction of the funds available for the Department of Scientific and Industrial Research. As stated in the report for the year 1930–31, in curtailing such expenditure, the policy of the Privy Council was to concentrate available funds on work of the most immediate practical value to industry, leaving to happier

times the expansion of work of which the results could only be available at some more distant date. In the campaign which has since been undertaken to secure support for the research association scheme following on the exhaustion of the Million Fund, stress has been laid once more upon the work of the most immediate practical value, and the prosecution and endowment of fundamental and long-range research have not received the attention which their place in the national economy demands. Apart from this, although the Department has done much to encourage fundamental research in universities and other institutions, it has from the first attempted to induce industries to undertake work for themselves rather than to carry out scientific work for them or even to organise fundamental research.

This position, while general, is fortunately not universal. Certain of the research associations, for example, have been and still are pursuing investigations of fundamental scientific importance, the application of which has yet to be demonstrated. Other sections of industry have made their own arrangements for assisting academic research at the universities by a system of grants in aid of investigations on purely scientific subjects which are likely to contribute indirectly to the solution or understanding of industrial problems.

As a prelude to such co-operation, it is essential that we should think out clearly the place and contribution of each variety of research organisation in relation to the economy of whole industries, and indeed of the national and not merely of individual industrial units or geographical or sectional interests. It should not be too difficult a task, given a broad outlook and a spirit of goodwill and co-operation, to elaborate a policy and devise a scheme which, while permitting full autonomy to individual research units, should offer immense advantages in efficiency, economy, and the interchange and discussion of ideas and results among research workers. It is unlikely indeed that under such conditions it would be necessary to create a fresh research institute or organisation. The more efficient utilisation of funds already available, or a comparatively moderate expansion of expenditure within the framework of our existing organisation, should suffice to finance a good deal of fundamental research the prosecution of which is overdue.

A further point made by Dr. Lampitt relates to the broader distribution of purely scientific data collected in the research organisations of industry. Even the smallest industrial research or analytical laboratory frequently acquires important scientific data, and it is rare for such physical or chemical knowledge to be of commercial importance to the firm, or for its disclosure to play into the hands of a competitor. If without disclosing the purpose of investigations of this type, means could be found of publishing the results, a large amount of knowledge locked up in individual units of an industry could be made available, to the advantage not merely of particular industries but also of the industrial and scientific world as a whole. It would, in fact, react to advantage and credit of those firms responsible for the work and would undoubtedly assist in the further and more efficient planning of our available resources.

The illustrations cited by Dr. Lampitt from the food industry were sufficiently suggestive, but they could easily be multiplied in such fields as analytical work, chemical engineering and corrosion, or in management methods. Much machinery for co-operative research already exists which might with advantage be used much more extensively in the exchange of information on non-competitive matters. Even in regard to the abstracting of chemical literature and information services, mistaken conceptions of individualism and independence still delay progress and make it difficult to achieve standards which are possible by co-operation alone.

These obsolete ideas are being steadily undermined by the work of various organisations, such as that of the British Chemical Manufacturers in regard to industrial safety, or of the British Standards Institution in the standardisation of materials and practice. The development of habits of co-operation and encouragement of the exchange of information on common problems quietly fostered in this way should go far to overthrow ideas of trade secrecy which have prevailed too long. With this, however, there is still need for a much fuller realisation of the place of research in everyday industrial practice. Industries which plead inability to meet a heavier demand for support of their research organisation cannot, in fact, expect much credence to be placed in their protestations, unless they can adduce evidence of a spirit of co-operation and of strenuous efforts to utilise to the maximum advantage by co-operation on such lines the organisations within their bounds already devoted to research.

The Gas Referees and the Gas Industry

SCIENCE and industry are dependent for much of their progress on the existence and authority of master men to whom the less experienced and less endowed may turn for direction and advice. During periods of stress or emergency their value is readily recognised and their services eagerly sought ; in normal times there is a danger that their existence may be forgotten because of their very modesty and the quiet and unobtrusive manner in which they work ; but their presence in the background as an ultimate source of effective authority is essential. Those whom the community choose as such counsellors are men of wide experience, of outstanding ability : men whose word is accepted without question. Often they have retired from the routine of daily duty and, unencumbered by masses of detail, they are thus better able to see a problem in its entirety and to set it in the frame of their whole experience.

In the light of these considerations, it is particularly regrettable that any community which in the past has been fortunate enough to possess such a source of counsel, should now contemplate its abandonment. The gas industry in Great Britain is a body which, for nearly seventy years, has possessed a source of inspiration and advice in the eminent men who have held the positions of Gas Referees and Chief Gas Examiner. Names such as those of Rücker, Tyndall and Harcourt, Williamson and Rayleigh, as past holders of these positions, coupled with those of the present gas referees—C. V. Boys, W. J. A. Butterfield, and J. S. Haldane—and the present chief gas examiner, Sir Richard Glazebrook, are in themselves evidence of the type of man who has given his services unsparingly in the interests of the gas industry.

The duties of the gas referees are to prescribe the places, times, apparatus and methods by which the gas is to be tested, and to determine if these tests are being carried out ; they also decide the methods by which the apparatus employed is to be tested. Gas examiners, who have to make the tests, are appointed by the local authorities. The referees issue a general specification applicable to all undertakings and, where necessary, special specifications for any particular supply company. They also issue full and detailed descriptions of the apparatus to be used, much of which is the invention of Dr. C. V. Boys himself, and of the method of using this. All this is scientific work involving a knowledge of test methods and of the conditions of manufacture of gas.

The gas companies can appeal on certain points, and the chief gas examiner has to hear and decide the appeals. They can appeal against the specification, but we believe that there never has been such an appeal ; nevertheless they value this privilege, and object to the Board of Trade, which is to make the specifications, also hearing appeals against them. They can also appeal against any particular test, and though usually the decision is easy, occasionally abstruse scientific questions are involved.

Such, in brief, are the chief duties of the gas referees and the chief gas examiner, and under their direction the routine business of gas testing has been ably conducted ; but their services to the gas industry have been greater than any which could be prescribed by an Act of Parliament. Their real value and their real function have been those of counsellors. In the Gas Undertakings Bill which was recently introduced to the House of Commons, the proposal is made that the offices of Chief Gas Examiner and of Gas Referees should be discharged by the Board of Trade. There can be no doubt that the routine of gas testing, the collection of data relating to the gas industry, and similar routine work, can be efficiently and competently carried out by the civil servants to whom these duties may be delegated by the Board of Trade ; but it is impossible that such civil servants, however efficient, can achieve that which has arisen from the eminence of the men who have previously been responsible for this work. The loss which the gas industry would incur by this change is beyond all computation.

It may be suggested, on behalf of the proposed change, that the replacement of the present holders of the offices would be no easy matter. Undoubtedly this is true, for eminent men are always scarce, but amongst present occupants of chairs of physics and chemistry at the universities of Great Britain there are men of outstanding merit who will, by the passage of years, be compelled to retire from active participation in academic work, and would be willing to place at the disposal of the gas industry the knowledge arising from their experience.

It seems incredible that the gas industry in Great Britain should wish deliberately to divorce itself from association with some of the ablest scientific men of the day. Must it not be that the change has been proposed without full consideration of the inevitable consequences ?

Atomic Theory

The Atom. By Dr. John Tutin. Pp. 109. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1934.) 6*s*. net.

ON the jacket of this interesting book appears the appetising paragraph: "No one interested in modern science should fail to read this book. It deals with a problem of profound importance, and although written by a scientist for scientists the clarity and simplicity of the argument are such that the general reader fond of science will find it attractive as well as intelligible." On second thoughts this may not mean very much. Science is a big subject, and it is by no means certain that any scientific worker, writing on a scientific subject outside his own field, deserves to be taken any more seriously than the layman. I should not personally consider myself entitled to be regarded as "a scientist writing for scientists" if I wrote a book on, say, biochemistry or mechanical engineering. But such a claim is made for Dr. Tutin, and being made, it is only fair to take it seriously. On thinking over past and conceivable future indiscretions of this nature that I have committed or might conceivably commit, I am clear that the great danger for the professional, venturing into another branch of the profession, must always lie in the lack of an adequate background. He may well provide exciting new ideas which may prove fruitful or unfruitful, but his critical discussion of current ideas is almost certain to be cruelly handicapped by lack of knowledge of what current theory can or cannot account for in its stride, and of what are the honest-to-goodness copper-bottomed facts.

We shall see that it is just here that Dr. Tutin's speculation fails. If he had known the facts and the present position of current theory, it is scarcely conceivable that he would have put his own alternative theory forward. There is, moreover, another danger which, from internal evidence, Dr. Tutin does not appear to have avoided—that of forming one's general opinion about the meaning of a theory almost entirely from popular and semi-popular expositions without any study of more profound or more original sources. Even when the popular expositors are such masters as Jeans or Eddington, this is highly dangerous. The fare they provide cannot constitute a well-balanced diet for a scientist. It lacks the vitamins essential to growth.

The thesis put forward by Dr. Tutin in this book may be described in outline as follows; the description for distinction is printed in italics.

(i) *The Rutherford-Bohr model of the atom (for short the R-B atom) was first put forward to explain the large angle scattering of α-particles, which it did successfully on the assumption that the scattering is due to a small heavy nucleus carrying the charge + Ze, where Z is the atomic number and e the (numerical) charge on the electron. The same scattering law would be found if the nuclear charge were − Ze.*

(ii) *There are grave deficiencies in the general theory based on the R-B atom, partly philosophical (the failure of a strict law of causation) and partly practical. Its obvious practical deficiencies are its failure to explain "why some atoms emit light and others do not, why some are electrical conductors and others insulators, why some are magnetic and others non-magnetic" (p. 15). It fails also to explain chemical valency and chemical combination generally.*

(iii) *Accepting the mathematical interpretations supplied by wave mechanics as to the fundamental nature and behaviour of protons and electrons (this is Dr. Tutin's own phrase, p. 13) a much more complicated and satisfactory alternative atomic model can be put forward (for short the A atom) in which the nucleus is a collection of Z electrons and the outer atom contains all the protons and the other electrons (mainly grouped in subordinate structures of mass less than or equal to four) required to produce a neutral structure of the correct mass.*

This is the foundation of the book in which Dr. Tutin first attempts to specify these and other deficiencies in the current theory using the *R-B* atom, and then to show how the *A* atom provides natural and simple explanations of these fundamental properties where the *R-B* atom fails, and provides them, moreover, *without any infringements of a strict law of causation.*

In his dislike of the law of causation Dr. Tutin hates in good company. It is a matter of taste about which no argument is necessary. But Dr. Tutin is wrong in attributing the failure of the law of causation in current theory to a weakness of the *R-B* atom. This failure has nothing whatever to do with any special model, but is an inherent property of that very quantum mechanics the results of which Dr. Tutin adopts to develop his *A* atom. Here it seems he has been misled by his study of some popular exposition. The failure of causation is, moreover, a far more refined concept than Dr. Tutin appears to believe, and

enters quantum mechanics (as the uncertainty principle) only because quantum mechanics, unlike Newtonian mechanics, does not permit of absolutely precise initial conditions ever being laid down in any problem. To the degree of precision permitted by the initial conditions, the state of affairs at any later time follows as rigorously and uniquely as ever it did in Newton's day. To the objection that if quantum mechanics imposes this restraint it is to that extent a bad mechanics, the answer is, of course, that only by imposing this restraint can quantum mechanics account for the *diffraction* of electrons by a regular lattice and that, in spite of the unexpected nature of the restraint, quantum mechanics can still in principle predict the results of any conceivable experiment. The phenomenon of electron diffraction, which is independent of any particular atomic model, is not discussed by Dr. Tutin, presumably for this very reason that diffraction will appear just the same whether the actual atoms are *R-B* atoms or *A* atoms. This is true enough. But the phenomenon disposes of any claim that his theory is either more or less causal than current theory; and the whole of his remarks about the law of causation seem to me to be beside the point.

Let us now return to the main thesis that the *R-B* atom, plus quantum mechanics, is a failure in the regions of physics and chemistry already mentioned and that the *A* atom succeeds at least qualitatively everywhere, without surrendering but rather incorporating whatever successes the *R-B* atom has had.

If quantum mechanics with the *R-B* atom had done no more than Dr. Tutin thinks it has done, it would certainly be highly vulnerable to his or any other attack. But this is far from the truth. To take first the question of electrical conductivity —that is, of forming a metal or an insulator in the solid state. It has been shown in detail just what conditions must be satisfied for the solid state to be a metal, and in particular it can be rigorously deduced from the *R-B* atom and quantum mechanics that the alkalis must be metals and not insulators. The proof can probably be extended to the noble metals. Owing to the complexity of the problem it has not yet been rigorously proved that, for example, diamond is an insulator. This is to be regretted, of course, but in a qualitative way the solution is already complete enough. It is merely the numerical computations which cannot be carried through. The qualitative solution extends also to include the queer substances now called semi-conductors the conductivity of which increases sharply with temperature. Boron, if its properties are correctly described by Dr. Tutin, is such a substance, but the classical example is cuprite.

To turn to magnetic properties, it is again hard to see that qualitatively the current theory fails in any way. Qualitatively, and even quantitatively, the paramagnetic properties of the rare earth salts are completely accounted for. The ferromagnetic properties of the iron group are already accounted for in the sense that, using only quantum mechanics and the *R-B* atom, and without any *ad hoc* hypothesis, it can be shown definitely that ferromagnetism will occur when certain possible conditions are satisfied, and in a general way that these conditions might be most easily fulfilled among the metals and alloys of the iron group. It is not, however, yet possible to say quantitatively that such a metal or alloy will be ferromagnetic and such another one not*.

In the optical and X-ray field the success of the *R-B* atom is of older date, and is not called in question by Dr. Tutin except that he maintains that an explanation is required why some atoms, particularly oxygen and sulphur, have a spectrum difficult or impossible (*sic*) to excite. I do not think that there is any difficulty here which calls for an explanation so ruthless as Dr. Tutin's, whose *A* atoms for oxygen and sulphur contain no 'free' electron. In fact, Dr. Tutin explains too much, for he forgets that conditions of excitation are all important. When left to itself, even the stubborn oxygen atom emits light, so much so that no spectrogram of the light of the clear night sky can be taken without showing the oxygen atom's auroral green line, while the lines of oxygen and sulphur in several states of ionisation are familiar features of the spectra of the hotter stars.

Finally, in the chemical field the qualitative successes of quantum mechanics and the *R-B* atom seem even more striking, and the promise of more quantitative success is rapidly being fulfilled. Current theory preserves and explains naturally the fundamental differences between covalent and electrovalent bonds, and accounts also perfectly satisfactorily for the number of possible covalencies—why a covalent link saturates in fact and cannot take part strongly in any further union. Complicated as the calculations are, the theory can even account in a general way

* In all this field of the atomic theory of solids, an excellent account of the existing state of current theory will be found in the article by Sommerfeld and Bethe in the "Handbuch der Physik", Vol. 24, Pt. 2 (Second Edition).

for the stereochemistry of carbon and why it is unique. Two quantum mechanical *R-B* atoms of suitable valency have, in short, in current theory the means to unite and the urge to do so, Dr. Tutin's statements to the contrary notwithstanding, the means to unite being an unpaired electron on each and the urge that by uniting with the formation of a new electron pair they can form a state of lower energy.

To sum up this survey of fields touched on by Dr. Tutin, bearing in mind evidence from other fields, such as collision theory, on which he does not touch, it seems fair to say that quantum mechanics working on the basis of the *R-B* atom promises to be completely competent to embrace in one simple theory the whole range of ordinary physics and chemistry. The whole general structure of the periodic table of the elements is explained in this way without any further hypothesis. There is no mystery about the periods $2n^2$. They are necessary logical consequences of the theory, which among other things allows only one electron to occupy any one state of given quantum numbers. Phenomena which with the *R-B* atom are classed as nuclear physics are at present excluded from this range. When we come to nuclear properties, though much success has already been achieved by the application of quantum mechanics to the heavy particles in the nucleus, the prospect is not so clear, and great modifications may be necessary before much further progress is made. It is well to emphasise finally with what beautiful economy of assumptions all this success can be achieved. We require nothing but quantum mechanics applied to electrons and heavy nuclei of charges 1–92, interacting with their ordinary Coulomb forces, nothing less and nothing more (except perhaps patience !).

What has Dr. Tutin to offer us in place of this elegant and well co-ordinated theory in which the diverse properties of, for example, C, N and O seem to find a natural place and to be referable, surprising as it may seem, to the slight change of one more electron and one more nuclear charge from one atom to the next ? If it were as yet only one tenth as successful, his theory would be worthy of the most elaborate exploration. The *A* atom has a light nucleus with charge $-Ze$ with the protonic masses at various distances in orbital motion round it, but so *rigidly* (*sic*) bound to it that the nucleus reacts like a body of atomic mass to any passing α-particle. This rigid binding is referred to a quantum mechanical restraint. Since Dr. Tutin's quantum mechanics is our ordinary quantum mechanics we can inquire more closely into this, which he has omitted to do. Extra rigidity of this type is found, for example, when electrons bombard atoms, but only when the energy of the bombarding particle is less than the energy of binding. Dr. Tutin must, therefore, assume new binding forces other than Coulombian to tie the protonic complexes to the nucleus so that their energy of binding may be of the order of 10^7 electron volts at least. Non-Coulombian forces are also required to enable quantised orbits of heavy particles to be of atomic and not nuclear dimensions (10^{-8} cm. rather than 10^{-12}). This is a grave inelegance in his theory, but let us allow these forces and proceed to inquire how such a structure, allowed to be rigid, will scatter α-particles.

When an α-particle passes near the nucleus it will be scattered by the usual Rutherford scattering law with a factor Z^2 for the nuclear charge Ze. Note that the extra forces are now ignored and the scattering purely Coulombian ! When it passes near one of the protonic complexes it will also be scattered by Rutherford's law with a factor P^2 when the charge on the complex is Pe. This extra scattering has been overlooked by Dr. Tutin. It does not occur for the *R-B* atom, because the electrons are light and not rigidly bound to the nucleus, so that they take no part in the large angle scattering. This extra scattering must be added on for each protonic complex. The resultant scattering will be given by Rutherford's law with the factor $Z^2 + \Sigma P^2$ instead of Z^2. Dr. Tutin's model gives a factor sufficiently greater than Z^2 to destroy the agreement between theory and experiment for the scattering of α-particles by elements of medium atomic weight. The alternative atom fails outright, self-strangled at birth.

If this point is ceded on the ground that experiments have not established for certain this rather fine distinction, we fall at once into all sorts of terrible difficulties with isotopes. For example, lithium consists of two isotopes, Li^6 and Li^7, of which, according to Dr. Tutin, the latter contains one free electron and is therefore a metal and the former none and is therefore presumably an insulator, though Dr. Tutin does not say so explicitly. (A slight conductivity in silicon is attributed to the possession of a free electron by its second isotope, p. 57 !) Since deposits of Li^6 and Li^7 can now be obtained separately, it might be interesting to Dr. Tutin if experiments

were made to determine their separate conductivities, though I doubt if any other chemist or physicist would expect any significant difference between them. To chemists in particular, differences so striking between the isotopes of a single chemical element are quite unbelievable, and their disbelief is amply warranted by all the available evidence. Since isotopic differences in general are referred by Dr. Tutin to the outer rather than the inner structure of the atom—definitely so for light elements—the chemical resemblances of isotopes can only be maintained by unnatural *ad hoc* hypotheses. Finally, of course, his theory requires us to refer radioactive properties to the outside rather than the inside of the atom.

It would be ungracious to pursue further Dr. Tutin's attempt to substantiate the *A* atom. He is continually involved in *ad hoc* arguments, which he rightly deplores when he thinks others have used them, as in the explanation with the *R-B* atom of the periodic table (p. 30). There is in fact nothing *ad hoc* in this. His attempted explanation of Moseley's diagram of characteristic X-ray lines seems to me shaky in the extreme and looks perilously like invoking a denial of the conservation of energy. But this may be doing him an injustice. At no point is there any indication that quantum mechanics applied to the models he proposes with some specified law of force between the various parts would give the results he postulates. No such law of force, which cannot be Coulombian, is ever specified. All his results are just pious hopes and no more, and most of them are demonstrably wrong.

Why then review at such length what is here stated to be in the reviewer's opinion entirely without substance? There seem to be reasons of some cogency. In the first place the appearance of an essay such as Dr. Tutin's forms a natural occasion on which to overhaul the present position of current theory and do some stocktaking in public. Again, no physicist who has worked as such during the last twenty-five, or even the last fifteen, years should be surprised by any extravagance in the development of physical theory or be unprepared to accept changes even more revolutionary still. Nothing could have exceeded the apparently wild extravagance of de Broglie's first work on electron waves which led directly to quantum mechanics. Experiments in thought such as that of Dr. Tutin must be made and made welcome just because they are experiments, and must not be condemned out of hand. But just because the current theory of the outer atom is a successful and flourishing theory, much must be required of any rival that could supplant it, and Dr. Tutin's theory cannot stand the pace. It must be discarded after examination, not because it is counter to current opinions, but because it is not internally self-consistent and does not correlate with sufficient elegance a wide enough range of physical and chemical facts. There is also one further reason remaining. Dr. Tutin's theory has been rather widely noticed in the non-scientific Press, where it has sometimes been discussed as if it were an accepted theory—a revolutionary overturning of current views—but alas it is far less momentous. Physical theory has undergone such striking and successful revolutionising in recent years that such Press notices can perhaps scarcely be avoided. It is all the more necessary that, when a would-be revolution, widely heralded, fails utterly, its masquerade as a success should be reduced to the shortest possible limits. R. H. FOWLER.

The Mitten Crab in Europe

Zoologischer Anzeiger. Herausgegeben von Berthold Klatt. Zugleich Organ der Deutschen Zoologischen Gesellschaft. Ergänzungsband zu Band 104: *Die chinesische Wollhandkrabbe* (Eriocheir sinensis *H. Milne-Edwards*) *in Deutschland*. Von Dr. Nicolaus Peters und Dr. Albert Panning. Mit einem Beitrag von Prof. Dr. W. Schnakenbeck. Pp. viii + 180. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1933.) 11.60 gold marks.

THE invasion of European inland waters by a Chinese river crab which has been in progress for more than twenty years has hitherto attracted little notice from zoologists in Great Britain. There is, however, a distinct possibility that the invasion may spread to our rivers and that this undesirable alien may establish itself as a member of the British fauna. It is therefore desirable that attention should be directed to the exhaustive monograph which has just been published by Dr. N. Peters and Dr. Albert Panning with an appendix by Dr. W. Schnakenbeck. The species is now being used as an easily obtainable 'type' and as a subject for experimental work in many German laboratories. The full and clear account of its morphology and development which is given in this monograph will therefore be very useful. In addition, the history of its appearance and spreading in Europe is recorded in detail with full

particulars of the damage it causes and with suggestions for its utilisation as food for man and domestic animals.

Eriocheir sinensis is known in Germany as the *Wollhandkrabbe* from the fact that the pincer claws are clothed with long soft hairs, and a writer in the *Times* has suggested 'mitten crab' as an appropriate name for it. It belongs to the family Grapsidæ and, like many of its allies, it is characteristically an inhabitant of brackish water, ascending rivers for long distances in fresh water but returning to the estuaries to breed.

The mitten crab must have been introduced into German rivers before 1912, for in that year a specimen was found by a fisherman in the River Aller, a tributary of the Weser. The specimen was fortunately preserved, although it was not identified until many years later. In 1923 the species was found to be established in the lower reaches of the Elbe and was determined as *Eriocheir sinensis*. Since that time it has become progressively more abundant in the Elbe and the Weser, and it is now caught by the hundredweight at certain seasons in the nets of the fishermen. It has penetrated inland as far as Berlin and even Prague, and has extended its range to the Rhine and the rivers of Holland on one side and to East Prussia on the other. In some localities it has become a very serious menace to the fresh-water fisheries, stealing the bait from the hooks and cutting and ruining the nets. It is also stated to damage the muddy banks of rivers by burrowing in them.

The means by which the mitten crab found its way to Europe remain something of a mystery. Dr. Peters discusses various possibilities and comes to the conclusion that it was most probably carried in the water ballast tanks of some vessel trading with the Far East. If so, there is no reason to suppose that such an incident might not happen again or that the mitten crab would find in the Thames a less favourable environment than in the Elbe and the Weser. Further, since the adult crabs seem to be equally at home in sea and in fresh water, it will be surprising if they do not succeed sooner or later in crossing the North Sea.

In view of the attempts that are being made to popularise in Germany the use of the mitten crab for human food and for feeding pigs and poultry, Dr. Panning directs attention to the fact that in the Far East the species is known to be one of the intermediate hosts of the lung fluke, *Paragonimus*. He points out, however, that owing to the absence from Europe of the species of water snails which are the first hosts of the worm in question, its spread in Europe is most unlikely; and since the crab would only be consumed in the cooked condition, no danger from it is to be apprehended.

The accidental introduction and spread of animals and plants in countries where they are not native is unfortunately common enough, but there are not many instances of aquatic animals being transported unintentionally from one country to another. The case of the mitten crab is therefore of some theoretical, as well as practical, interest.

W. T. C.

Short Reviews

Pharmaceutical Formulas. Vol. 2. *Being the Chemist's Recipe Book of Formulas for Adhesives, Beverages, Cleaning Materials, Culinary and Household Requisites, Horticultural and Agricultural Preparations, Inks, Lozenges, Perfumes, Photographic Preparations, Polishes, Soaps, Toilet Articles, Varnishes, Veterinary Preparations, etc., including numerous Descriptions of Practical Methods employed in their Manufacture and other Information of use to Pharmacists and Manufacturers.* Tenth edition, entirely revised and rewritten by G. P. Forrester. Pp. xx+983. (London: The *Chemist and Druggist*, 1934.) 15*s*.

"PHARMACEUTICAL FORMULAS", which appeared as a first edition in 1898, is a collection of formulæ of both old and new preparations of interest not only to pharmacists, but also to other manufacturers of articles and preparations of allied types. With the increasing scope of the book, it has been deemed necessary to publish the tenth edition in two volumes, vol. 1 being essentially pharmaceutical and medicinal, whilst vol. 2, now under review, has collected those formulæ of more general and varied interest, such as cosmetics, perfumes, polishes and horticultural and agricultural preparations such as fungicides and insecticides. These sections are but a few of the many varied ones, but they probably constitute those in which the greatest advances have been made in recent years.

The last two decades have seen an enormous increase in the demand for toilet preparations, such as face powders, creams, lipsticks, etc., each with so many varieties that their preparation now requires considerable skill and knowledge. Moreover, fashion would appear to maintain them in popularity, and with ever-varying design and purpose, so that the manufacturers must of necessity keep pace and satisfy the demand. The

advent of the cellulose-finished motor-car body has led to the demand for hard, high gloss polishes with a quick effect, which demand has resulted in a large number of new types of formulæ.

The proof, however, of the value of a book of formulæ lies not only in the ingredients, but also in the description of the exact working conditions and correct manipulation without which most technical formulæ are useless. The book does appear to satisfy this requirement, and moreover each section is preceded with a monograph discussing the development and modern requirements of the preparations concerned. H. B.

A Bibliography of Sir James George Frazer, O.M. Compiled by Theodore Besterman, with Portraits and Facsimiles, and a Note by Sir J. G. Frazer. Pp. xxi+100+3 plates. (London: Macmillan and Co., Ltd., 1934.) 12*s.* 6*d.* net.

THIS bibliography of the works of Sir James Frazer has been produced by the subscription of friends and admirers and under the ægis of the Folklore Society in celebration of his eightieth birthday in January last. The work of Sir James Frazer is too well known for this list of his books, essays, lectures and addresses to call for extended comment. It chronicles a remarkable achievement. It may, perhaps, come as a surprise to those who are not intimately acquainted with the extent and variety of his writings to find that although "The Golden Bough" bulks large, it by no means expresses the whole of his interests, nor, notwithstanding its many editions, has it absorbed one tithe of the apparently boundless store of energy upon which he has drawn in the fifty-five years of his life as an author. "The Golden Bough" is extensive enough to have been the life-work of any ordinary individual—assuming that he had the genius to conceive it. Yet Sir James in his "Totemism and Exogamy", his "Folklore of the Bible" and his study of immortality has produced three major works, any one of which would have taxed the industry and made the reputation of a research worker.

The bibliography has been admirably produced and is illustrated with excellent portraits of Sir James and with facsimiles which show his method of working. The first page of the list is marred by a misprint, the editor having fallen into the familiar schoolboy trap of "Cataline".

The Woodlands and Marshlands of England. By H. A. Wilcox (Mrs. G. S. Treleaven). Pp. 55+2 maps. (Liverpool: University Press of Liverpool; London: Hodder and Stoughton, Ltd., 1933.) 6*s.* net.

THE University Press of Liverpool has recently published two maps of the woodlands and marshlands of England prepared on the researches of H. A. Wilcox. These are founded on several years of research, which was assisted by the British Association. The first map is founded on geological, climatic and topographical evidence, and the second is drawn from the evidence deduced from early literature. To these have been added a discussion of the problems involved and of some of the regional questions. The first map involved considerations of the underlying rocks and their soil covering, of the surface configuration of relief, height and aspect, and of the climatic conditions, which as yet are not sufficiently determined even in the immediate past. But all three of these act together, or in opposition, to provide the area which was woodland-covered, or heath, or bare grassland. Then again, woodlands may destroy themselves by the accumulation of their decaying materials and by holding up water, changing lands into marshes. Many areas can be only tentatively mapped, awaiting the local research of counties. The corrections made thereby are essential to this study, and it is requested that they be communicated to Prof. Roxby of the University of Liverpool. The subject is an important one, for it is basal to the study of early man in Britain, determining his track ways and early settlements.

Grundriss der physikalischen Chemie. Von Prof. Arnold Eucken. Vierte Auflage. Pp. xxiii+699. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1933.) 29 gold marks.

THE third edition of Eucken's "Grundriss der physikalischen Chemie" was merged in a "Lehrbuch" of 1,000 pages, issued in 1930 (NATURE, Dec. 27, 1930, p. 988); but even then the project existed of splitting the product into two parts, the more general and elementary part being issued as a fourth edition of the "Grundriss" and the more special and advanced part as a second edition of the "Lehrbuch". The first portion of this project has now been carried out, and has yielded a volume of 700 pages with 179 instead of 250 figures. The tables and figures have been taken for the most part from the "Lehrbuch", but the text has been condensed by omitting much descriptive matter (for example, Aston's mass-spectrograph) and concentrating on fundamental laws. Numerical exercises have also been added at the ends of certain chapters.

Science and God. By Bernhard Bavink. Translated by H. Stafford Hatfield. Pp. ix+174. (London: G. Bell and Sons, Ltd., 1933.) 5*s.* net.

IN recent years, fundamental changes have taken place in all the assumptions upon which philosophical and religious discussions are based. The author makes the point that mechanistic physics by no means implies atheism and materialism as a necessary consequence; and that the so-called neutrality of science with regard to religious questions is no more an axiom of procedure. In fact, the old materialistic arguments, still put forward in free-thinking circles, will be found to be out-of-date doctrines in the light of a correct interpretation of the results of present-day science.

T. G.

Germination of Seeds*

By SIR ARTHUR W. HILL, K.C.M.G., F.R.S.

THE ovule, which later becomes the seed, is enclosed in the fruit vessel or ovary, the covering provided by the mother plant. During its development, the offspring is protected and nourished by its mother, and the ovule gradually develops into the seed, with its own protective skins or coats, lying within the enlarged ovary, which in the course of time has become the fruit.

Examples of fruits with their contained seeds are such familiar objects as the fleshy-fruited tomato with its dry, flat seeds, the broad bean or the scarlet runner with the enclosed seeds or beans, and the Brazil nut, where the mother plant has provided a thick, woody, cannon-ball-like protective fruit—which can only be broken by a powerful hammer or cut across with a saw—enclosing the well-known hard-shelled 'nuts'.

Many seeds have been so well protected by the mother plant that the liberation of the seeds contained in the fruit is often a matter of some difficulty. The Brazil nut fruit is perhaps the most remarkable example. In other cases, however, the seeds are shed or scattered from the fruits with the greatest ease when the fruit is ripe, as any gardener knows only too well who attempts to save seed of an *Impatiens* (balsam), or collect the seeds of gorse, which are shot out from the fruit as if from a catapult. The horticulturist, of course, is concerned only with the seeds when he wishes to replenish his stock of plants. In the majority of cases he merely sows the seed, and germination, that is, the escape of the embryo from the protective seed-coats, takes place sometimes in a few days, sometimes after some weeks from sowing. In the case of willows and poplars the seed will germinate the day after it is sown, and if the minute seed should be kept for more than a few days it will completely lose its power of germination. In other cases seeds may remain viable for years. I remember well the late Sir Michael Foster showing me a pot of *Iris*, in which the seed was just beginning to germinate fourteen years after it had been sown! Then there are the seeds of the Australian wattles (acacias), which rarely germinate until a fire has passed over the ground in which they are lying, or which, if sown at home, have to be scraped with a file, or treated with strong sulphuric acid, as is also the case with some other seeds, in order to induce germination, so strong and resistant is the seed-coat. It is known that seeds of *Acacia lophantha* will germinate after being stored for sixty-eight years and recently, in connexion with inquiries as to seed vitality, we have experimented at Kew with seeds long stored in bottles in our Museum and have successfully germinated seeds of *Anthyllis vulneraria* and *Trifolium striatum* both ninety years old, and seeds of four other leguminous plants, including the Spanish broom (*Cytisus scoparius*), all eighty-one years old.

How long the poppy seed, which germinated and flowered so wonderfully after the shelling of the Somme battlefield, had lain buried in the soil, or how long charlock seed will remain living when buried, we do not really know; but it is truly remarkable that life can persist for so long a time in a body so minute as the embryo of a seed imprisoned within its seed-coats, when the seed is preserved under suitable conditions. What the nature of such life may be, and to what extent respiration, and the other functions we associate with living matter, may be carried on in dormant seeds, is scarcely within the scope of my text, nor could I throw much light on this arresting problem. For the moment we are concerned with the embryo prisoner, whether serving only a brief or a long sentence of confinement, and the nature of the prison.

There is a minute orifice in the seed, the micropyle, originally the point of entry of the pollen tube into the ovule, behind which ultimately the radicle or root tip of the embryo will lie in the mature seed. Through this minute and well-sealed pore, and also by absorption through the coats, moisture enters the seed when conditions become favourable for germination, and the radicle emerges at the micropyle. In the case of most seeds it is safe and usually advisable to store them through the winter and sow them in the spring, since the embryo is in the resting or dormant condition, whatever that may signify. There are, however, a few seeds which do not undergo any resting stage, but development is continuous, and the embryo is in an advanced stage of germination when the seed is shed. The prisoner effects his escape, as an Irishman might say, before he has been shut up! Willow seeds, as I have mentioned, almost come within this class, but the mangrove, with its viviparous seeds, is a classic illustration. Here the seed in the inverted-pear-like fruit germinates while the fruit hangs on the trees. The long fusiform radicle grows downwards and eventually the young plant falls off into the water where it floats upright and gets carried to a safe landing in the mud of a tropical estuary. *Typhonodorum*, a giant aroid from Madagascar, behaves in a similar manner, and well-developed young plants, still attached to the large, bean-like seeds, are shed into the water where they float upright with the young leaves in the air.

In these cases, we might say that the embryo, realising how flimsy and insecure are its prison walls, considers it wiser to escape at once and so avoid the risk of being killed by insufficient protection, which might have happened should it

* From the Friday evening discourse entitled "The Escape of the Prisoner: Studies in the Germination of Seeds" given at the Royal Institution on November 3, 1933. A fuller account of the devices here described, with illustrations, will be found in *Annals of Botany*, **47**, 873, Oct. 1933.

have 'gone to sleep' for a period, like other embryos, after the maternal influences had ceased.

The normal seed consists of two close-fitting coats, the inner usually membranous, the outer being either papery, leathery or woody, and often ornamented with most beautiful surface markings, which cover and protect the embryo. The embryo may be embedded in food material on which it can draw when germination commences—the type known as albuminous—or it may have absorbed into itself, during its development, all the nutritive materials supplied by the mother plant and stored them for future use in its seed leaves or cotyledons —which is known as the exalbuminous seed. In either case germination, with the majority of seeds, is simple and straightforward: the emergence of the radicle, the splitting open of the seed-coats and the withdrawal of the cotyledons or seed leaves follows in due course. In a few cases, of which the vegetable marrow (*Cucurbita*) is a good example, the young seedling takes special care to free itself from its seed-coat and develops a special peg-like outgrowth at the apex of its young root which presses on the lower valve of the seed-coat, while the arch of the young stem carrying the cotyledons lifts up the upper valve and so effects its escape. The youthful prisoner thus puts its foot on the floor of its prison house and raises the roof with its bent shoulders.

The palms show certain peculiarities in the germination of their seeds, which are unlike those of other plants. I will take the familiar date stone (*Phœnix*) as my example. Dates are fleshy fruits with a hard horny-like stone in the centre, which is the seed. In the middle of one side of the seed there is a small circular umbilicus or navel behind which lies the embryo. Owing to the horny nature of the endosperm of the seed, it would be well nigh impossible for the embryo to escape if the date attempted to germinate in the usual way, since the cotyledon and shoot apex could not get free from the seed, even though the root could grow out and push down into the ground. The problem is solved by the date, coco-nut, double coco-nut and other palms by transporting bodily the whole embryo out of the seed through the navel-like depression and burying it in the ground some distance below the surface of the soil. This is accomplished by the outgrowth of a closed germ-tube, the cotyledonary sheath, completely surrounding the embryo, which in the double coco-nut is a stout formidable looking article. Though the embryo has been taken out of the seed, however, and is being nourished by the supplies contained in the seed through the cotyledonary sheath or tube, the problem of its escape is not yet solved, since it is still a prisoner within its own tube-like sheath. It is as if the walls of its prison cell had become elastic and extensible and the cell had extruded itself through its window, carrying the embryo still imprisoned within the elongated cell; a procedure which may be compared to a person sliding down a tubular fire escape from a window.

The embryo, however, is able to solve the problem; for the young shoot with its seed leaf grows and forces its way through the wall of the germ tube and emerging into the air finally starts on an independent existence. This may take place in a fairly short time, but in the case of the double coco-nut several months elapse after the embryo is carried out of the seed before the young palm leaf of the seedling escapes into the daylight. The coco-nut and double coco-nut differ a little from the date in that the actual seed is enclosed in the innermost wall or endocarp of the fruit, and are thus similar to cases I am about to describe; otherwise the procedure is exactly like that exhibited by the date.

Turning now to those seeds which have an additional protection in the way of part of the fruit wall as well as their normal seed-coats, as in the coco-nut to which I have just referred, I may mention first the more simple cases of plums, cherries, almonds and olives. In these cases the edible flesh is part of the 'fruit' proper, but the stone is also a portion of the fruit wall, so that it is not strictly correct—botanically—to speak of plum or peach stones or coco-nuts as 'seeds', since the stone is a fruit structure and only the kernel is the actual seed.

The fruit wall or pericarp consists of three layers or coverings: the outer one which is the skin; the middle fleshy and edible portion, the mesocarp; and the hard, innermost layer, the stone or endocarp, which encloses the seed or seeds. Stones or stony endocarps of this nature may contain one, two or several seeds.

Cherry or plum stones afford good examples of stony endocarps containing a single seed, and the embryo has not only to solve the problem of escaping from its seed-coats, but also the more difficult task of getting out of the woody box-like stone, which has to be cracked by hand should one wish to obtain the kernel.

Careful examination of a plum stone shows the endocarp to consist of two similar and closely-united halves, only separable when the plane of weakness becomes softened. The cells of the stone do not cross the line of junction of the two halves of the stone, but are turned at right angles at the median line and the two distinct halves are firmly 'cemented' together. The stone thus easily splits into its two halves, after sufficient moistening, by the pressure exerted by the emerging radicle or root tip of the embryo, and in due course the cotyledons or seed leaves, with the young shoot apex between them, are successfully drawn out from the seed coats and enclosing stone, and expand in the air.

The walnut, *Juglans*, the shell of which again is a fruit structure, behaves much like the plum on germination, the shell splitting into its two component halves. Here, however, there is the difference that the shell is formed by the close adhesion of two carpels, each half of the shell being a separate entity.

(*To be continued.*)

Mitogenetic Radiation and Bioluminescence

By DR. J. B. BATEMAN

THIS article is occasioned by recent popular descriptions[1–5] of an apparently well-attested case of luminescence in a human being in Italy, and the references to mitogenetic radiation which accompany them. The subject is a woman suffering from asthma. She is psychologically abnormal —intensely religious and hysterical—and the phenomenon of light emission occurs during light sleep, in circumstances which suggest that it is connected with these abnormalities. It lasts about three seconds, is of sufficiently high intensity to be photographed with an exposure of one sixteenth of a second, and is accompanied by increased respiratory movements, greatly increased pulse rate, and by the utterance of "moaning sounds and expressions".

The phenomenon is certainly unusual. The Italian peasants are said to regard it as a manifestation of holiness; Signor Protti[5] attributes it, less picturesquely and perhaps less correctly, to the action of "blood radiation" in causing luminescence of certain substances in the skin. Protti's explanation is very unconventional, for bioluminescence is generally supposed to be a type of chemiluminescence, produced during the oxidation of certain substances, the luciferins, in presence of enzymes known as luciferases[6]. Naturally this mechanism has not been demonstrated in the rare cases of luminescence in human beings, but one would hesitate to accept an entirely different kind of explanation without strong positive evidence in its favour. It is possible that some instances of human luminescence are due only to infection by luminous bacteria.

The casual references to "blood radiation" are presumably intended to imply that the existence of such radiation is firmly established and its nature quite generally known. This is not the case. The fundamental experiment of Gurwitsch, claiming to show the emission of radiation from an onion root tip which could stimulate mitoses in a second root placed near it, has been, and continues to be, subjected to severe criticism. Indeed, the state of the subject at present makes a final decision with regard to the validity of this experiment quite impossible. This uncertainty has not, however, deterred Gurwitsch and his pupils from an elaborate development of their ideas, both experimental and speculative; unfortunately, there are contradictions at almost every stage.

The supposed identity of the radiation with short-wave ultra-violet light, fundamental to the most important later experiments, itself rests on contradiction, the resolution of which should have been the primary object of later research. Thus, although behaving in certain experiments like ultra-violet light (being transmitted by quartz and absorbed by glass, etc.), mitogenetic radiation can pass, without being significantly absorbed, along the interior of an onion root or through a considerable thickness of a suspension of yeast in beer wort. Further, there is no agreement with regard to wave-length. Gurwitsch[7], by experiments with filters and by spectral dispersion of the radiation, found a wave-length 190–250 mμ; Reiter and Gabor[8], by the same means, found 340 mμ, and both sets of workers were able to confirm fully their own conclusions by experiments with ultra-violet light from artificial sources. Ignoring, or explaining away, these very serious discrepancies, Gurwitsch continues to regard mitogenetic radiation as ultra-violet radiation of wave-length 190–250 mμ.

If this contention is correct, it should be possible to detect mitogenetic radiation by purely physical means, but satisfactory evidence is unfortunately lacking. Positive results obtained with a photosensitive form of the Geiger-Müller electron counter[9,10], the most sensitive apparatus available, are offset by several negative results[11–13], and the latter also demonstrate how easily spurious positive effects can be obtained if experimental conditions are not properly controlled. The most recent experiments[13] suggest that mitogenetic radiation, if it exists, cannot be detected by any known physical method; its intensity is certainly less than about 300 $h\nu$/cm.^{2} sec.

There is no space for a more detailed discussion: some quite characteristic points have already been referred to in NATURE[14] and a detailed review will appear elsewhere[15]. It is only important for the present to note that references to mitogenetic radiation, and with them Protti's reference to blood radiation, should be regarded with scepticism. Even if mitogenetic radiation exists, it is almost certainly too feeble to be capable of causing emission of visible fluorescence. Protti's explanation for his remarkable case of bioluminescence is therefore to be rejected.

[1] *Times*, April 7, 1934.
[2] *ibid.*, April 12.
[3] *ibid.*, May 5.
[4] *Observer*, April 22, 1934.
[5] Protti, *Illustrated London News*, May 19, 1934.
[6] Newton Harvey, "The Nature of Animal Light" (Lippincott, Philadelphia, 1920).
[7] Gurwitsch, "Das Problem der Zellteilung physiologisch betrachtet" (Berlin, 1926). "Die Mitogenetische Strahlung" (Berlin, 1932).
[8] Reiter and Gabor, "Zellteilung und Strahlung". *Sonderheft der wissenschaftlichen Veröffentlichungen aus dem Siemens-Konzern* (Berlin, 1928).
[9] Rajewsky, *Phys. Z.*, **32**, 121; 1931. "Zehn Jahre Forschung auf dem physikalisch-medizinischen Grenzgebiet." Herausgegeben von F. Dessauer (Leipzig, 1931).
[10] Frank and Rodionow, *Biochem. Z.*, **249**, 322; 1932.
[11] Seyfert, *Jb. wiss. Bot.*, **76**, 747; 1932.
[12] Gray and Ouellet, *Proc. Roy. Soc.*, B, **114**, 1; 1933.
[13] Kreuchen and Bateman, in press.
[14] Hill, NATURE, **131**, 501, April 8, 1933.
[15] Bateman, *Biol. Rev.*, in press.

Obituary

CARL OLOF LUNDHOLM

CARL OLOF LUNDHOLM who died on May 8, at the ripe age of eighty-four years, was born in Sweden in 1850. His father was Court Quartermaster and had filled this important office, which however is now extinct, to four of Sweden's kings. He was what we would now designate a chemical engineer, though the term was then not known. Through the personal influence of his great fellow countryman, Alfred Nobel, he obtained facilities for studying the manufacture of fulminate of mercury in a French factory on the outskirts of Paris. Largely as the result of this special knowledge he was invited to join the staff of the Nobel Explosives Co., Glasgow, in 1878.

This company, which was brought into being to exploit Nobel's discoveries in the realm of high explosives, had at that time established two factories in Scotland: one at Ardeer, Ayrshire, where nitro-glycerine explosives were made, and another at Polmont, Stirlingshire, where detonators were made. Both of these branches of manufacture were at that time extremely hazardous and accidents were fairly frequent. With both of them Lundholm became intimately associated and on both he left the impress of his strong and courageous personality. He was most assiduous in improving the safety factor while increasing efficiency, and the industry to-day, considered from the world point of view, is a monument to his ingenuity and foresight. This, indeed, is generally recognised, even though the great public never knew very much about him, as he never courted publicity in any shape or form.

Lundholm became manager of the Ardeer factory in 1889 and retired from that position in 1909 to become technical adviser to the Nobel Dynamite Trust, with headquarters in London. On the outbreak of the War this Trust automatically came to an end, as did also Lundholm's thirty-six years' intimate association with the high explosives industry. But even in his retirement he maintained his interest to the very end, and though in later years afflicted by blindness, he kept up a world-wide correspondence with old and new friends associated with the industry. Indeed, until a few days before his death, he was actively engaged on the writing up of his early experiences in the development of high explosives.

Although Lundholm was a member of many societies, he was not a writer of papers, though he inspired many. On the other hand, he did recognise the value of research, and with the encouragement of his board, he inaugurated what was probably the first research laboratory in the British Isles. His name appears fairly frequently, too, on patent specifications.

Lundholm was known to everyone in 'explosives' circles, and during his period of management at Ardeer he must have had thousands of callers from all over the world. By those of them who are still alive, his loss will be keenly felt, for he was a kindly soul and was always ready to help and encourage young men. He was, however, a stern but just disciplinarian and in times of danger, and these were not infrequent in the early days, he was cool and collected and always master of the situation.

WILLIAM CULLEN.

THE REV. J. H. HOLMES

JOHN HENRY HOLMES, who died on April 19, was born on June 19, 1866. Having been ordained in 1893, he was appointed by the London Missionary Society at first to the Fly River District, Papua, and a year later to the Elema District (Gulf of Papua); he settled at Jokea in November 1894. In 1897 he removed to Orokolo, and in 1910 he finally settled at Uriki in the Purari Delta. He left Papua at the end of 1917 and, having retired from active service, returned to England in 1920. Thus for more than twenty years "Homu" laboured among two of the most interesting of the peoples of the 'Papuan' stock, about whom previously there was but scanty and often erroneous information.

Mr. Holmes had a genuine regard for and sympathy with his people, and he recognised that, in order to understand their point of view, it was first necessary to have a thorough command of their language and then to study their customs and beliefs. He wrote short papers on the initiation and religious ideas of the Elema tribes (*J. Anth. Inst.*, 418–431; 1902), on their distribution and history (*J. Anth. Inst.*, 125–134; 1903), on their totemism and social conditions (*Man*, Nos. 2, 10; 1905), and on their toys and games (*J. Roy. Anth. Inst.*, 280–288; 1908). He also published a preliminary study of the Namau language, Purari Delta (*J. Roy. Anth. Inst.*, 124–142; 1913). It was not until 1924 that he collected his observations in a book on a comparison of the Purari and Gulf natives ("In Primitive New Guinea"). Finally, in 1926, he published "Way Back in Papua", in which he attempted in narrative form to give a picture of the old native ways of looking at things and of the effects of the introduction of Christianity.

Unfortunately, Mr. Holmes had received no scientific training, so there is a lack of precision in many aspects of his work; nevertheless, he has given us very valuable accounts of the ethnography of his two areas, and thus he takes an honourable place among those missionaries who have materially added to our knowledge of backward peoples.

A. C. HADDON.

SIR MAX MUSPRATT, Bt.

THE public career of Sir Max Muspratt, who died on April 20 at the age of sixty-two years, is very well known. He was the third generation of a family of chemical manufacturers. His father,

the late E. K. Muspratt, built the Muspratt Laboratory of Physical Chemistry at the University of Liverpool, and Sir Max was brought up in a scientific atmosphere. He was one of the first of the great modern industrialists to receive a chemical education. He was educated at Clifton College, and from there he went to Zurich, where he received the Swiss Government's diploma in applied chemistry.

I have the most lively recollection of lunching with Sir Max Muspratt and Prof. Donnan twenty-seven years ago, on which occasion Sir Max expressed that extraordinary interest in science, an enthusiasm for research, which never left him.

It is not too much to say that Sir Max Muspratt had a large part in bringing about the growth of the large research establishments in which Great Britain can justly pride itself. In spite of the fact that his latter years were clouded by great personal misfortunes, he was always willing and anxious to discuss any scientific subject, not so much as regards its direct practical bearing, but in general terms. His death is regretted by a far larger number of people than he would have imagined.

F. A. FREETH.

WE regret to announce the following deaths :

Prof. H. G. Chapman, director of cancer research in the University of Sydney, president of the Linnean Society of New South Wales in 1917–18, on May 25, aged fifty-five years.

Prof. G. C. Comstock, emeritus director of the Washburn Observatory and professor of astronomy in the University of Wisconsin, on May 11, aged seventy-nine years.

Prof. Otto J. Kauffmann, emeritus professor of medicine in the University of Birmingham, on May 15, aged seventy-one years.

Prof. J. Y. Simpson, professor of natural science in New College, Edinburgh, known for his work on the re-interpretation of religion in the light of modern biology, on May 20, aged sixty years.

News and Views

King's Birthday Honours

THE King's birthday honours list includes the names of the following men of science and others associated with scientific work and development. *Baron :* Sir Hugo Hirst, chairman and managing director of the General Electric Company, Ltd. *G.B.E. :* Sir John Reith, Director-General of the British Broadcasting Corporation. *K.B.E. :* Dr. F. G. Banting, Dominion of Canada, discoverer of insulin. *Knights :* Major R. G. Archibald, director of the Wellcome Tropical Research Laboratories, Sudan ; Mr. A. W. Flux, honorary vice-president (past president) of the Royal Statistical Society ; Mr. Albert Howard, lately agricultural adviser to the States in Central India and Rajputana ; Dr. W. H. Moberly, vice-chancellor of the University of Manchester ; Dr. C. E. Saunders, lately Dominion cerealist, Dominion of Canada, discoverer of Marquis, Ruby, Reward and Garnet Wheat ; Prof. G. Elliot Smith, professor of anatomy in the University of London (University College). *C.B. :* Dr. R. E. Stradling, director of Building and Road Research, Department of Scientific and Industrial Research. *C.M.G. :* Mr. A. C. Bagshawe, secretary of the Department of Agriculture and Lands, Southern Rhodesia ; Prof. R. S. Troup, director of the Imperial Forestry Institute and professor of forestry in the University of Oxford, for services to forestry in the Colonies. *C.I.E. :* Mr. F. Canning, chief conservator of forests, United Provinces ; Mr. P. E. Aitchison, chief conservator of forests, Bombay Presidency ; Mr. W. McRae, director and Imperial mycologist, Imperial Institute of Agricultural Research, Pusa. *C.B.E. :* Dr. W. L. Balls, chief botanist, Egyptian Ministry of Agriculture ; Mr. L. St. L. Pendred, editor-in-chief of the *Engineer ;* Dr. L. J. Spencer, keeper of minerals, British Museum (Natural History). *O.B.E. :* Dr. S. G. Barker, for research services to the Empire Marketing Board ; Mr. A. D. Cotton, keeper of the Herbarium and Library, Royal Botanic Gardens, Kew ; Miss E. H. Ekins, principal of Studley Horticultural and Agricultural College for Women ; Miss Annie Lorrain-Smith, for contributions to mycology and lichenology ; Dr. C. Raeburn, assistant director of the Geological Survey Department, Nigeria. *M.B.E. :* Mr. F. G. Harcourt, curator of the Botanical Gardens and Agricultural Superintendent, Dominica, Leeward Islands ; Mr. J. D. Kennedy, sylviculturist, Nigeria. *I.S.O. :* Mr. G. E. Greig, lately senior warden of mines, Federated Malay States.

Johann Bauschinger, 1834–93

AMONG those to whom German industry and engineering owed much in the latter part of last century was Johann Bauschinger, who was born on June 11 a century ago. He began life as a school teacher, but became very widely known for his work on the testing of materials. One of a large family of an artisan, Bauschinger was born in Nuremberg and was educated at the Nuremberg Commercial School, and the Polytechnic. He was enabled to proceed to the University of Munich and, after studying mathematics and physics, at the age of twenty-three years he secured a post as teacher in the Commercial School at Fürth, where he spent nine years. He then taught for a time in the Realgymnasium of Munich, and in 1868 was appointed professor of mechanics and graphic statics in the Technical High School there, which henceforth was the scene of his activities. By 1870, he was in possession of a mechanical laboratory where, said Unwin, "Engineering experiments were carried out with a thoroughness and delicate accuracy never previously equalled".

He designed a new form of testing machine and applied Gauss's method of reading by reflection in instruments for measuring deformation of bodies when strained, made tests of cement, mortar, timber, cast iron, wrought iron and steel, and for the railway authorities made investigations on defective axles, rails, etc. Much of his work was inspired by the labours of his famous countryman August Wöhler (1819–1914). An important outcome of Bauschinger's labours was the formation in Germany of a society for exchanging views on investigations similar to his own, and this led to the foundation of the International Association for Testing Materials. In his own particular line, he was regarded by Unwin as "the prince of observers". He died at Munich on November 25, 1893.

Preparations for New Ascents into the Stratosphere

THE National Geographic Society, Washington, D.C., is co-operating with the U.S. Army Air Corps and other donors in a new ascent to the stratosphere to be made this month. According to the *National Geographic Magazine* of April, the balloon to be used will have a capacity of 3,000,000 cubic feet, and will be manned by Maj. William E. Kepner and Capt. Albert W. Stevens. The balloon fabric is of cotton impregnated with rubber, and the spherical gondola, which is made of a magnesium-aluminium alloy, is 8 ft. 4 in. in diameter. The total weight to be raised, including balloon, gondola, equipment and crew, is nearly eight tons. It is estimated that when the balloon rises from the earth partly inflated, the top will be 295 ft. from the ground; at its 'ceiling', the balloon will be a sphere 180 ft. in diameter. Hydrogen is to be used for inflating it. The gas valve in the top of the balloon will be operated from the gondola by compressed air. The programme of scientific work includes the collection of samples of the atmosphere of the stratosphere, determination of electric gradient, observations of cosmic rays and of ozone content and photography at great heights. According to the Brussels correspondent of the *Times*, Dr. Max Cosyns, who accompanied Prof. Piccard on his second ascent to the stratosphere, has completed his preparations for a new ascent (NATURE, Nov. 25, 1933, p. 812). The gondola of the Belgian balloon has been constructed of aluminium.

New Paris Zoo

The lures of Paris are many. Its latest is a new zoo at Vincennes which should be well worth seeing. Hagenbeck, in Germany, was one of the first to abolish the old and hideous system of keeping birds and beasts in cages. The Zoological Society of London, when Sir Peter Chalmers Mitchell took over the reins of government, followed suit, starting with the fine sea-lions pond, and the now famous Mappin Terraces. These last seem to have inspired the director of the new Paris Gardens, Prof. Urbain, and the architect, M. Charles Letrosne, for the dominant feature of the Gardens, we are told, is a towering mass of reinforced concrete, 200 ft. high, shaped and coloured to look like reddish-brown rock, with ledges for sheep, goats, and antelopes. The interior of this mass contains two large reservoirs for the storage of water to supply pools in various parts of the Gardens. In the London Mappin Terraces similar reservoirs supply the wonderful Aquarium—the finest in Europe. Another noteworthy feature of the Paris Gardens is a great aviary giving the birds plenty of room for flying. Occupying an area of about 23 acres, it would seem to be reminiscent of the Gardens of the Zoological Society in London and at Whipsnade, and there is no doubt they will be as much appreciated. The new Gardens occupy the site of the Colonial Exhibition in the Bois de Vincennes. They were opened on June 2 by the President of the Republic, M. Lebrun.

The Indian Earthquake of January 15, 1934

THIS great earthquake is being studied by officers of the Geological Survey of India. Their investigations in the central area are expected to last for several weeks longer, and their results will be published by the Survey at an early date. In the meantime, three papers of some interest have appeared. Sir E. Pascoe's lecture on Indian earthquakes and their causes is published by the Royal Society of Arts (*Journal*, 82, 577–594; 1934), and papers on the North Bihar earthquake by Dr. M. S. Krishnan and Dr. S. K. Banerji in *Current Science* (2, 323–326, 326–331; 1934). From the observations so far made, it seems, according to Dr. Banerji, that the earthquake fault reaches from Motihari to Monghyr, a distance of about 135 miles. There is probably also a second fault, branching from near the middle of the latter and running in the direction of Purnea. Most of the seismographs in India were thrown out of action by the shock, but good records were obtained, and are here reproduced, at Colaba (Bombay) and Agra. From the great preponderance of the surface waves compared with the primary and secondary waves, Dr. Banerji concludes that the focus was at a very slight depth below the surface. All three writers agree in attributing the earthquake to a disturbance of the isostatic compensation.

After-Shocks of the Bihar Earthquake

AT the end of May, the after-shocks of the Bihar earthquake of January 15 increased in frequency and strength. The strongest, which occurred at about 1 A.M. on May 31, seems to have originated within the focus of the principal earthquake, for it caused alarm at Muzaffurpur, Patna and other places in its epicentral area. So far as is known, there was no loss of life and no damage except that walls injured in January collapsed, while fissures that had become filled with dust reappeared. Shocks were also felt about noon on the same day in Assam, the first of which is reported to have lasted two minutes and to have been felt in Calcutta.

Element No. 93

THE Rome correspondent of the *Times* states, in a short communication published in the issue of June 5, that an article in the *Giornale d'Italia* which surveys recent work on induced radioactivity by Prof. Enrico Fermi, of the Royal University, Rome,

includes the announcement that Prof. Fermi has produced a new element, of atomic number 93. The new element was found when uranium, atomic number 92, was bombarded with neutrons; it is radioactive, with a half-period of about 13 minutes. This announcement would appear to be a sequel to the experiments reported by Prof. Fermi in NATURE of May 19, p. 757, when he described the effects of bombarding various elements with a powerful stream of neutrons. Uranium was not among the elements mentioned by Prof. Fermi in his communication, but it would seem that he has now succeeded in obtaining an effect from it.

Science and Psychical Research

EARLY this year (January 6, p. 18) we referred to the proposed formation of a body to be called "The International Institute for Psychical Research", and expressed the hope that the men of science who had allowed their names to appear on the circular announcing the new organisation would see that whatever investigations were undertaken were in accord with what science demands of such inquiries. Apparently it has been difficult to secure these essential conditions, for Prof. D. F. Fraser-Harris, who was announced as the research officer of the Institute, informs us that he has resigned that position. When he invited a number of scientific friends to serve on the Committee of the Institute, he was under the impression that a laboratory was to be provided, but he now finds this is not so, and that there is a lack of appreciation of what scientific investigation signifies. It may be recalled that Prof. Elliot Smith, who was advertised a short time ago as president of the Institute, resigned a few weeks ago on account of ill-health. We understand that most of the chief men of science whose names were advertised in the list of members of the Consultative Committee of the Institute have also resigned. In connexion with the subject of psychical research, Prof. Fraser-Harris, referring to the article "From a Correspondent" in NATURE of May 19, p. 747, writes :—"There is one circumstance not mentioned by the author of the account of the experiments of MM. Osty (1932) on 'the unknown powers' produced by Rudi Schneider. It is the fact that, between the medium and the sitters on one hand and the recording apparatus on the other, there was interposed a sheet of muslin stretched on a wooden frame. Clearly, the medium on one side of this partition, even with all his limbs free and surrounded by any number of accomplices, could not have played any tricks with the apparatus on the far side of the partition. (A photograph of this screen is on p. 54 of *Revue Métapsychique*. 1932. No. I.)"

Tornado at Concepcion

A BRIEF summary of damage and loss of life caused by a tornado on May 27 in the Chilean town of Concepcion, the chief port of entry to southern Chile, appeared in some evening papers on May 28, and in the *Times* of May 29. The storm was described as a "cyclone", but the note in the *Times* stated that the damage occurred in a strip 65 ft. wide, and if that statement is correct, there can be no doubt that this was a tornado of the American pattern, and a vigorous example at that, seeing that trees were uprooted and buildings were wrecked as the storm swept across the town, moving apparently from east to west. One account stated that a house was lifted off the ground and carried along for a distance of nearly 55 yards. The incident is of especial scientific interest; if the 'dust devils' of desert regions and the maritime or lacustrine 'waterspouts' are included under the term 'tornado', there appears to be hardly any part of the world where this small intense rotary storm may not occasionally occur; they are not uncommon in the Mediterranean, and Concepcion lies in the corresponding southern latitude and has the same type of climate with maximum rainfall in the winter half of the year. It is then that the westerly winds invade a region that fringes the trade wind belt during the summer. The date of this particular storm corresponds with late November in the Mediterranean, and in both regions the late autumn is in general about the middle of the wettest quarter of the year, when the tornado might be expected to occur most often in coastal regions, even though the American tornado is more a phenomenon of the late spring and summer.

Trevithick Centenary Commemoration

AT a meeting of the general committee of the Trevithick Centenary Commemoration, held on May 31 at the Institution of Civil Engineers and presided over by Sir Murdoch Macdonald, the report of the Executive Committee appointed in October 1932 to make arrangements for the commemoration was presented by Mr. H. W. Dickinson, honorary secretary, and passed. The report showed that about £500 had been subscribed, and that the committee had been able to carry through the plans laid down. Memorial services were held in Westminster Abbey and Dartford Parish Church, a memorial lecture was delivered by Prof. C. E. Inglis, and memorial tablets have been erected at Merthyr Tydfil to mark the site of Trevithick's experiment of 1804, and at University College, London, to mark the experiment with the locomotive *Catch-me-who-can* in 1808. A sum of money had also been allocated to assist in the erection of a tablet at Trevithick's birthplace. The work of the committee had been greatly assisted by the hospitality of the Institution of Civil Engineers and by the generosity of Messrs. Babcock and Wilcox, Ltd., who had defrayed the cost of the publication of the memorial volume on Trevithick by Messrs. Dickinson and Titley. An interesting outcome of the celebration was that it had led the Institution of Civil Engineers to appoint a committee to make an annual visitation to Westminster Abbey to inspect the various memorials to engineers there.

Expedition to the Canadian Arctic

AN expedition, organised by the Oxford University Exploration Club with the full support of the Royal Geographical Society and the Canadian Government, is sailing shortly for Ellesmere Land in the Canadian

Arctic, under the leadership of Dr. Noel Humphreys. The plans of the Expedition are to leave London in July in a sealer chartered from Norway and to winter in Ellesmere Land, next spring being devoted to an exploration of Northern Ellesmere Land. The interior is unexplored and a geological survey of this country will be the chief scientific work undertaken. The Expedition is financed partly by its members and partly by scientific societies and individual subscribers. The greater part of the food supply has been obtained free owing to the generosity of a number of firms. The Expedition will consist of five or six members, but a geologist is still urgently required. Besides being physically fit and prepared to be away from England for a year, he should have had some field experience. Communications referring to the Expedition should be addressed to Mr. E. A. A. Shackleton, Oxford University Ellesmere Land Expedition, 1934, Royal Geographical Society, London, S.W.7.

Archæological Exploration in Alaska

DR. ALEŠ HRDLIČKA, accompanied by a number of volunteer students, left Washington on May 11 for a further season's work on Kodiak Island, Alaska. Several seasons have already been devoted by Smithsonian expeditions, of which Dr. Hrdlička has been in charge, to the examination of sites on this island. The results have shown that it was at one time thickly populated and was in all probability a stepping stone in the peopling of America by migrants from Asia. The earliest inhabitants, whose skeletal remains have been found at the bottom of the accumulated debris, represent the earliest remains of man which have been found in the far north. They are not, however, ancient in the geological sense. In type they approach the physical characters of the Indians of California and the west coast. The earliest immigrants introduced a high order of stone culture, and many of the objects found with them are unique. They were succeeded by the Aleut, who were the inhabitants at the time of the coming of the Russians. A remarkable feature in the culture of the older population is that it is not identical throughout. A marked change takes place in the course of their period of occupation. In the coming season, work will be confined to one large village, already partially explored. The site will be subjected to intensive study in the hope of obtaining a decisive answer to some, at least, of the problems which have been raised in the investigations of previous years.

International Eugenics Conference

THE biennial conference of the International Federation of Eugenic Organisations will take place at Zurich on July 18–21 under the presidency of Prof. Ernst Rüdin of Munich. A programme has been arranged providing for the discussion of subjects of immediate interest in which eminent specialists have been invited to take part. Addresses will be delivered by, among others, Prof. Rüdin on "Racial Psychiatry—a Scheme for Topographical Research in Europe", Dr. Mjoer on "Measurement of Psychological Faculty as shown in Musical Ability", and Prof. Von Verschuer on "Researches in Twins". Dr. Rüdin will also explain the provisions of the recent German eugenics law; and it is hoped that one of the public health officers of the Reich will give an address on the questionnaire now used in Germany for assessing intelligence grade. Among the subjects down for discussion are the assessment of feeble-mindedness—to be held in a joint session of the Committee for Racial Psychiatry and Section B of the International Committee for the Standardisation of Human Measurement—mental measurement and its relation to diagnosis of temperamental type, aspects of the problems of differences between, and inheritance in, monozygotic and dizygotic twins, and the best methods of conducting a central clearing house for human heredity, this last-named including the questions of the establishment of national bureaux, and the protection of authors whose material is published. The work of the Standardisation Committee in Anthropometry will be continued at the International Congress of Anthropological Sciences to be held in London at the end of July.

Prof. Erwin Baur

HEFT 17–18 of *Die Naturwissenschaften*, which appeared on April 27, is devoted to the memory of Erwin Baur, who died in December last. A short general account by Dr. Max Hartmann of his work and its significance in leading to a general appreciation of genetics in Germany is followed by a series of twelve articles written by colleagues of Baur whom he trained in the institute of which he was head, outlining in more detail the results achieved by the institute for plant breeding which he founded at Müncheberg. Five papers dealing with his theoretical work discuss respectively his investigations of mutation, linkage, specific crossing and self-sterility in *Antirrhinum*, and his genetical work on *Pelargonium* and *Cleome*. In seven other papers are considered the practical plant-breeding results obtained with rye, wheat, barley, sweet lupins, fodder plants, potatoes and grapes. Further papers on the practical results will appear in later numbers of the same journal. An obituary notice of Prof. Baur appeared in NATURE of February 17.

Barter in Great Britain

IN the United States, the direct barter of goods and services has developed rapidly since 1931 as a practical method of alleviating unemployment and social distress. So far, little appears to have been done in Great Britain along similar lines, possibly because social insurance is highly developed, whereas in the United States it is practically non-existent. It is of interest therefore to note that, according to *Progress and the Scientific Worker*, experimental barter schemes have been inaugurated near Cheltenham and Petersfield. The Cheltenham scheme was started under the leadership of Prof. Scott of University College, Cardiff. Four acres of land were purchased

to be cultivated co-operatively by a group of men. They receive no remuneration for their work other than coupons signed by Prof. Scott according to the time spent on work. These coupons are equivalent in value to half a pound of potatoes, and can also be exchanged for knitted socks made by a member or for boot repairs undertaken by another member. Later on, it is hoped to extend the variety of goods and services obtainable for the coupons. At Petersfield the system is further developed and the work undertaken by various members includes cultivation of allotments, poultry farming, wood cutting, cobbling, carpentry and general repairs. To break up the land, a tractor has been borrowed from a local firm. The commodities or services are exchanged among the members while surplus farm produce is sent to an occupation centre in exchange for surplus clothes made in the centre.

Gutta Percha, Balata and Caoutchouc

PROF. G. G. HENDERSON, in delivering the twenty-sixth Bedson Lecture in Newcastle-upon-Tyne on May 18, outlined the work carried out in his laboratories on the subjects of gutta percha, balata and caoutchouc. The peculiar difficulties of the subject—which he advised research workers to avoid—are the lack of criteria of purity, complete absence of crystalline compounds, ready resinification at temperatures above 40°, and attack by air. Oxidation experiments with hydrogen peroxide yielded alcoholic substances in each case, which when treated successively with acetic anhydride, further peroxide and aqueous barium hydroxide gave, from each source, so far as could be determined, the same final alcoholic product. Hydrogenation with a palladium catalyst gave results in agreement with the general formulæ $(C_5H_8)_x \rightarrow (C_5H_{10})_x$ with the anticipated increase in stability. This is in agreement with the general conception of chains of isoprene units linked head to tail with loss of one double bond per unit. The hydrochlorides of these substances on treatment with metallic zinc gave, not the same dihydrides, but quite different substances with the original empirical formula but one unsaturated linkage to each two isoprene units, which may be due to cyclisation on loss of hydrogen chloride. Finally, the dibromo addition compounds condensed with phenols in the presence of anhydrous ferric chloride to yield coloured substances with the properties of indicators, one being very suitable for the titration of halides with silver nitrate.

Marine Electrification

SEVERAL important developments in connexion with marine electrification are described in the *G.E.C. Journal* of February. In the past, fishing trawlers have been illuminated by means of carbide lamps which, apart from their disadvantages from an illuminating point of view, introduce a serious fire risk. Special equipment has now been designed and installed on one of the trawlers of a Scottish fishing fleet which enables electric lighting to be used. The installation has been very successful and the practice of electrically floodlighting the decks of trawlers will be widely used. The Company also completed the electrical propulsion equipment of the Diesel-electric tug, *Acklam Cross*. This is the first British vessel of her type, the first to have high-speed Diesel prime movers, the first to have a clear after deck, and the first to have an electrical system of starting the prime movers. The system adopted seems admirably suited to fulfil all the special requirements of a tug. It is capable of going on duty at a moment's notice. It is also capable of rapid manœuvring when towing large vessels in and out of congested harbours. There is practically no delay in exerting full power ahead or astern. The Diesel-electric engine can be started up as quickly as a motor-car engine and during periods of inactivity no fuel at all is consumed. The control of the speed and the direction of the controller is directly in the hands of the navigating officer. Starting is effected immediately by pressing a button. The mean speed over the measured mile was 11·15 knots. The time taken from rest to full speed ahead was 24 seconds and from stop to full astern was 16 seconds. The electro-hydraulic steering gear was very efficient, the vessel being capable of turning at full speed in under two lengths.

Research Activities of the Mellon Institute

THE twenty-first annual report of the Director of the Mellon Institute, covering the year 1933–34, directs attention to the improvement in the position of research during recent months and illustrates the wide range of industries which benefit from the activities of the Institute. Sixty-six industrial fellowships were in operation during the year, requiring the services of 101 fellows and 34 assistants, and fifty-five fellowships were in operation at the end of the year. Fellows and assistants then numbered 104 as against 98 in the previous year; new fellowships commencing operations during the year dealt with cosmetics, nitrogen compounds, calgonising, rayon, new plastics, phosphates, tar acids, textile finishing, etc. The calgonising fellowship is concerned with the properties and utility of sodium metaphosphate ('calgon') in textile and laundry technology, the fellowship on phosphates is occupied with their pharmacology and therapeutic value, and a fellowship to investigate problems in starch technology has recently been accepted. The discovery of a process for flaking coffee by the application of high pressure to ground freshly roasted coffee made in a study of the packing of coffee is claimed as an important technical and practical advance. Other investigations have led to the marketing of new and improved strained foods. Industrial applications of the newer organic solvents have been assisted and a new water-soluble lubricant has been introduced for worsteds and wool. New plasticisers, new types of resins, adhesives which do not cause discoloration of envelopes on sealing, the synthesis of new types of amines, are among other achievements of the Institute, which can also point to important investigations on steel, the development of novel building materials, studies on heat insulation and efforts at smoke abatement as other evidence of its importance

to the general welfare. The fellows of the pure chemistry department have completed a number of important investigations on quinine, the cinchona alkaloids, etc., while the Institute has also supported investigations on pneumonia and pulmonary diseases at the Western Pennsylvania Hospital.

Aquarist and Pond Keeper

THE sixth volume of the *Aquarist and Pond Keeper*, which opens with the March–April issue, has a change of cover, a new headpiece and other improvements in printing and illustrations. The magazine keeps up its character in every way, and is full of information for those who are fond of aquaria, vivaria and pond culture. The articles in the present number include the first of a new series by Arthur Denham on the keeping, breeding and rearing of tropical fishes, and aquarium notes by E. G. Boulenger, director of the Zoological Society's aquarium, and by S. W. Weller, curator of the Brighton Aquarium. An angler fish or 'fishing frog' more than three feet in length, said to be the finest specimen of its kind ever exhibited alive, has been acquired for the Brighton Aquarium. It will be interesting to see how long it lives, for this species is notoriously difficult to keep in confinement, especially those of such a large size.

The Merseyside Aquarium Society

ONE of the most extensive collections of British fresh-water aquaria and aquatic and river-side vegetation, in addition to foreign aquaria, has lately been brought together by the Merseyside Aquarium Society at its aquarium at Cliff House, Wallasey, which was opened by the Mayor of Wallasey in March 1932. The collection, which now comprises some sixty tanks, is claimed to be the most extensive of its kind in the North of England, and situated in extensive glass-houses, is largely the result of much hard work by enthusiasts in all classes of life in an effort to establish a really efficient scientific and public aquarium on Merseyside. The Merseyside Aquarium Society was instituted in 1926, largely through the efforts of Mr. F. Jefferies, a past president of the Liverpool Naturalists' Field Club, and incorporated in 1930, and its first president was the late Prof. James Johnstone. The president of the Society is Alderman A. H. Evans of Wallasey, the vice-presidents Prof. J. H. Orton, professor of zoology in the University of Liverpool, W. S. Laverock, lately of the Liverpool Museums, and Alderman D. R. Charlesworth, ex-mayor of Wallasey, and the honorary secretary, Mr. F. Jefferies. By a system of exchange, the Cliff Aquarium has acquired a number of valuable exhibits from the New York Aquarium Society, and it has lately been successful in breeding and rearing the axolotl (*Amblystoma*) to maturity. The present premises have been loaned the Society by the Wallasey Corporation, but the Aquarium is only considered a nucleus for a much larger building which it is hoped to have built as a municipal affair in the future. The Society issues a volume of *Proceedings*, holds six indoor meetings annually, and affords special help for the amateur aquarists, for the exchange of knowledge and experience amongst experts, and to promote school aquaria and vivaria.

Advances in Oceanographical Research

THE great and growing importance of fundamenta research in marine biology and oceanography has recently been emphasised by the launch of two new vessels specially ordered and designed for this work. On September 23, 1933, a new French research vessel, the *Président-Théodore-Tissier*, left the builder's yard. This ship, built to the order of L'Office Scientifique et Technique des Pêches Maritimes de France, is approximately 160 ft. in length, fitted with up-to-date Diesel engines capable of producing a maximum speed of 11 knots, and fully equipped with all the latest apparatus for both oceanographical and biological researches. The *Président-Théodore-Tissier* has now completed her trials and is already in commission. A few months before the launch of the French vessel, the Danish Biological Station, Copenhagen, took over from the builders the new research ship *Biologen* (Report of the Danish Biological Station to the Ministry of Shipping and Fisheries, 38, 1933. Copenhagen: C. A. Reitzel). Though considerably smaller than the *Président-Théodore-Tissier*, the Danish vessel is also fully equipped for carrying out scientific work in both narrow and high seas. In view of the acquisition of these two highly efficient modern research vessels by foreign powers, it is all the more regrettable that H.M.S. *Challenger*, originally destined for similar work by Great Britain, should have had to be given over to other purposes, and the activities of our existing ships seriously curtailed.

A Potato Research Station

THE establishment of such a station in one of the important potato-growing districts is advocated by Sir John Russell in the foreword to the report of the sixteenth Rothamsted Conference, upon "Problems of Potato Growing" (Harpenden: Rothamsted Experimental Station. 2*s*.). Sir John concludes that economical production of potatoes necessitates the use of good seed of the most suitable varieties, appropriate schemes of manuring and cultivation, control of insect and fungus pests and of other agencies causing disease, and methods for dealing with excess produce. All these topics are dealt with by expert contributors in this report. The fields of research developed around this homely plant, notably the virus disease problems, show how technical and specialised are the problems raised by this crop, and though the present research and advisory system deals very effectively with them to a point, Sir John concludes that there is room for such a special research station continuously concerned with investigations into the physiology of the potato and the utilisation of the tuber.

Research Regulations in Germany

THE April number of the *Fight Against Disease*, the quarterly journal of the Research Defence Society,

among other matter, gives extracts from the new German law controlling vivisection, which show that the German regulations governing experiments on living animals are substantially the same as those which have been enforced by the Home Secretary in Great Britain for more than half a century.

National Baby Week Council

THE annual report of this Council, recently issued, describes the work accomplished during 1933 and constitutes another record of increased activity and influence. A tribute is paid to the co-operation of the Press and of shops and stores in propaganda respecting maternity and child welfare problems. It is suggested that propaganda should this year be devoted to the subject of "The Making of an A.1. Nation", and "National Baby Week" is to be celebrated on July 1–7. The Council has suffered from the financial stringency, but by exercising the strictest economy, income for the year exceeded expenditure by the small margin of about £12.

South-Eastern Union of Scientific Societies

THE thirty-ninth Annual Congress of the South-Eastern Union of Scientific Societies will be held at the University of Reading on July 11–14, under the presidency of Prof. H. L. Hawkins, professor of geology in the University. On July 11, Prof. Hawkins will deliver his presidential address entitled "Fossils and Men". The presidents of sections will deliver the following addresses during the Congress: T. D. Kendrick (Archæology), "The Art and Archæology of the Early Anglo-Saxons"; Dr. Macgregor Skene (Botany), "Some Problems of Germination"; Dr. C. B. Williams (Zoology), "Insect Immigration in Great Britain"; T. H. Edmunds (Geology), "The Water Supply and Geology of the South-East of England; C. H. Grinling (Regional Survey), "Surrey for Action". On July 13, at 8 p.m., Prof. E. B. Poulton will deliver a public lecture entitled "The Power of Changing Colour as a Form of Protective Resemblance". Further information can be obtained from the Hon. General Secretary, 14, High View Close, Norwood, S.E.19.

American Academy of Arts and Sciences

AT the annual meeting of the American Academy of Arts and Sciences held on May 9, the following officers were elected for 1934–35: *President*, Prof. G. H. Parker; *Corresponding Secretary*, Prof. Tenney L. Davis; *Recording Secretary*, W. E. Clark; *Treasurer*, I. Bowditch; *Librarian*, Prof. Alfred C. Lane; *Editor*, Prof. Robert P. Bigelow; *Foreign Honorary Members*, Prof. R. A. Fisher, Galton professor of eugenics in University College, London; Prof. A. V. Hill, Foulerton Research professor of the Royal Society, and University professor of physiology in University College, London; Prof. Arthur H. Holmes, professor of geology in the University of Durham; Prof. Paul Janet, professor of electrotechnics in the Sorbonne, Paris; Prof. Luigi Lombardi, Rome; and Prof. R. Willstätter, Munich.

Announcements

PROF. A. V. HILL will open a discussion at the Royal Society on June 14 on "Methods of Measuring and Factors Determining the Speed of Chemical Reaction".

THE RIGHT HON. WALTER E. ELLIOT, Minister of Agriculture and Fisheries, will inspect the field plots and laboratories of the Rothamsted Experimental Station on June 20, at 11.15 a.m. On the same day, Mr. Elliot will present to the Trustees the deeds of the land newly acquired as a result of the recent public appeal.

PROF. J. B. CONANT, president of Harvard University, formerly professor of chemistry in the University, has been awarded the medal of the American Institute of Chemists. The award is made in recognition of "outstanding service to the science of chemistry and the profession of chemists in America". Prof. Conant is well known for his work on reduction and oxidation in organic chemistry, and on hæmoglobin and chlorophyll.

WE have received the second supplement, 1931–1933, to the "Catalogue of Lewis's Medical and Scientific Lending Library" (London: Lewis's Library, 136, Gower Street, London, W.C.1. 2*s*. net). Works are listed alphabetically under authors' names, and at the end there is a classified index of subjects, under each of which authors' names are given, and the full title of the works will be found on reference to the body of the catalogue. All the sciences appear to be represented, and the list contains nearly 3,000 titles.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer in physics in King's College, London—The Secretary (June 12). A veterinary officer to the Berkshire County Council—The Clerk, Shire Hall, Reading (June 19). Assistant lecturers in geology and geography, chemistry, and physics at University College, Swansea—The Registrar (June 20). A superintendent of parks in the Borough of Barking—The Town Clerk, Town Hall, Barking (June 20). A lecturer (woman) in geography at Norwich Training College—The Principal (June 20). An inspector of agriculture in the Department of Agriculture and Forests, Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S.W.1 (June 21). A lecturer in pure and applied technology at Leicester College of Technology—The Director of Education (June 22). An assistant in the Department of Natural Philosophy in the University of St. Andrews—The Secretary (June 23). A senior lecturer in mathematics at the Huguenot University College, Wellington, Cape Province, South Africa—The Registrar (Aug. 14). Evening teachers of pure and applied mathematics, economics, economic geography, etc., at the Wandsworth Technical Institute, London, S.W.18—The Secretary.

ERRATUM: NATURE, June 2, p. 837. "Chemistry of Red and Brown Algæ." For "polymerised uronic acid" read "polymerised mannuronic acid".

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.*]

Activities of Life and the Second Law of Thermodynamics

WE regret the necessity of prolonging this discussion, but in spite of the letter of Sir James Jeans[1] we persist in the conviction that it is his reasoning, not ours, which is fallacious. We are quite aware that the change of positional entropy associated with the type of process which he cites involves the factor Nk, where k is the Boltzmann constant and N the number of 'particles' concerned in the process, nor do we dispute the correctness of the well-known formulæ which he quotes. We must, however, point out that he is wrong in assuming that the number of 'particles' *must* coincide with the number of molecules. We might ask, why not the number of atoms, or the number of protons and electrons? The answer is, that for a given process of redistribution the 'particles' are those units whose relationship to one another is altered but whose internal structure remains unaffected. In the process of sorting out trucks each truck is to be reckoned as a 'particle'; in the process of steering the *Mauretania* the ship is a 'particle'.

To revert to the type of case originally considered by Sir James Jeans, let us imagine a large number of equal spheres of glass on a frictionless horizontal plane. If N of these spheres be moved from a place where the (superficial) density of distribution of the spheres is ν to a place of higher density ν^1, then the decrease of positional entropy of the system is equal to kN (log ν^1 − log ν). According to Sir James Jeans, however, the decrease of positional entropy would be kn_1N (log ν^1 − log ν), where n_1 is the number of molecules contained in each sphere. If he reasons in this manner, we would ask him why the decrease of positional entropy should not also be kn_2N (log ν^1 − log ν), where n_2 is the number of atoms, or the number of protons and electrons, contained in each sphere. This paradox clearly reveals the fallacy in his reasoning.

Finally, we would point out that the total entropy of an assembly of N identical systems, each made up of n ultimate particles, may be resolved into the sum of two terms, the first of the order Nk determined by the configuration (and relative motion) of the centres of mass of the N systems, the second of the order $N(n-1)k$ determined by the internal arrangement of the ultimate particles in each system. In any process in which the internal arrangement of the systems remains unchanged, only the *first* term in the entropy is affected. We think it scarcely possible that Sir James Jeans would dispute this statement, although the views expressed in his last letter contradict it.

F. G. DONNAN.

University College, London.

E. A. GUGGENHEIM.

University, Reading.

[1] NATURE, 133, 612 April 21, 1934.

Calcium Isotopes and the Problem of Potassium

BY the systematic use of the purest materials, I have succeeded in reducing the effect of potassium in the mass-spectrum of calcium to a negligible quantity. Under these conditions, the line 41 disappears completely and it is quite safe to conclude that the isotope Ca 41 does not exist, at least to 1 part in 1000, in the element. Photometry gives the following provisional constitution for calcium:

Mass numbers ..	40	42	43	44
Abundance ..	97	0·8	0·2	2·3

It will be noted that the abundance of Ca 44 is much greater than that originally reported by Dempster[1] and is in better accord with the chemical atomic weight.

I have been kindly supplied with compounds of calcium extracted from biotite by Prof. G. v. Hevesy and from pegmatites from Rhiconich and Portsoy by Prof. J. Kendall. On the view that the radioactivity of potassium is due to the simple beta ray transformation of K 41 to Ca 41, these samples should be rich in the latter. On analysis their mass-spectra showed no appreciable difference from that of ordinary calcium, so that the abnormal atomic weights reported by Kendall[2] cannot be ascribed to the presence of the hypothetical isotope 41.

Hevesy's beautiful distillation experiments have shown that the radioactivity of potassium is unlikely to be associated with the abundant light isotope 39, so that the failure to detect Ca 41 appears to favour some more complex theory of the disintegration such as that recently suggested by Gamow[3].

F. W. ASTON.

Cavendish Laboratory,
Cambridge.
June 1.

[1] *Phys. Rev.*, **20**, 633; 1922.
[2] NATURE, 131, 688, May 13, 1933.
[3] NATURE, 133, 746, May 19, 1934.

Interaction of Radio Waves

IN our letter published in NATURE of February 10 last, Dr. Martyn and I stated that we had found that Tellegen's observation of an apparent interaction of radio waves could be explained by taking account of the changes, in the mean velocity of agitation of electrons in the ionosphere, produced by a strong electric wave.

Another interesting consequence of this effect due to an electric wave may be pointed out, namely, the production of so-called 'atmospherics' in a radio receiver by modulation of the received carrier wave.

An atmospheric electric pulse, acting on the electrons in a part of the ionosphere through which the carrier wave passes, momentarily increases the absorbing power of that part and so momentarily reduces the amplitude of the received carrier wave. Thus an irregular succession of sounds is produced in the receiver, similar to the effects produced more directly by atmospheric pulses.

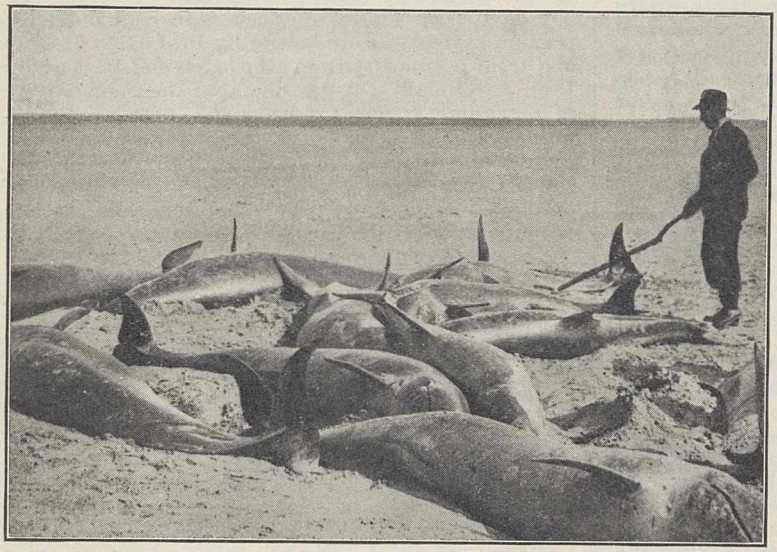
Thus it appears possible that observed 'atmospherics' are of two types, one associated with and proportional to the intensity of the carrier wave, and the other completely independent of the carrier wave.

V. A. BAILEY.

Department of Physics,
University of Sydney.
April 11.

Pseudorca crassidens (Owen) on the Glamorgan Coast

DURING the night of Sunday, May 6, a school of cetaceans was stranded at Whiteford Sands, Llanmadog, on the Gower coast of Glamorgan. We visited the spot as soon as possible and found twenty-one specimens, which we identified as False Killers, *Pseudorca crassidens* (Owen). Mr. M. A. C. Hinton, who has examined one of the skulls, agrees with the identification. It was possible to make a more or less detailed examination of these and to procure some material for this Museum; another specimen, which was not reported to us until later, was some distance away and we did not have an opportunity of examining it.



[*Photo: Western Mail and Echo, Ltd.*

FIG. 1. False killer dolphins stranded on Glamorgan coast on May 6, 1934.

It will be remembered that this dolphin was by many considered to be one of the rarest of cetaceans, "on the verge of extinction", until October 1927, when a school of about 130 was stranded in the Dornoch Firth. In December 1928 a still larger school was reported from the South African coast, near Cape Town, and another school from Velanai Island, near Kayts, in Ceylon, in August 1929. Sir Sidney Harmer, in a letter to these columns[1], gave a summary of occurrences of this species and suggested that its supposed rarity was due to its being an inhabitant of the open seas and thus seldom observed in the neighbourhood of land.

A certain amount of data of biological interest has been obtained about the Llanmadog specimens, and it is hoped to publish this in due course.

COLIN MATHESON.
LIONEL F. COWLEY.

Department of Zoology,
National Museum of Wales,
Cardiff.

[1] NATURE, 127, 60, Jan. 10, 1931.

Meteorology and Gliding

IN a letter to NATURE of May 5, Mr. G. E. Collins asks whether a sensitive thermometer would be useful on a sailplane for detecting rising air, and desires indications as to how sailplane pilots can assist the science of meteorology.

To make satisfactory measurements of temperature and humidity inside and outside clouds by carrying a meteorograph on an aeroplane is difficult, because the instruments at present made are not nearly rapid enough in their responses to record features lasting about a second; and in Germany they have developed a scheme whereby the more slowly moving sailplane carries the self-recording apparatus and is towed by an aeroplane to the region where observations are required, because the demands for rapidity in the meteorograph will then be less severe.

In the absence of a special institution devoted to these purposes, measurements of the variations of temperature and humidity are difficult; but information of value to the gliding movement as well as to meteorology could be got by systematic measurements, or careful estimates, of the vertical air movements in the neighbourhood of clouds of the different types, especially if the type were defined by the use of a camera. Thus on March 18, the day when Mr. Miles, Mr. Collins and Mr. Humphries all made long flights, some of the verbal descriptions that I heard indicated line-squalls; but the photographs and the account given in the *Sailplane and Glider* of April show, I think conclusively, that the clouds belonged in general either to the type that has been classed as 'longitudinal' or to the 'rectangular' type. The photograph on p. 52 of that issue, which illustrates the 'streets of clouds' utilised by the pilots, shows very clearly the spiral form that is characteristic of longitudinal cells: it suggests also that the maximum lift would not be immediately under the axis of the spiral.

My impression, derived solely from theoretical considerations, is that under such clouds the up-currents would not usually be strong; but the formation of soft hail and the shapes in the photographs indicate that on that day the ascent was fairly rapid—in fact, some at least of the clouds were approximating to cumulo-nimbus. It will be interesting to see whether the development of convection in these types is stronger in summer than in spring.

G. T. WALKER.

Imperial College of Science,
South Kensington, S.W.7.

Molecular Weights of Celluloses

DURING recent years a good deal of attention has been given to the investigation of the molecular weight of 'native' cellulose, but the results are highly discordant, the values most frequently quoted being those of Mark[1] (about 30,000, on the basis of micell length by X-ray analysis and other data), Stamm[2] (40,000, by sedimentation equilibrium in the ultra-centrifuge) and Staudinger[3] (about 120,000 by extrapolation of viscosity vs. molecular weight data). The sedimentation equilibrium method is the soundest theoretically, and we have recently demonstrated experimentally[4] that it gives correct molecular weight values for long-chain molecules which, like cellulose, give highly viscous solutions.

In continuation of Stamm's work, we have determined the molecular weights (by sedimentation equilibrium in the Svedberg ultracentrifuge), and we find that the specific viscosity increases for a number of celluloses and regenerated celluloses dissolved in cuprammonium solvent. Calculating the results in the same manner as Stamm did, we obtain apparent molecular weights of the cellulose-copper complex ranging from 100,000 to 300,000, depending upon the extent to which degradation had occurred during the previous history of the specimens. The 300,000 value was obtained for a portion of cellulose which Stamm studied, and for which he reported a value of 55,000 for the cellulose-copper complex. We suspect that degradation inadvertently occurred during Stamm's determinations. To obtain the molecular weight on a copper-free basis, Stamm assumed one copper atom combined per glucose group, corresponding to a correction factor of 72 per cent and leading to his final value of 40,000. Our results on combined copper, and also consideration of the partial specific volume of the copper compound, yield a correction factor of 60 per cent, so that our cellulose molecular weights range from 60,000 to 180,000. We estimate the molecular weight of native cellulose to be in the neighbourhood of 300,000.

The specific viscosity of the cuprammonium solutions of the celluloses increases in a definite manner with the molecular weight, so that after empirical calibration of the relationship by ultracentrifugal analysis, it is possible to calculate average molecular weights from viscosity data. The numerical relationship in the range of molecular weight that we have studied varies appreciably with the composition of the solvent and is not in agreement with the relationship published by Staudinger. The application of Staudinger's equation to our viscosity data gives molecular weight values of 20,000 to 90,000, that is, from a third to a half as great as the ultracentrifuge values.

ELMER O. KRAEMER.
WILLIAM D. LANSING.

Experimental Station,
E. I. du Pont de Nemours and Co.,
Wilmington, Delaware.
April 26.

[1] H. Mark, *Trans. Faraday Soc.*, **29**, 41; 1933.
[2] A. J. Stamm, *J. Amer. Chem. Soc.*, **52**, 3047; 1930.
[3] H. Staudinger, *Trans. Faraday Soc.*, **29**, 18; 1933.
[4] *J. Amer. Chem. Soc.*, **55**, 4319; 1933.

Natural Interconversion of Isomeric Sugars

THE mechanism involved in the smooth transformation of one simple sugar into another is a matter of the utmost importance to the chemist and the physiologist alike, but little light was thrown upon the subject until Robinson[1] introduced the interesting theory that Walden inversion (conditioned by the enzymatic hydrolysis of phosphoric esters) within the sugar molecule is an agency for such changes. This hypothesis presents a simple and rational explanation of the conversion of glucose into galactose by the mammary glands during lactation, and lends colour to the suggestion that the primary constituent of nucleic acid is the commonly-occurring xylose, which undergoes conversion to ribose in an analogous manner. Mathers and Robertson[2], in a research on the hydrolysis of *p*-toluenesulphonyl esters of glucose, recently adduced evidence which strongly supported this view, in as much as they were able to convert a derivative of glucose into a derivative of altrose in one operation. Cognate researches have brought to light the following significant facts.

The alkaline hydrolysis of:

(1) 2 : 3-Di-*p*-toluenesulphonyl 4 : 6-dimethyl α-methylglucoside yields a 2 : 3-anhydro 4 : 6-dimethyl α-methylhexoside and 4 : 6-dimethyl α-methylaltroside[2].

(2) 2 : 3-Di-*p*-toluenesulphonyl 4 : 6-benzylidene α-methylglucoside yields a 2 : 3-anhydro 4 : 6-benzylidene α-methylhexoside and a monomethyl 4 : 6-benzylidine α-methylhexoside which is not a derivative of glucose or mannose.

(3) 2 : 3-Dimethyl 4 : 6-di-*p*-toluenesulphonyl α-methylglucoside yields a complicated mixture containing a derivative of glucoseen.

(4) 3-*p*-Toluenesulphonyl diacetone glucose gives a quantitative yield of diacetone glucose.

(5) 2 : 3-Dimethyl 4-*p*-toluenesulphonyl 6-triphenylmethyl α-methylglucoside gives an almost quantitative yield of 2 : 3-dimethyl 6-triphenylmethyl α-methylglucoside.

(6) 2 : 3 : 6-Trimethyl 4-*p*-toluenesulphonyl β-methylglucoside gives unchanged material and 2 : 3 : 6-trimethyl β-methylglucoside.

Viewing the results as a whole, it is evident that these hydrolytic reactions fall into two main groups, which may be characterised as normal and abnormal, according as the original substance contains one or two *p*-toluenesulphonyl residues in neighbouring positions. It is also worthy of note that in the cases where Walden inversion has been proved to occur, such inversion is accompanied by anhydro formation. This fact at once suggests the idea that anhydro formation may be a necessary precursor to this type of inversion, which follows as a consequence of the opening of the anhydro ring. Such a hypothesis is in keeping with the main principle of the Robinson conception, and at the same time invalidates the criticism levelled against it by Levene[3], whose evidence is based upon the hydrolysis of a phosphoric ester of 5-methyl monacetone xylose, in which the possibility of anhydro formation is precluded.

A full account of these investigations will be published later, and it is hoped that the various extensions of the work which are now on hand will lead to a definite elucidation of this complicated but highly important problem.

G. J. ROBERTSON.
J. W. H. OLDHAM.

Chemical Research Laboratory,
University of St. Andrews.
April 27.

[1] Robinson, NATURE, **120**, 44, July 9, 1927.
[2] Mathers and Robertson, *J. Chem. Soc.*, 1076; 1933. cf. NATURE, **132**, 789, Nov. 18, 1933.
[3] Levene and Raymond, *J. Biol. Chem.*, **102**, 347; 1933.

A New Type of Artificial β-Radioactivity

THE energy spectrum of positive electrons from magnesium, when bombarded by α-particles of radium C′ reduced in range to 6·3 cm., were investigated by a method already described[1]. It was found that the number of positives is less than that expected from the measurements of the integral effect. Changing the direction of the magnetic field, a great number of negative electrons could be observed. The number of negative electrons was about four times as great as the number of positive electrons.

In order to ascertain the true origin of the negative electrons, the following experiments were performed. A sheet of tinfoil or paper was exposed to α-rays under the same conditions as the magnesium. The absence of radioactive impurities was proved by the absence of β-particles in these two cases. The β-particles were also absent when the source was covered by a tinfoil in order to stop the α-particles. Thus it is evident that the phenomenon is due to the bombardment of α-particles.

The number of negative electrons quickly diminishes with time (the half-period is about 3 min.). The limit of the continuous spectrum of the negative electrons is above 2×10^6 e.v. The probable nuclear reactions in the case of positive and negative electrons may be written in the following way:

$$_{12}Mg^{24} + {}_2He^4 \rightarrow {}_{14}Si^{27} + {}_0n^1; \quad {}_{14}Si^{27} \rightarrow {}_{13}Al^{27} + e+$$

(Curie-Joliot reaction)

for positives and

(1) $_{12}Mg^{25} + {}_2He^4 \rightarrow {}_{13}Al^{28} + {}_1H^1; \quad {}_{13}Al^{28} \rightarrow {}_{14}Si^{28} + e-$

or

(2) $_{12}Mg^{26} + {}_2He^4 \rightarrow {}_{13}Al^{29} + {}_1H^1; \quad {}_{13}Al^{29} \rightarrow {}_{14}Si^{29} + e-$

for negatives. In both cases we ought to detect radioactive atoms of aluminium.

In the case of aluminium we were also able to obtain the emission of negative electrons, but their number is considerably less than the number of positive electrons.

A. J. ALICHANOW.
A. J. ALICHANIAN.
B. S. DVHELEPOW.

Physical-Technical Institute,
Leningrad.
May 13.

[1] Alichanow, NATURE, 133, 581, April 14, 1934.

Absorption of Hydrogen by Nickel

IN order to measure the adsorption of hydrogen by pure nickel, free from oxygen, I used a silica tube, containing 12 kilometres of a very thin nickel wire (total weight of the wire 42 grams, mean diameter 0·022 mm.), giving an available surface of at least 8,400 cm.². The preliminary results indicate that between 200° and 650° C., and pressures up to 0·2 mm. Hg, there is no measurable adsorption of hydrogen, but an appreciable absorption (homogeneous solution). The results are in good agreement with Sieverts' measurements with much thicker nickel wire at higher pressures and temperatures[1]. The amount of absorbed hydrogen at a constant temperature is, within the experimental error, proportional to the square root of the pressure, and increases at constant pressure with increasing temperature, obeying the simple equation: $\log a = A - B/T$. The heat of absorption, calculated from this isobare, is a little less than − 3 k.cal. per gram mol hydrogen.

Further details, together with the results at lower temperatures, which are under investigation, will be published shortly.

J. SMITTENBERG
(Netherland Ramsay Memorial Fellow).

The University,
Bristol.
April 17.

[1] A. Sieverts, *Z. physik. Chem.*, **60**, 129; 1907. A. Sieverts and J. Hagenacker, *Ber.*, **42**, 338; 1909. A. Sieverts, *Z. physik. Chem.*, **77**, 591; 1911.

Production of Large Quantities of Heavy Water

FROM the discussion recently held in the Royal Society[1], and from several communications on heavy hydrogen published in NATURE, it is obvious that larger quantities of heavy water are at present much needed for investigations in several branches of physics, chemistry and biology. To meet this demand, Imperial Chemical Industries, Ltd., is to undertake commercial production at Billingham[2]. It may also be of interest to report in this connexion, that various concentrates of the new water are now produced on a large scale in Norway by Norsk Hydro-Elektrisk Kvælstofaktieselskab, Oslo. Large quantities of '1 : 300-water' can be obtained from the above company, and richer concentrates will be available at a later date.

This company at its works in Rjukan has one of the largest electrolytic hydrogen plants of the world, with a capacity of about 20,000 m.³ per hour. Assuming the efficiency of separation by electrolysis so low as 10 per cent[3], a quantity of about 10 litres of 'pure' heavy water a day can be produced if the consumption requires.

In full agreement with other investigators, it has been found that the efficiency is only slightly affected by the conditions of the electrolysis[1,4]. However, certain difficulties arose using sulphuric acid with lead electrodes, due to the formation of porous lead on the cathodes and to the formation of fog. The efficiency of separation in both acid and alkaline solution agree fairly well with that found, for example, by Harteck[5]. Further details of the experimental results are to be published shortly in the *Zeitschrift für Elektrochemie*.

LEIF TRONSTAD.

Institute of Inorganic Chemistry,
Norwegian Technical High School,
Trondhjem, Norway.
May 4.

[1] *Proc. Roy. Soc.*, A, **144**, 1; 1934.
[2] NATURE, **133**, 604, April 21, 1934.
[3] Taylor, Eyring and Frost, *J. Chem. Phys.*, **1**, 823; 1933.
[4] Compare, for example, Topley and Eyring, NATURE, **133**, 292, Feb. 24, 1934. Bell and Wolfenden, *ibid.*, p. 25.
[5] Harteck, *Proc. Roy. Soc.*, loc. cit. and *Proc. Phys. Soc.*, **40**, 277; 1934.

Galvanometer Amplification by Photo-Cell

I NOTE with interest Prof. A. V. Hill's letter in NATURE of May 5, describing the use of a Weston 'photronic' cell in a differential galvanometer relay. It is somewhat surprising that Prof. Hill's apparatus gives such a small amplification. A Weston cell which has been used in a photo relay in this Laboratory for the last three months has given consistently a current amplification of 200. As we are using the same type of galvanometer as Prof. Hill, it would seem that the only reason which can explain his having not obtained more than a twenty-fold amplification must be the difference in the optical system.

Full details will be found in a Laboratory Note communicated to the *Journal of Scientific Instruments* early in March.

V. R. JONES.

Clarendon Laboratory,
University Museum,
Oxford.
May 5.

A Simple Modification of Morse's Rule

MORSE[1] introduced an empirical rule to the effect that

$$\omega_e r_e^3 \approx 3 \times 10^{-21} \text{ cm.}^2 \quad \ldots\ldots\ldots(1)$$

where ω_e, r_e, respectively, are the equilibrium nuclear vibration frequency (in cm.$^{-1}$) and the equilibrium nuclear separation (in cm.) of a diatomic molecule, as deduced from spectra. In a recent paper[2], dealing with the classification of non-hydride diatomic molecules into groups and periods, I have emphasised the importance of the 'group number' n, equal to the number of 'shared' electrons, or total number of 'valency' electrons of the two separate atoms. The way in which the errors from the strict requirements of Morse's rule distribute themselves in certain periods suggests that the insertion of some function of the group number into the Morse expression might lead to better agreement with observation. For non-hydride diatomic molecules of the period containing two completed K rings associated with each nucleus, I have derived the following empirical modification of Morse's relationship:

$$\omega_e r_e^3 \sqrt{n} = 9{\cdot}55 \times 10^{-21} \text{ cm.}^2 \quad \ldots\ldots(2)$$

The mean error in deduction of r_e from ω_e values for 29 test cases of electronic levels of diatomic molecules of the specified kind amounts to $\pm$ 1·3 per cent from experimental values, whilst the mean error using the unmodified Morse expression for the same cases is $\pm$ 5·2 per cent. The results will be communicated in due course in another place.

C. H. DOUGLAS CLARK.
Department of Inorganic Chemistry,
University,
Leeds.
May 4.

[1] P. M. Morse, *Phys. Rev.*, (ii), **34**, 57–64; 1929.
[2] C. H. Douglas Clark, *Proc. Leeds Phil. Soc.*, **2**, 502–512; 1934.

Inheritance in Fresh-water Ostracods

PROF. MACBRIDE'S recent article in NATURE[1], on "Inheritance of Acquired Habits", leads me to direct attention to some interesting information which is available from the study of fresh-water ostracods.

Fresh-water ostracods possess both relatively and absolutely the largest sperms known throughout the animal kingdom, while quite recently it has been discovered that these enormous sperms are highly motile. The sperms are passed into the spermatheca of the female, which possesses a spermathecal duct highly complicated in structure and also exceptionally long. Under the proper conditions, the large sperms can be seen moving very actively both in the spermatheca and also in the upper or proximal region of the duct. The fresh-water ostracods are also remarkable for the wide prevalence of parthenogenesis. In some cases, whole genera exist in which males are unknown. One of the best known genera in this connexion is that of *Herpetocypris*, containing the well-known species *H. reptans* which abounds practically in every pond in the British Isles and is distributed throughout Europe.

The genus is a well-defined one, and two years ago, taking the genus as described by Sars in "Crustacea of Norway" (vol. 9), I estimated that there were some twelve species occurring throughout the world, and in no case were the males known. The most remarkable fact remains, however, that the spermatheca, and in particular the spermathecal duct, remains in *H. reptans* and in all other species examined, nor does it show the slightest sign of degeneration. It is not proposed to give here further taxonomic details, but anyone familiar with the taxonomy of fresh-water ostracods will know many parallel instances.

It is fairly obvious that at one time the males must have existed in each species of *Herpetocypris*, and, since the males have disappeared entirely from the genus, exclusive parthenogenetic reproduction must have been going on for a considerable length of time, most probably for thousands if not millions of generations; yet this useless spermathecal duct remains.

If we treat the matter from a genetical point of view there is a fairly simple explanation, but it seems to me extremely difficult to account for the persistence of this highly complicated genital organ if we accept the theory of the "Inheritance of Acquired Habit". Moreover, the case becomes all the more striking when we consider other groups of animals in which parthenogenesis occurs. For here it is almost universally true that individuals reproducing solely by parthenogenesis usually have their genital organs impaired in some way.

A. G. LOWNDES.
Marlborough College.

[1] NATURE, **133**, 598, April 21, 1934.

MR. LOWNDES has misunderstood my article. Its purpose was not to put forward a *theory* of the heritability of acquired habit but to show that this heritability has been experimentally *proved to be a fact*. If this is so, it is possible to explain all cases where the course of evolution has been followed in detail, as well as to explain the recapitulatory element in development.

E. W. MACBRIDE.
Imperial College of Science,
London, S.W.7.

Parasitism in Heavy Water of Low Concentration

THE first biological experiments[1] with heavy water (May 1933) showed that a low concentration of diplogen (1 part in 2,000) may have a beneficial effect on forms such as *Spirogyra* (the average longevity of 355 cells, in filament sections of 10–50 cells, in the diplogen water was 7·6 days, and the average for 322 cells in ordinary water was 1·6 days). It was also reported[2] that cell division in *Euglena* is increased in this dilute heavy water (density 1·00006). Meyer[3] confirmed the dilute heavy water effect by demonstrating that mats of *Aspergillus* showed sixteen times the dry weight of controls.

We have found that flatworms (*Planaria maculata* and *Phagocata gracilis*) kept in dilute heavy water for long periods show a striking difference in the rate of shrinkage in body size. After four months, the animals in ordinary water were only one fifth the length of the specimens in the diplogen water. This was probably due to reduced enzymic hydrolysis in the starving animals, since we have shown[4] that the dilute heavy water reduces the activity of amylase and zymin (the enzyme and substrate were incubated separately in the water and no effect was

obtained if the substrate only was incubated, or if both were allowed to react immediately). The experiment was repeated in more concentrated heavy water (1 : 213 diplogen ratio) and a new effect appeared. The *Planaria* in heavy water of this concentration were rapidly parasitised by moulds and succumbed within three weeks (Fig. 1). In some cases the living animal becomes invested with slime mould, and in others is covered with tufts of mycelium. The reduced metabolism and movement are possible factors in addition to the specific effect of this concentration of diplogen on mould growth.

A similar increase in the growth of moulds was seen in tests of *Aquilegia* seeds kindly supplied by the Cambridge Seed Testing Station, through the courtesy of Mr. Hugh Richardson of Wheelbirks,

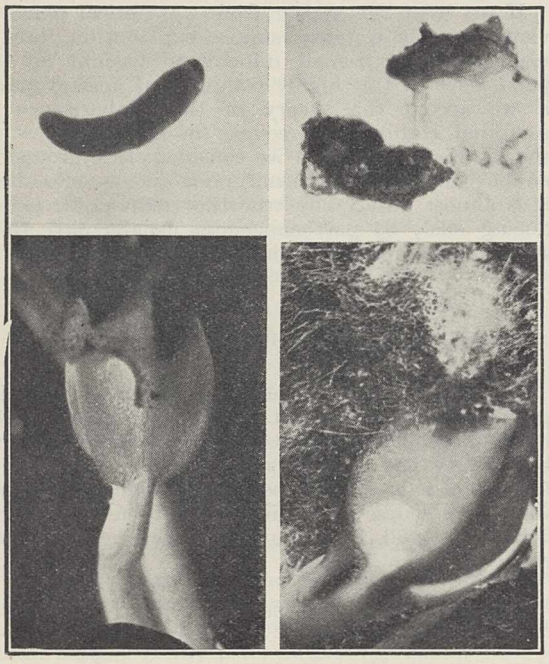


FIG. 1. Upper left : a control planarian in ordinary water. Upper right : two representative planarians killed by mould in 0·47 per cent heavy water. Lower left : sprouting *Aquilegia* seeds in ordinary water. Lower right : seedling in 0·47 per cent heavy water surrounded by white mould.

Northumberland. In the 0·47 per cent diplogen cultures, masses of white mould mycelium appeared (Fig. 1), but these were chiefly saprophytic, since they occurred mostly on the unsprouted seeds.

It would appear from the work of Meyer on *Aspergillus* and the experiments reported in this note, that diplogen in 1 : 200 concentrations has a specific effect in stimulating the growth of moulds and possibly bacteria. This property should afford many interesting problems in parasitology, and might be of considerable importance in the possible therapeutic use of dilute heavy water.

E. J. LARSON.
T. CUNLIFFE BARNES.
Osborn Zoological Laboratory,
Yale University.
May 8.

[1] T. C. Barnes, *J. Amer. Chem. Soc.*, **55**, 4332 ; 1933.
[2] T. C. Barnes, *Science*, **79**, 370 ; 1934.
[3] S. L. Meyer, *Science*, **79**, 210 ; 1934.
[4] T. C. Barnes and E. J. Larson, *J. Amer. Chem. Soc.*, **55**, 5059 ; 1933.

Physiology of Deep Diving in the Whale

PROF. KROGH in discussing the liability of whales to caisson disease[1] writes : "Supposing the whale to stay 5 minutes at 100 m., the 1,000 litres of blood passing per minute would take up an extra amount of 100 litres . . .", and apparently calculates that diffusion would take place as readily at 100 m. depth as at the surface of the sea. I venture to think that he has overlooked an important consideration.

Prof. Krogh assumes, and I think everyone who has considered the matter will agree with him, that the air in the whale's lungs must stand at the same pressure as the water outside the thorax. At 100 m. the total pressure is about 11 atmospheres absolute, so, at that depth, the whale's lung is compressed until an average alveolus has only one eleventh of the volume it had when the whale left the surface and began to dive. This shrinking of the alveoli must greatly decrease the surface available for diffusion and, in addition, the epithelium of the alveolus must become thicker, still further hindering diffusion. The effect of these changes is to obstruct the entrance of excess nitrogen into the blood when the whale is at a considerable depth and to favour its discharge when the animal is breathing at the surface.

G. C. C. DAMANT.

[1] NATURE, **133**, 636, April 28, 1934.

THE point raised by Capt. Damant is certainly important. I have not found it possible to conjure up a mental picture of the whale's thorax and lungs compressed to one tenth or less, and it becomes especially difficult when the air passages are taken into account, since these must take up an increasing proportion of the total quantity of air available. If the compression fails to interfere with the circulation, I do not think that the diffusion of nitrogen or oxygen will be *very* seriously impaired. M. Krogh found[1] that the diffusion in human lungs became independent of the volume when this was diminished below a certain point and explained this by the folding of the alveolar walls. Such folding must take place to a very large extent in the lungs of the diving whale.

AUGUST KROGH.
Copenhagen.

[1] *J. Physiol.*, **49** ; 1915.

The Giorgi System of Units

I REGRET to say my recent article on the Giorgi system[1] contained a mistake, inexcusable I fear in the case of a pupil of Maxwell. In the evaluation of K_0 I used electromagnetic instead of electrostatic units. The value I gave needs dividing by v^2, the square of the velocity of wave propagation. If we take 3×10^{10} cm. per sec. as the value of v, then K_0 becomes

$$\frac{1}{4\pi} \frac{10^{11}}{9 \times 10^{20}} \text{ or } \frac{1}{36\pi} 10^{-9}$$

and this is the value used by Prof. Giorgi.

I have to thank more than one correspondent for the correction.

R. T. GLAZEBROOK.

[1] NATURE, **133**, 597, April 21, 1934.

Research Items

Ancestor Worship in Portuguese East Africa. An account of a village temple and ceremonial of WaBarwe ancestor worship by the Rev. D. Shropshire appeared in *Man* for May. The temple was situated in a banana grove which was entered through a doorway in a decorated bamboo screen. It consisted of a small house, 7 ft. by 5 ft., with a gabled thatched roof. It was built of poles and reeds and had a small wicket gate of reeds. Within the temple were two clay pots sunk in the ground. A large banana leaf lay on the ground in front of them, and two small pieces of bamboo and a calabash hung from the roof. An empty calabash upside down was inserted in the ground. One of the pots was for offerings to the mothers of the forefathers of the head of the village, the other for the mother of his father. In the ritual of worship the head of the village (or in this instance his deputy) swept the floor of the temple and its precincts. He then placed a reed mat in front of the door of the temple and a new large clean banana leaf inside the temple in front of the two pots. At a house in the village a procession was then formed which made its way to the temple, the wife of the representative of the village headman carrying mealie meal on a wooden plate. On arriving at the temple, all knelt and clapped hands ceremonially in greeting to the ancestors. The deputy then entered the temple and sat on the ground. After further clapping of hands he made offerings of the meal, with an invocation, to each of the pots in turn. The procession then returned to the house from which it started. At the time of the great offering and worship of the ancestors at the sowing season, they offer beer, bananas and rice in addition to the mealie meal. They do not pray to the Supreme Being except when out hunting, in prolonged drought or when the medicine man has failed to make a person well. He is too far away, and on ordinary occasions they pray to the ancestors to intercede with him, instead of addressing him directly themselves.

Tutelary Deities in Lower Bengal. A village shrine sacred to two sister deities in a paddy field near Gangājaorā in the neighbourhood of Calcutta has recently been described by Dr. Sunder Lal Hora (*J. and Proc. Asiat. Soc. Bengal*, N.S. **29**, No. 1). The two deities were installed in a small hut built on a low mud platform like a Mohammedan tomb. They were represented by beautiful clay figures, dressed in fine and gorgeously coloured clothes. The right arm of each was upraised in the attitude of benediction. Nearby and on the platform were scattered earthen lamps and shells of coco-nuts, showing that some sort of *pūjā* had recently been performed there. Inquiry elicited the information that the deities were worshipped on a day convenient to the whole village in the Hindu month of *Māgh* (January–February). They are known as *Olā*, *Jholā* and *Bŏn Bībī*. *Olā* and *Jholā* are believed to be sisters, the former presiding over cholera, the latter over smallpox. Their worship secures immunity for the village from these diseases. *Bŏn Bībī* (lit. the goddess of jungles) is worshipped to secure protection from jungle beasts. The *pūjā* is a common affair for the whole village and the necessary articles are purchased from a common fund to which all contribute according to their means. The principal item is the goat for sacrifice. When it is beheaded, the head is taken as his fee by the blacksmith who performs the killing, while the remainder of the meat is distributed among the villagers. The plot of land on which the *pūjā* is performed has been made over to the village in perpetuity by some rich villager. The social status of the Pod caste, to which the villagers belong, is so low that high class Brahmans will not take food or water from the Brahmans who act as their priests. An appended note by Dr. S. K. Chatterji adds that in Bengal, Hindu and Moslem frequently unite in worship of the cholera deity, when she is known as *Bŏn Bībī* as a concession to Moslem feeling.

Parasitic Worms of Marine Fishes. The attention of zoologists interested in the collection and determination of the parasitic worms of the marine fishes, and also of the marine birds and mammals, found in the British area, is directed to a recently issued section (Lief. No. 24, 1933) of "Die Tierwelt der Nord- und Ostsee" (Leipzig: Akademische Verlagsgesellschaft m.b.H.) which contains the parts of this work dealing with the Trematoda and the Acanthocephala. The part on the Trematoda, by C. Sprehn, includes useful tables for the discrimination of the 46 genera of Monogenea and of the 144 genera of Digenea which have been recorded from marine hosts taken in the area of the North Sea and the Baltic. A total of 374 species is recorded and the host of each is stated. The part on the Acanthocephala, by D. Wulker and J. H. Schuurmans Stekhoven, Jr., opens with an admirable summary, in about thirty pages, of the anatomy, life-history and ecology of the group. Lists follow of the invertebrate and vertebrate hosts of the worms, and keys are provided for aiding the determination of the orders, families, genera and species. The characters of the fourteen genera and 29 species recorded from the area are concisely stated. This part includes 54 illustrations; there are 20 in the part on the Trematoda.

Hawaiian Cypræacea. Dr. F. A. Schilder in his paper "Cypræacea from Hawaii" (*Bernice P. Bishop Museum, Occasional Papers*, **10**, No. 3, 1933) investigates a large collection of 594 specimens and 19 species collected from Pearl and Hermes Reef, Laysan Island and French Frigates Shoal, Hawaii. Most of them are well-known shells but they are interesting as they show an extension in range of distribution, and the large number of individuals of many species makes possible the investigation of local variability by statistical methods. The distribution of the Eratoidæ (Triviinæ) does not indicate any peculiarity. With regard to the Cypræidæ, however, it is evident that the relatively large or callous species have been collected chiefly in French Frigates Shoal and in Laysan Island, whereas the smaller, less callous, or finely sculptured species occur chiefly in Pearl and Hermes Reef. The difference, which is striking, indicates ecological differences in these islands. *Lyncina sulcidentata* seems to live equally well in both environments. There is no difference in the shells from Pearl and Hermes Reef. All Eratoidæ are relatively small. The Cypræidæ from Pearl and Hermes Reef are of medium size to small, or if larger

they are always surpassed in size by those from French Frigates Shoal and from Laysan Island, where most species become large to gigantic.

American Foraminifera. Dr. Thomas Wayland Vaughan completes the description of the species of the genus *Lepidocyclina* that have come into his hands during a number of years, thereby aiding in the solution of problems of geological correlation in the Mexican Gulf and Caribbean region in "Studies of American Species of Foraminifera of the Genus *Lepidocyclina*" (Smithsonian Miscellaneous Collections, **89**, No. 10, 1933). The large and valuable material, much of which was collected by the author himself from Mexico and Antigua helped by many others, and the collections from Cuba contain numerous species, and the account of them is practically complete. These are from the Eocene, Oligocene and Antiguan formation. *Lepidocyclina* is found to vary enormously and the difficulty of defining certain species is great. The variations are of two kinds, first the difference due to alternation of microspheric and megalospheric generations, secondly the difference due to relative age. Because of this large variation it is shown that many so-called species are invalid. This paper, which is a very valuable one, is illustrated by 32 photographic plates. In the same periodical (Smithsonian Miscellaneous Collections, **89**, No. 11, 1933) Mr. Donald Winchester Gravell describes some of the Tertiary larger Foraminifera of Venezuela.

Evolutionary and Mutative Degeneration of Eyes in Gammarids. Recently obtained results on the normal and mutant eyes of *Gammarus chevreuxi* (cf. Wolsky and Huxley, *Proc. Roy. Soc. London*, B, 114; 1934; see also NATURE, February 13, 1932) make it possible to compare the mutative degeneration of eyes with the evolutionary process of eye-degeneration in Gammarids. This has been attempted by A. Wolsky in a paper published in Hungarian (*Math. Termt. Ért. Budapest*, 51; 1934), which also gives a description of the loss of eyes in *Niphargus aggtelekiensis*, a recently discovered cave gammarid from the Aggtelek cave in northern Hungary. The findings on this species confirm the general view held by various authors (Schneider, Vejdovsky, Strauss), that the evolutionary process of eye-degeneration in Gammarids shows a centripetal tendency. That is to say, the superficial elements of the eyes (crystalline cones) are affected first, and from these the degeneration proceeds towards deeper regions, finally affecting the optic nerve. In *Niphargus aggtelekiensis* the eyes are entirely obliterated, but traces of the optic nerve are still present, although much reduced, and probably fused with elements of another nerve. On the other hand, the eye-reduction of *Gammarus chevreuxi* mutants ('albino' type) must be considered as centrifugal, because the elements affected most are the deeper ones (retinula, optic nerve and optic tract), whereas the crystalline cones, although highly degenerated, are still present. The embryological results confirm this, and indicate that in ontogeny degeneration starts at the junction between the base of the eye and the brain, and proceeds in both directions from this centre. Thus the comparison does not support the view put forward by various authors (Banta, Nachtsheim), that blind cave species might have arisen from mutants with reduced eyes. The mutations involved in evolutionary eye-reduction must have been of other types than those which occur under laboratory conditions.

Transmission of Streak Virus by a Leafhopper. At the East African Agricultural Research Station, Amani, Dr. H. H. Storey has shown that the leafhopper, *Cicadulina rubila*, transmits the virus of streak disease from plant to plant of maize. He has since found (*Proc. Roy. Soc.*, B, 112, 46) that this vector capacity of the species is hereditary and that certain individuals do not possess it. The hoppers when hatched are always non-viruliferous and some of them are incapable of natural infection. Pure lines of active and inactive insects were bred and crossed, the results of reciprocal crosses showing that the vector ability is inherited as a simple dominant sex-linked Mendelian factor. No difference could be found in the mouth parts of the two types. In a further investigation (*Proc. Roy. Soc.*, B, 113, 463), Dr. Storey finds that after feeding on an infected plant the virus is present in the intestine but soon disappears from the rectal contents after they are voided. In the 'active' insect the virus can also be detected in the blood, whereas in an 'inactive' insect it is confined to the intestine. The intestine wall of the latter therefore resists the passage of the virus, but this may be overcome by puncturing the abdomen with a fine glass needle. Some secondary mechanism must also be present, since the frequency of success with this method is higher in active than in inactive insects. An insect once infective remains so throughout its life. In another species, *C. zeæ*, the inactive races were shown to be susceptible to inoculation by the same method.

Fusarium Wilt of Asters. A disease of China asters, which gives symptoms very similar to those of 'foot-rot' or 'black-leg', has been found in England by Messrs. L. Ogilvie and B. O. Mulligan (*Gardeners' Chronicle*, March 31, 1934, p. 215). The causal fungus of foot-rot was not present, and it was ultimately found that the asters were attacked by the fungus *Fusarium conglutinans*. Two strains of the parasite were found—var. *callistephi*, and var. *majus*. Symptoms are most conspicuous when the plants form their first flower buds. Black areas extend from the base of the stem to the flower stalks, whilst the leaves turn yellow. The plant ultimately wilts. Trials with a large number of aster varieties have shown that English varieties are almost all susceptible, but an imposing list of American varieties which are resistant in Great Britain is given. The disease appears to be the same as that known in the United States and in various European countries.

Fungi Destroying Leather. The condition known to the leather trade as 'red heat' may cause loss to salted hides by producing thin spots of weak texture. A study of the bacteria which cause this disease in Canada has been made by A. G. Lochhead ("Bacterial Studies on the Red Discolouration of Salted Hides", *Canadian J. Res.*, 10, No. 3, pp. 275–286, March 1934). Two organisms were isolated—one was similar to *Serratia salinaria*, which causes reddening of cured codfish in eastern Canada, and the other was apparently a new species, named *S. cutirubra*. Both organisms can live on substrate containing relatively large quantities of salt, and are proteolytic. They are considered to cause more damage than a species of red halophilic sarcinæ which was isolated from

Argentine hide. Non-chromogenic bacteria were also isolated from salted hide, but seem to be less injurious than those which produce the red colour.

Submarine Valleys. The submarine valleys of continental margins have generally been explained as having originated during a period of emergence and having retained their form for one reason or another during subsequent submergence. This origin, at least in relation to the submarine valleys of the coast of southern California, is questioned by the late Prof. W. M. Davis in the *Geographical Review* for April. Several of these valleys are continued to depths of 200–300 fathoms, which is considerably lower than Daly's estimate of the glacial lowering of sea-level. Nor is there any evidence of upheaval or subsidence by that measure of height. Further, ordinary depositional processes which are building up the shallow sea-floor ought to have obliterated at least the inner part of these valleys, but the reverse is true : some process is keeping these valleys open. Prof. Davis termed these valleys submarine mock valleys, since he does not believe they are due to subaerial erosion. He throws out the suggestion that the real explanation lies in a slow process of submarine erosion in rock disintegrated by a sea-floor current due to some peculiarity of coastal configuration and accelerated no doubt during stormy weather. This submarine erosion, or 'marosion' as Prof. Davis termed it, might create a valley in the course of time and meanwhile of course no sedimentation would occur in it but only on either side. Monterey mock valley, seventy miles south of the Golden Gate, is cited as a typical example.

Architectural Acoustics. The issue of the *Journal of the Franklin Institute* for April contains the address delivered before the Institute in December by Dr. Paul E. Sabine on recent developments in architectural acoustics. Since Prof. Wallace Sabine of Harvard, the founder of the subject, gave an address on it nineteen years ago, great improvements have taken place in both the production and the measurement of the intensity of sounds of all audible frequencies, mainly due to the vacuum tube and amplifier, and we now know that the response of the ear to a sound is proportional to the logarithm of the intensity of the sound. So far as sound insulation is concerned, it is now established that materials like felt reduce the sound transmitted through them to a much smaller extent than solid walls, 4 in. of felt giving less reduction than one inch of solid plaster. The transmission through walls and partitions depends on their forced vibrations, and the sound reduction produced by them is very nearly proportional to the cube of the weight per square foot of wall. In the case of double walls or partitions, structural connexion between the two should be avoided and one of them should be of the heavy and the other of the light type.

Isotopic Separation by Electrolysis of Water. It is known that the lighter hydrogen isotope is evolved preferentially when an alkaline solution is electrolysed, and Polanyi has concluded that this is due to a difference of overpotential for the deposition of H^1 and H^2 on the cathode. R. H. Fowler (*Proc. Roy. Soc.*, A, April) has examined alternative mechanisms for the preferential evolution. He writes equations for the concentration of hydrogen ions in different parts of the cell in steady electrolysis. The self diffusion of the water is apparently sufficient to keep the ratio of heavy to light hydrogen normal near the cathode in spite of the different mobilities of the ions. In addition to the mechanism proposed by Polanyi, however, there may be differential rates of molecule formation by combination of atoms at the cathode surface. It may be noted that Polanyi's mechanism is not consonant with Gurney's theory of electrolysis, while the theory is not inconsistent with the alternative explanation.

Crystal Structure of the Heusler Alloys. The Heusler alloys are remarkable in that they become ferromagnetic after suitable heat treatment, although they contain only non-ferromagnetic elements (copper, manganese and aluminium). A. J. Bradley and J. W. Rodgers (*Proc. Roy. Soc.*, A, April) have investigated the alloys by X-ray crystallography in order to find if the ferromagnetic behaviour is correlated with a particular crystal structure. The annealed alloys (non-magnetic) mainly show a structure like that of a γ-brass, but the quenched specimens (magnetic) show a body-centred cubic structure with a face-centred cubic superlattice. The further investigation of this structure was carried out by careful intensity measurements on powder photographs. It was found possible to distinguish the positions of the copper and manganese atoms by observing the powder patterns with iron, copper and zinc K-radiation, since the scattering power of an atom for X-rays varies rather rapidly in the neighbourhood of an absorption edge. This is a new method which may have important applications. The magnetic alloys have a structure in which copper, manganese and aluminium atoms occupy quite definite positions in the lattice, but when the composition of the alloy differs from Cu_2MnAl, the positions normally occupied by atoms of one element may be replaced according to definite rules by those of another, the structure remaining homogeneous.

Lubricating Grease. Choice between grease and oil is a vital problem in industrial plant lubrication to-day and cannot be made without a comprehensive knowledge of physical characteristics and behaviour of the lubricants in question, as well as an understanding of prevailing operating conditions. Much work already done on lubricating oils has led to their several varieties being classified and their characteristics standardised. With greases, however, this is not the case since, until recently, they were regarded merely as an outlet for by-products of the petroleum industry, and not assessed on their true value as lubricants. H. S. Garlick, in a paper read on May 8 before a meeting of the Institution of Petroleum Technologists, stated that the most convenient method of classification of greases is according to the soap used in their manufacture : thus, the main types are lime, soda, lead and aluminium base greases with a fifth class of miscellaneous types and special products. In all cases, consistency, melting point (flow point), stability both in storage and in use, colour, odour and load-carrying capacity of greases should be determined under known conditions and by accepted methods before application and, in circumstances where the manufacturer or user may require fuller information, exhaustive physical and chemical analyses should be carried out. Unfortunately, research on lubricating greases has not yet reached a point where standard methods of testing can be fixed.

The Royal Observatory, Greenwich

ANNUAL VISITATION

THE annual meeting of the Board of Visitors of the Royal Observatory, Greenwich, was held on June 2. The outstanding feature of the report, presented by the Astronomer Royal, Dr. H. Spencer Jones, is the announcement of the completion and erection of the new 36-in. reflector, the gift of Mr. W. Johnston Yapp. The new telescope was formally opened by the First Lord of the Admiralty on the afternoon following the Board meeting.

On the occasion of the formal opening, Dr. Spencer Jones referred to the generosity of the donor, and to the fact of the gift having been made in recognition of the work of his predecessor, Sir Frank Dyson. The telescope is not, of course, nearly so large as the giant reflectors in use in the United States, but it is as large as might profitably be installed at Greenwich, on the fringe of the great smoke cloud of London. As an instance of Dyson's eagerness in following up new avenues of astronomical work, Dr. Spencer Jones reminded his hearers that during the darkest hours of the War, Sir Frank organised an eclipse expedition in order to make use of the favourable eclipse of 1919 at which the general relativity theory might be tested. Despite the short interval which elapsed between the end of the War and the eclipse, and despite the great difficulties of the times, an expedition was successfully organised, parties being sent from Greenwich and from Cambridge. The success of these expeditions in establishing the observational evidence for the general relativity is well known.

Sir Frank Dyson, who spoke next, paid a tribute to the keenness and enthusiasm of his staff, which he said, had contributed very materially to the progress of the Observatory under his direction. The First Lord then formally accepted the gift on behalf of the Admiralty, which, he said, is very proud of its connexion with Greenwich.

The new telescope is fully described in the May issue of the *Observatory*, and also in the *Engineer* of May 18 and 25, by courtesy of which we are reproducing a general view of the instrument (Fig. 1). It may be said here that the great mirror, which was cast by the Parsons Optical Glass Co., Derby, is of 36-in. aperture and has a focal length of 15 ft. The instrument is intended primarily for use in the Cassegrain form, and there is a hole, 7 in. in diameter, in the great mirror. The secondary mirrors, of which there are two, are made of fused quartz. The secondary mirror which is in use at present is convex and has an aperture of 7 in. and a focal length of 30 in. Set 30 in. inside the principal focus of the great mirror, it sends a parallel beam on to a slitless spectrograph. The alternative secondary mirror is also convex but has a diameter of 11 in. and a focus of 75·75 in. It will be set 50 in. inside the principal focus and will be used to project a real image of a star on to the slit of a slit-spectrograph. The equivalent focal length of this arrangement is 45 ft.

The slitless spectrograph is actually in use. It was constructed by Messrs. Hilger, Ltd. It takes a 6-in. parallel beam through a single 45° prism. The refracted beam is focused by a 9-in. concave mirror of 36-in. focus placed about 36 in. behind the prism. The returning rays are deflected by a flat to a camera at the side of the spectrograph. The use of a mirror instead of a lens is designed to give perfect focus over a large range of wave-lengths, as the instrument will be used to continue the Greenwich work on colour temperatures of stars. The light grasp of the combination of telescope and spectrograph is such that a well-exposed spectrogram of a star of magnitude 3·0 is obtained in three minutes. The instrument was brought into use on April 20, and the report of the Astronomer Royal mentions that 19 comparisons of 12 stars with standard stars (for colour temperature) have been secured on four nights. Attention will be concentrated on stars from types *O* to *A*0 down to the fifth magnitude.

The mounting of the telescope is the modified English form. A long polar axis is supported by piers resting on very solid concrete foundations at the north and south ends and carries a crosshead to which the telescope is attached. The general arrangement resembles the mounting of the 72-in. reflector at Victoria, B.C., but the Greenwich polar axis is so long—21 ft.—that the whole telescope can pass under it if desired. All the bearings are in ball races and the telescope moves with great ease. It can be turned in Right Ascension and Declination by electric motors, both quick and slow motions being provided in each co-ordinate. The telescope proper consists of a heavy casting to which is attached the mirror cell and an open-work tube which supports the secondary convex mirror. The dome is 34 ft. in diameter, and provides ample room in which to work the telescope. It is built of a steel frame covered with papier mâché and sheathed with copper. The dome is rotated by a continuous cable operated by an electric motor. There is a silvering room for the great mirror, which will be carried there on a special trolley.

The instrument is by Messrs. Grubb, Parsons and Co., and the building was erected by the Civil Engineer's Department of the Admiralty. A slit spectrograph has been designed for use with the instrument. This will have three prisms made of a glass transparent in the ultra-violet, but an alternative camera for use with one prism alone will be provided.

Turning to other features in the Astronomer Royal's report, it is noted that progress has been made with the new transit circle, which is being constructed by Messrs. Cooke, Troughton and Simms, Ltd. The house for this instrument has already been erected. This is semi-cylindrical in shape, the axis of the cylinder coinciding with that of the transit circle, and the interior diameter being 30 ft. Two shutters, which are opened by electric motors, give an aperture of 8 ft. in the meridian. The housing is covered with copper sheeting over a layer of compressed cork slabs, three inches thick, to give thermal insulation.

During the past year, meridian observations of the sun were secured on 148 days and of the moon on 100 days. The mean correction to the moon's longitude from Brown's tables has decreased still further. It is now $+4{\cdot}2''$. Two hundred and eighteen plates

for latitude variation were taken with the Cookson floating telescope, and 358 observations of 227 double stars were secured with the 28 in. equatorial. The parallaxes of 32 stars were determined.

The work with the 30-in. reflector on the colour temperatures of the stars was continued until the Yapp reflector was ready to supersede the older instrument. Attention has been concentrated on re-determining the zero point of the Greenwich colour temperature system. The acetylene burner formerly employed has been replaced by an Osram unifilar tungsten filament vacuum lamp, which was calibrated at the National Physical Laboratory at the beginning and at the end of the programme. The combined results of the old and new determinations of colour temperature of standard stars, which agree very well with one another, give a temperature of 18000° K. for *A*0 stars.

The measurement of plates taken at the 1930–31 opposition of Eros is proceeding. Photo-heliographs of the sun have been obtained on 271 days, and observations with the spectrohelioscope on 190 days. The frequency curves of the Greenwich observations of radial velocities of dark flocculi associated with sunspots have been plotted and are found to be in agreement with the predictions of Chandrasekhar's recent theory of the chromosphere. Sunspot activity has been slight. The new sunspot cycle, however, appears definitely to have commenced. Magnetic and meteorological records have been kept, as usual, by the Observatory, the former having been secured at the magnetic station at Abinger. The mean magnetic elements for 1933 at Abinger were: Declination, 11° 51·7′ W.; Horizontal Force, 0·18532; Vertical Force, 0·42942; Dip, 66° 39·4′.

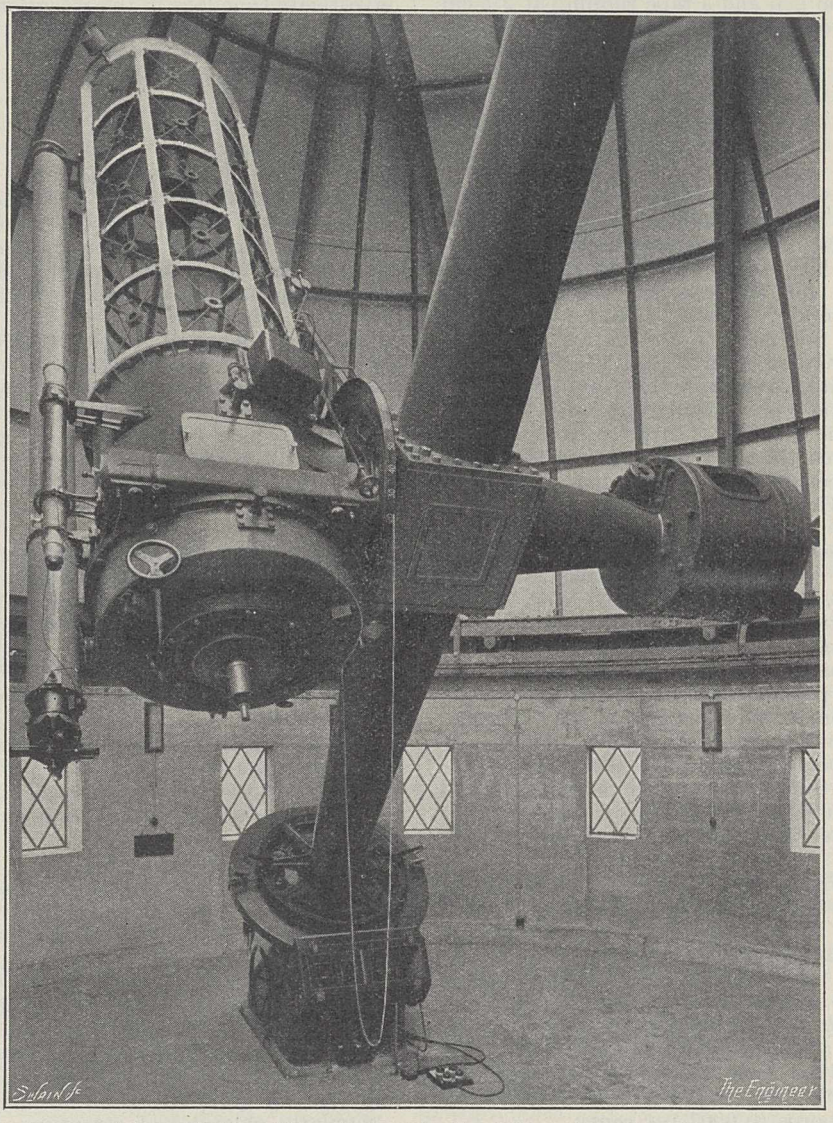


FIG. 1. The Yapp 36-in. reflector at the Royal Observatory, Greenwich.

As is well known, last year was marked in Great Britain by a great scarcity of rainfall. The total rainfall at Greenwich for twelve months ending 1934, April 30, was 16·96 in., which is 7·28 in. less than the average for the years 1841–1915. In

view of special interest attached to observing conditions in England, apropos the advisability or otherwise of erecting large telescopes in Great Britain rather than in South Africa, it may be noted that the sky was completely unclouded on 41 nights only in the entire year.

Special interest is attached to the time determinations at Greenwich during the past year, as an international longitude programme was organised in October–November, 1933, in which Greenwich took an active part. A new type of chronograph, with a very light syphon pen and a tape running at 2·5 cm. per sec. instead of the old-fashioned barrel, has been installed. It is now estimated that the probable error to be attached to each determination of time is $0{\cdot}010^{s}$, but that there are still personal equations to be attached to individual observers in spite of the use of the moving wire micrometer. Two of the routine observers differ from one another by $0{\cdot}04^{s}$. At present the mean of three regular observers is taken as standard for Greenwich Mean Time. It is hoped to construct a personal equation machine in the future. Meanwhile, a cathode ray oscillograph has been purchased with which it is intended to investigate time lags in the reception of wireless time signals.

R. v. d. R. W.

Spectroscopically Pure Substances

ABOUT ten years ago, Messrs. Adam Hilger, Ltd., the well-known firm of optical instrument makers, first undertook to place on the market substances of a high degree of purity such as could be relied upon for the exacting requirements of spectroscopic work. It was intended that such supplies should not only be the purest obtainable by modern technique, but should also be accompanied by a detailed report of the exact amounts of residual impurities as measured by both chemical and spectroscopic methods. In some cases, indeed, so pure have been the products obtained, that only quantitative spectroscopic analysis has been available. Messrs. Hilger have obtained their supplies from specialists in all parts of Europe and the United States, and they have been produced in the laboratories of universities, technical institutes, industrial works, and of private individuals, as well as from the National Physical Laboratory.

Up to 1932, metals alone had been produced, but recently oxides and salts have been added to the list. Of these highly purified materials some twenty-two are metals, eleven are rare earths, and the remainder are largely commoner salts and oxides. The magnitude of this achievement and the considerable advance in the technique of both preparation and analysis made in recent years may perhaps best be judged from the facts relating to a few typical substances.

Manganese. This metal has been prepared in the National Physical Laboratory according to the formula of Dr. M. V. Gayler. A high-frequency induction furnace is used to distil the metal at a temperature just above its melting point (1244° ± 3° C.), at a pressure of one or two mm. Brittle silver-grey nuggets obtained in this way were found to have a purity of 99·99 per cent. The principle impurities were aluminium (0·0003 per cent), iron (0·0024 per cent), nitrogen (0·0027 per cent) and phosphorus (0·0007 per cent).

Germanium has been prepared in the laboratories of the Sir John Cass Technical Institute of at least 99·98 per cent purity. The impurities found were iron (less than 0·001 per cent) and sulphur (0·002 per cent).

Cadmium and Zinc. Both of these are of exceptional purity, namely, of more than 99·999 per cent. The zinc contains copper (less than 0·0001 per cent), lead (about 0·0002 per cent), and slight traces of calcium and iron. The cadmium contains traces of bismuth, lead and copper, in each case to an extent of less than one part in a million.

Columbium of 99·8 per cent purity has been prepared. According to Dr. W. F. Meggers the metal is free from the frequently associated elements vanadium, tantalum, zirconium and molybdenum and contains as impurity chiefly tin—which is not of great inconvenience from a spectroscopic point of view.

Iron rods obtained electrolytically with a purity of 99·96 per cent are available. These contain 0·02 per cent of non-metals (of no spectroscopic interest), silicon (0·01 per cent) and 0·01 per cent of various metals of which full details are supplied.

Silver with a purity of 99·999 per cent is probably one of the purest substances produced. It has been freed entirely from copper and contains as residual impurity chiefly calcium.

Gallium with a purity of 99·938 per cent, which contains only 0·05 per cent of zinc, is probably the purest specimen of this element so far produced.

Copper rods of 99·964 per cent purity have been obtained. Of the impurities, oxygen accounts for 0·03 per cent, and the remainder is constituted of various metals in very small amounts. Very recently, Messrs. Hilger have obtained supplies of copper of which the impurities are only about one twentieth those quoted above.

We turn now to a few chemical compounds which are made available under the trade name of 'Specpure' substances.

Beryllium Oxide and Chloride of 99·99 per cent purity contain only iron (0·005 per cent) with a trace of sodium and a minute trace of magnesium. These compounds have been hitherto very rare in a highly purified form.

Calcium Chloride is notable for its high general purity of 99·993 per cent and especially for its complete freedom from strontium. The latter achievement must be rare, if not unique, since Hönigschmid's recent atomic weight determination was made on material not quite free from strontium.

Similarly chlorides of strontium, aluminium and cobalt, and also powdered silica, all of 99·99 per cent purity, can be supplied. Lead nitrate with a purity of 99·999 per cent and containing only traces of bismuth, copper and antimony, is also noteworthy.

These illustrations will suffice to show the excellence and range of the materials now available. A new standard of purity has been introduced on an extensive scale, and Messrs. Adam Hilger deserve the congratulations and thanks of physicists and chemists alike for their enterprise and its well-merited success.

R. C. JOHNSON.

Heavy Hydrogen

THE April issue of the *Journal of the American Chemical Society* contains some communications on the subject of 'heavy hydrogen' and 'heavy water' (names used by the authors). H. S. Taylor and Selwood announce an error in the calibration of apparatus which makes the viscosity previously reported erroneous; the correct value is 12·6 millipoises at 20°. The ratio of specific gravities of heavy and light waters at 25° is 1·1079, whilst Lewis and Luten give 1·1056. Pure D_2O apparently readily takes up moisture from the atmosphere. The ratio D_2O/H_2O in natural water is about 1 in 5000–6000, in agreement with the mass-spectrograph results of Bleakney and Gould.

Dole reports that the water formed by the combustion of kerosene, benzene and honey was 7, 8 and 4 parts per million, respectively, heavier than ordinary water, whilst Washburn and Smith had found that water from the combined hydrogen of a willow tree was 5 to 6 parts per million heavier. G. N. Lewis and Hanson show that the vapour pressures of mixtures of H_2^1 and H_2^2 approximate closely to Raoult's law and the temperature at which freezing begins also proved to be nearly linear with the mole fraction. While the solid phase is richer in H_2^2 than the liquid, the difference is not great, say 0·55 mole fraction for the solid when that of the liquid is 0·50.

The same investigators also report measurements of the vapour pressures of pure H_2^2 and mixtures of H_2^2 and H_2^1 in a separate communication. The triple point of H_2^2 is 45·40 cm. and 18·66° *K*. An equation of state for H_2^2 is to be published later. When H_2^2O is treated with sodium, a considerable amount of H_2^1 is present, which came from the sodium. Lewis and Schutz have measured the vapour pressures of liquid and solid H^2CN; those of liquid H^2CN differ very little from those of H^1CN. The freezing point of H^1CN is 259°*K*. and of H^2CN 261°*K*.

The same experimenters find that the ionisation constant of deutacetic acid in heavy water is less than one third as great as that for ordinary acetic acid in common water, which indicates that $(H^2)^+$ is much more firmly held by a pair of electrons of another atom than is a proton.

University and Educational Intelligence

CAMBRIDGE.—Mr. A. J. Berry, of Downing College, has been appointed University lecturer in chemistry and Dr. C. P. Snow, of Christ's College, University demonstrator in chemistry. Mr. J. A. Ramsay, of Gonville and Caius College, has been appointed University demonstrator in experimental zoology. J. H. Halliday, of Downing College, and J. F. Everett, of St. John's College, have been nominated to use the University's table at the Zoological Station at Naples.

Applications for the E. G. Fearnsides scholarship for clinical research on the organic diseases of the nervous system must be sent to the Registrary before June 27.

The Master and fellows of Pembroke College announce that the Stokes studentship, of the annual value of £400–450, will shortly become vacant. Candidates should send their applications to the Master before June 23. They must have shown capacity for research in mathematical or experimental physics or in subjects cognate thereto such as physical chemistry or the study of physical laws in relation to living matter.

OXFORD.—In presenting Dr. Edwin Powell Hubble, of the Mount Wilson Observatory, for the honorary degree of D.Sc. on May 29, the Public Orator, Mr. C. Bailey, recalled the fact that Dr. Hubble is a former Rhodes scholar at Oxford. Referring to the great telescope at Mount Wilson as a structure "worthy of giants", he directed attention to Dr. Hubble's researches on remote nebulæ, and made especial mention of his conclusions as to the speed with which they are retiring from our view. The Vice-Chancellor addressed Dr. Hubble as illustrious among the illustrious masters of astronomy, and as a revealer by his penetrating sagacity of the secrets of the universe.

Mr. Battiscombe Gunn, curator of the Egyptian Section of the University Museum, Philadelphia, has been appointed professor of egyptology in the University, to hold office from October 1.

THE Science Scholarships Committee of the Royal Commission for the Exhibition of 1851 have made the following appointments to senior studentships for 1934:—On the recommendation of the University of Cambridge: Mr. C. H. Waddington, for research in biology; and Dr. C. B. O. Mohr, for research in physics. On the recommendation of the Imperial College of Science, London: Dr. J. D. Solomon, for research in geology. On the recommendation of the University of Oxford: Mr. S. G. Hooker, for research in applied mathematics. On the recommendation of the University of Aberdeen: Dr. D. J. Bell, for research in physiology.

UNIVERSITY COLLEGE, London, continues to attract students from all parts of the world in increasing numbers. Its recently issued annual report shows that of 3,121 students enrolled in 1932–33, 56 per cent were from homes within 30 miles of the College, 24 per cent from elsewhere in the British Isles, 9 per cent from the rest of the Empire and 11 per cent from the rest of the world. India, Ceylon and Burma contributed 169 (including 57 post-graduate and research students), China and Japan 24, Palestine 16, four other Asiatic countries 23; Germany 55 (including 12 vacation course students), Scandinavian countries 30, Holland and Belgium 25, Switzerland 23, France 20, Italy 15, thirteen other European countries 60; the United States 45, Canada 15, West Indies 12; Australia and New Zealand 41 (33 postgraduate); South Africa 20, Egypt 19, seven other African countries 16. The total number of postgraduate and research students was 496, being 31 more than in the preceding year. The medical student enrolment also showed a notable increase from 200 to 230. The most conspicuous decrease was in the department of fine arts, from 299 to 253, chiefly women. The enrolment of students for the current session up to January 31 was 3,000 as compared with 2,862 at the corresponding date of 1933. The report refers to the completion of the new accommodation for the reorganised Department of Zoology and Comparative Anatomy which, it is claimed, is, alike in planning and equipment, second to none in Great Britain.

Science News a Century Ago

H.M.S. *Beagle* enters the Pacific

For about two and a half years, H.M.S. *Beagle* under Capt. FitzRoy had been engaged on the exploration of the eastern shores of South America, including Patagonia, the Falkland Islands and Tierra del Fuego ; but in June 1834 the ship passed from the Atlantic to the Pacific and started on that part of her voyage which was to carry her to Tahiti, New Zealand, Australia and home by the Cape of Good Hope. Weighing anchor on June 8, the vessel left Port Famine and proceeded down the Magdalen Channel, "that gloomy passage which", says Darwin, "I have before alluded to, as appearing to lead to another and worse world". On the evening of that day the ship anchored at Cape Turn close to Mount Sarmiento, the highest peak in Tierra del Fuego, and the passage was resumed next day in good weather. By night, however, the western part of the channel had been reached, "but the water was so deep that no anchorage could be found. We were in consequence obliged to stand off and on in this narrow arm of the sea, during a pitch-dark night of fourteen hours long". On June 10, Darwin says, "In the morning we made the last of our way into the open Pacific. The western coast generally consists of low, rounded barren hills of granite and greenstone. Sir J. Narborough called one part South Desolation, because it is 'so desolate a land to behold', and well indeed might he say so. . . . One sight of such a coast is enough to make a landsman dream for a week about shipwrecks, peril and death ; and with this sight we bade farewell for ever to Tierra del Fuego."

Sir James South's Telescope

In his autobiography, Airy records that on June 14, 1834, "I went to London, I believe for the purpose of trying the mounting of South's telescope, as it had been strengthened by Mr. Simms by Sheepshanks's suggestions. I was subsequently in correspondence with Sheepshanks on the subject of Arbitration on South's Telescope, and my giving evidence on it. On July 29th, as I was shortly going away, I wrote him a Report on the Telescope to be used in case of my absence. The award, which was given in December, was entirely in favour of Simms." South, who was born in 1785 and died in 1867, was a London surgeon who through his friendship with Joseph Huddart (1741–1816) became an amateur astronomer. His first observatory was in Southwark and his second, built in 1826, on Campden Hill, Kensington, where he had a "princely collection of instruments such as have never yet fallen to the lot of a private individual". His work gained for him the Copley Medal in 1826 and the presidency of the Royal Astronomical Society in 1829. About this time he purchased a 12-in. object glass made by Cauchoix from glass supplied by Guinand, and employed Edward Troughton (1753–1835), then in partnership with William Simms (1793–1860), to construct an equatorial telescope for it. The mounting unfortunately did not prove successful, and after an attempt at arbitration the matter went into the courts and led to "the most remarkable astronomical trial which ever took place in England". South, who was of a very litigious nature, was so embittered by losing the case that he broke up the instrument, placarded the walls of his observatory with an extraordinary bill and sold the debris by auction. Fortunately the object glass was not destroyed. In 1862, South presented it to Trinity College, Dublin, and it was afterwards used by Brünnow and Ball at the Dunsink Observatory.

Thilorier's Experiments on Carbonic Acid

Faraday succeeded in 1823 in liquefying carbonic acid, and in 1834 Thilorier obtained it in the solid form of 'snow'. Thilorier, the details of whose life do not appear to be known, contributed several papers to the Paris Academy of Sciences, one of which was read on June 16, 1834. In a report of this paper the *Athenæum* said : "M. Thilorier presented for inspection a machine for obtaining chemically, and in a short time, a quart of carbonic acid : the memoir presented a variety of experiments upon this almost intangible liquid, since it can only be procured in vessels hermetically sealed. M. Thilorier announces that in gases the pressures at different degrees of temperature do not correspond with the densities, as is generally believed. Liquid carbonic acid, he says, is of all bodies, that which dilates and contracts itself the most under the influence of atmospheric variations in temperature. Its enormous power of dilation points it out as a new principle of movement far more powerful than any hitherto applied. . . . It is also the liquid that produces the greatest depression of temperature. Directing a jet of it on the ball of a thermometer of spirits of wine, it reduced it to 75° below zero, the greatest depression hitherto observed being 68°. M. Thilorier intends to apply this liquid to an air gun."

Societies and Academies

LONDON

Royal Society, May 31. A. F. W. HUGHES : Development of blood vessels in the head of the chick. The development of both arteries and veins in the head of the chick from the stage of two days of incubation to that of hatching is described, thus continuing the previous account of Sabin, whose methods have been employed in the present study. The simultaneous study of both arteries and veins has thrown light on the well-known fact that one type of vessel tends to accompany the other in adult anatomy. Frequently a nerve also enters into this relationship. Such a complex has been found, in the head of the chick, to develop from a capillary plexus developed along the course of a nerve, out of which both an arterial and a venous channel differentiate. There is evidence that in other vertebrates, and in other regions of the body, similar developmental processes take place. Questions of vascular homology, and current theories on the developmental mechanics of the circulatory system are discussed in the light of the facts which this study discloses. The suitability of the embryonic vascular system as an object of experimental embryological study is stressed. A. FARKAS, L. FARKAS and J. YUDKIN : Decomposition of sodium formate by bacterium coli in the presence of heavy water. The isotopic composition of the hydrogen evolved from mixtures of heavy and ordinary waters with sodium formate by the action of this organism has been analysed. Its composition is defined by the equilibrium $H_2O + HD \rightleftarrows HOD + H_2$. Since the gas liberated is in equilibrium as defined by the equation

$H_2 + D_2 \rightleftharpoons 2HD$, the generally accepted mode of decomposition of sodium formate by the hydrogen-lyase must be wrong and either atoms or radicals must be involved. Palladium black behaves in a similar manner. The importance of this equilibrium in the preferential liberation of light hydrogen in electrolytic and chemical reactions is emphasised.

PARIS

Academy of Sciences, April 9 (*C.R.*, 198, 1329–1372). HENRY LE CHATELIER : The law of the displacement of chemical equilibrium. Reply to M. Posthumus. CHARLES RICHET : The growth in ten years of the towns and peoples of Europe, Asia and America. The rate of increase of the pure white races is only one fifth to one sixth of the yellow or mixed races. Amongst the pure white races, the Europeans have the smallest rate of increase. CHARLES NICOLLE and MME. HÉLÈNE SPARROW : The existence of a typhus virus in Tunis rats. The character of this virus. J. HAAG : Certain problems of the theory of harmonic functions. HENRI DEVAUX and JEAN CAYREL : The electrical conductivity of thin sheets of copper sulphide obtained at the surface of copper solutions. Copper sulphide films of thickness 100–200 A. show metallic and not electrolytic conductivity. This conductivity is much less (1/3,000 to 1/6,000) than the conductivity of solid copper sulphide. E. CECH : The decomposition of a pseudo-variety by a closed subensemble. B. DE KERÉKJÁRTÓ : The similitudes of space. KASIMIR ZARANKIEWICZ : The conformal representation of a doubly connex domain on a circular ring. SCIOBERETI : The determination of a parabolic orbit by the method of Laplace-Leuschner. J. WINTER : The refractive indices of electronic waves. MLLE. SIMONNE CAILLÈRE : The incandescence of certain serpentines after their dehydration. V. AGAFONOFF and G. JOURAVSKY : The thermal analysis of soils of Tunis. HENRY HUBERT : The distributions of air currents in tropical cyclones. G. PONTIER and R. ANTHONY : Concerning the morphological evolution of the molars in mastodons of the series of *Tetraboledon angustidens*. GEORGES TRUFFAUT and SÉBASTIEN PASTAC : The influence on plants of the application of electrical currents by contacts. According to the mode of application, the growth of plants can be either accelerated or retarded by electric currents. LÉON PALFRAY and MLLE. ANNE MARIE LEPESQUEUR : The constitution of essence of carrot. G. MALENCON : New observations concerning the etiology of *bayoud*. MME. BARTHÉLEMY and R. WOLFF : The distribution of calcium and magnesium in the organs of the dog.

April 16 (*C.R.*, 198, 1373–1464). R. FOSSE, P. E. THOMAS and P. DE GRAEVE : Lævorotatory allantoin. Natural or artificial allantoin is a racemic compound. The preparation and isolation of the lævorotatory form by the action of allantoinase from soya is described. J. L. WALSH : Interpolation by rational functions. R. MAZET : A proposed law for completing the laws of friction. A supplementary condition is suggested capable of resolving the indeterminate case known as the Painlevé paradox. JEAN LOISEAU : The impossibility, in space of three dimensions, of constructing a rational mechanics capable of representing with certainty all observable phenomena. JACQUES VALENSI : The vortex phenomena below an aerial screw. MAX SERRUYS : The mechanism of shock in explosion motors. Arguments opposed to the peroxide theory as to the cause of knocking. E. JOUGUET : Remarks on the preceding paper. EMILE BELOT : The pulsation of stars with constant ellipsoidal volume and variable flattening. HENRI MINEUR : The application of two methods of study of the galactic rotation of the *B* stars. A. BUHL : The extreme indetermination of certain propagations connected with Schrödinger's equation. R. ZAÏCOFF : The tensorial form of undulatory mechanics. NICOLAS DE KOLOSSOWSKY and W. W. UDOWENKO : The determination of the specific heats of liquids. NY TSI-ZÉ and TSIEN LING-CHAO : The development of electricity by torsion in quartz crystals. MLLE. SUZANNE VEIL : Some anodic oxidations in gelatine. HUBERT GARRIGUE : New results on the green line of the non-polar aurora in the night sky. JEAN BECQUEREL, W. J. DE HAAS and J. VAN DEN HANDEL : The paramagnetic rotatory power, and the law of magnetisation of tysonite in the direction of the optic axis at very low temperatures. RENÉ COUSTAL : The action of the silent electric discharge on the phosphorescence of certain alkaline earth sulphides. A description of changes in the luminosity of phosphorescent sulphides produced by the silent discharge. P. SAVEL : The complex radiation excited by the α-particles in light bodies. LOUIS MÉDARD : The Raman effect of the hydroxyl radical. A Raman band about 3000–3600 cm.$^{-1}$ has been observed with water, sulphuric, nitric and phosphoric acids, and six alcohols. Hence this band is not peculiar to water, but is shown by liquids the molecule of which includes the (OH) group. H. SPINDLER : A new property of substances possessing the structural number 56. J. PERREU : The thermochemistry of aqueous solutions of the sulphates of zinc, aluminium and manganese. PAUL MONDAIN-MONVAL : The crystallisation of vitreous bodies. Study of the metastable crystalline forms of sulphur and selenium. PICON : The chemical properties of the titanium sulphides. HENRI MOUREU and ARMAND MARIE DE FICQUELMONT : A new mode of formation of phosphorus nitride, P_3N_5. DESMAROUX : The stability of the nitrocelluloses. Study of the saponification, hydrolysis and combustion in dilute nitric acid. D. LIBERMANN : The supposed triarylorthosulphurous acids of Richter. ROGER PERROT : The action of nitrosyl chloride on some aromatic hydrocarbons. At 150° C., the hydrocarbons studied reacted according to the equation $RH + 2NOCl = 2NO + RCl + HCl$. M. LESBRE and MLLE. G. GLOTZ : Some stannonic acids. G. DARZENS and MACENCE MEYER : A new method of synthesis of β-quinoline bases containing alkyl groups in the pyridine ring. J. A. GAUTIER : The chloride of α-hydroxyphenethylpyridinium and of *N*-α-hydroxyphenethyl-α-pyridone. C. LEFÈVRE and CH. DESGREZ : Contribution to the study of the organic sulphides. MARCEL MATHIEU : Two remarks on the structure of cellulose and its derivatives. CONRAD KILIAN : Tectonic and volcanic phenomena in the Ajjer (Central Sahara). H. VAUTRIN : Contribution to the study of the Jurassic series in the Anti-Liban chain and more particularly in Hermon (Syria). P. MARTY and L. GLANGEAUD : The Pontian deposits of Bourboule and the age of the Choussy fault. DANIEL CHALONGE, F. W. PAUL GÖTZ and ETIENNE VASSY : Simultaneous measurements of the proportion of ozone in the lower layers of the atmosphere at the Jungfraujoch and at Lauterbrunnen. The results given tend to prove that the

concentration of ozone increases with the height above the ground. J. ROTHÉ: The magnetism of the basalts of Alsace. GEORGES DUBOIS and MME. CAMILLE DUBOIS: The Flandrian fossil forest modifications of the Paris region. Results of a pollen analysis of the peat bogs of Bresles and Sacy-le-Grand (Oise). GEORGES DEFLANDRE: A siliceous fossil Foraminifera from the Miocene diatomites of California, *Silicotextulina diatomitarum*. LÉON MORET: The corroding Algæ of the Cyanophyceæ group. New observations made at the Lac de Marinet, in the Chambeyron (Basses-Alpes) massif. GEORGES UNGAR: The mechanism of production of the sympathetic effect. The phenomena of liberation. MAURICE PIETTRE: The trophic activity of the mammary cell in a period of functional repose. Besides the functional activity, the elaboration of the milk components, the mammary cell possesses a more general activity called by the author trophic activity. M. and MME. GILBERT S. ADAIR and M. and MME. JEAN ROCHE: Researches on the osmotic pressure and the molecular weight of the hæmocyanines. F. TRENSZ: The use of choroidian melanine, made soluble in distilled water, for the serodiagnosis of paludism. A. BESREDKA and L. GROSS: The nature of the pathogenic principle contained in neoplasic tumours.

GENEVA

Society of Physics and Natural History, February 15. J. WEIGLE: A new recording microphotometer. The author describes a new recording microphotometer, based on the amplification of the photoelectric current. This allows the use of a galvanometer of reduced sensibility and of relatively short period. J. WEIGLE: The deformation of cubic crystalline lattices. P. ROSSIER: The width of the composite line $H_\epsilon + H$ in the spectrograms of $B0$ and $F0$ stars. This line, observed with a small spectrograph with objective prism, has the same width for the two spectral types cited, provided that the time of exposure corresponds closely to the magnitude of the star considered. P. ROSSIER: The relative widths of the lines of hydrogen and of calcium in the spectrograms of $A0$ and $F0$ stars. Although narrower on the spectrograms of $F0$ stars than on those of the $A0$ stars, the ratios of the widths of the hydrogen lines are the same for the two spectral types. The width of the K line of calcium varies widely. E. FROMMEL and D. ZIMMET: Volume of the spleen and pitressine.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, June 11

VICTORIA INSTITUTE, at 4.30.—Sir Ambrose Fleming: "Truth" (Presidential Address).

INSTITUTE OF PHYSICS (MANCHESTER SECTION), at 5.—(in the Physics Department, The University).—J. D. Bernal: "Heavy Hydrogen".*

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Sir John Cadman: "Middle-East Geography in Relation to Petroleum".

Tuesday, June 12

BRITISH SCIENCE GUILD, at 4.—(in the Lecture Theatre of the Royal Society of Arts).—Annual General Meeting. Prof. E. N. da C. Andrade: "Friction".

Wednesday, June 13

INSTITUTE OF PHYSICS (MANCHESTER SECTION), at 5.—(in the Physics Department, The University).—Prof. E. N. da C. Andrade: "Viscosity".*

Thursday, June 14

UNIVERSITY COLLEGE, LONDON, at 3.—Sir Flinders Petrie: "Recent Discoveries at Gaza, Palestine" (repeated on June 16 at 3, and June 19 at 5.30).*

ROYAL SOCIETY, at 4.30.—Discussion on "Methods of measuring and Factors determining the Speed of Chemical Reaction", to be opened by Prof. A. V. Hill.

CHADWICK PUBLIC LECTURE, at 5.—(at Chelsea Physic Garden, Swan Walk, Chelsea).—E. Augustus Bowles: "Simples and Herbals".*

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. Ernest Cassirer: "The Origin of the Modern Concept of Nature in the Philosophical and Scientific Thought of the Renaissance" (succeeding lecture on June 19).*

Official Publications Received

GREAT BRITAIN AND IRELAND

Forestry Commission. Fourteenth Annual Report of the Forestry Commissioners for the Year ending September 30th, 1933. Pp. 41. (London: H.M. Stationery Office.) 9*d*. net.

Kenya Land Commission Report: Summary of Conclusions reached by His Majesty's Government. (Cmd. 4580.) Pp. 8. (London: H.M. Stationery Office.) 2*d*. net.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1566 (T. 3434): Wind Tunnel Interference on Wings, Bodies and Airscrews. By H. Glauert. Pp. iii+75+22 plates. (London: H.M. Stationery Office.) 4*s*. 6*d*. net.

Armstrong College, Newcastle upon Tyne: Standing Committee for Research. Report, Session 1932–1933. Pp. 49. (Newcastle upon Tyne).

Papers from the Geological Department, Glasgow University. Vol. 15 (Octavo Papers of 1931–1934). (Glasgow University Publications, 31.) Pp. viii+19 papers. Vol. 16 (Quarto Papers of 1931–1933). (Glasgow University Publications, 32.) Pp. iv+6 papers. (Glasgow: Jackson, Wylie and Co.)

OTHER COUNTRIES

Smithsonian Miscellaneous Collections. Vol. 89, No. 12: Tribal Migrations East of the Mississippi. By David I. Bushnell, Jr. (Publication 3237.) Pp. 9+4 maps. Vol. 91, No. 8: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep—New Polychaetous Annelids. By Prof. Aaron L. Treadwell. (Publication 3236.) Pp. 9+2 plates. (Washington, D.C.: Smithsonian Institution.)

University of California Publications in American Archæology and Ethnology. Vol. 33, No. 5: Two Paiute Autobiographies. By Julian H. Steward. Pp. 423–438. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.)

Publications of the Observatory of the University of Michigan. Vol. 5, No. 13: The Masses and Luminosities of Spectroscopic Binaries determined by the Mass-Luminosity Relation. By R. M. Petrie. Pp. 169–176. Vol. 5, No. 14: Visual Light Curves of Beta Lyrae. By Ralph H. Curtiss. Pp. 177–187. Vol. 5, No. 15: The Orbit of Comer 1933f (Whipple), Second Paper. By Allan D. Maxwell. Pp. 189–191. (Ann Arbor, Mich.)

Education, India. Progress of Education in India, 1927–32. By Sir George Anderson. (Tenth Quinquennial Review, Vol. 1.) Pp. ix+273. (Delhi: Manager of Publications.)

The Imperial College of Tropical Agriculture. Third Annual Report on Cacao Research, 1933. Pp. 71+3 plates. (Trinidad.) 5*s*.

Union of South Africa. Report of the South African Museum for the Year ended 31st December 1933. Pp. 17. (Pretoria: Government Printer.)

Publications of the South African Institute for Medical Research. No. 31: Immunity in Rous Fowl Sarcoma and its Bearing on the Problem of the Nature of Normal and Cancerous Growth. By Dr. M. J. A. Des Ligneris. Pp. 193. No. 32: Entomological Studies—Observations on *Anopheles funestus* and *Anopheles gambiæ* in the Transvaal. By Dr. Botha De Meillon. Pp. 195–248. (Johannesburg.)

Bernice P. Bishop Museum. Bulletin 108: Jungle Fowls from Pacific Islands. By Stanley C. Ball. Pp. 121+7 plates. (Honolulu.)

Bulletin of Yale University, Supplement. Report of the Director of the Peabody Museum. Pp. 29. (New Haven, Conn.)

Annals of the Observatory of Lund. Nr. 4: Cosmic Ultra-radiation in Northern Sweden. By Axel Corlin. Pp. A113+B80. (Lund.)

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