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The Devolution of Government

POLITICAL events of the last year have scarcely encouraged scientific workers who are dubious about the capacity of our present structure of society to meet our economic, industrial or political needs without profound modification to look hopefully towards the corporate State as exemplified by Italy or Germany. Not even Dr. Levinstein's recent eulogy of nationalised industry is likely to tempt them to support policies so threatening to the stream of independent thought upon which progress in science, as in every other sphere, ultimately depends. Nor is the alternative to Fascism as represented in Soviet Russia, for all the encouragement given to scientific research and to scientific methods, likely to turn them *en masse* to the support of the more extreme socialistic or communistic ideals.

Scientific workers therefore who think less pessimistically than Mr. G. D. H. Cole, Prof. H. J. Laski and others about the capacity of our existing system to modify and reform itself in accordance with the changed needs and demands, will be inclined therefore to give a sympathetic hearing to Capt. Harold Macmillan's recent plea\* for a national policy which is an alternative to either Fascism or Communism. In his recent book he describes in greater detail suggestions previously made in his pamphlets "The State and Industry in 1932" and "The Next Step" which have already been noted in NATURE.

The scientific worker should not be altogether unprepared for the proposals now outlined. They have to some extent been foreshadowed by General Smuts in his lecture on "Science and Democracy", and represent essentially an attempt to find within our existing political constitution a means by which the expert advice and criticism may be brought effectively to play on the mechanism of Government. It is an attempt to substitute knowledge for prejudice in the affairs of industry and State, without recourse to the autocracy which violent change either towards the left or the right is so liable to provoke, and displays an example of hard thinking which must be much more widely practised if we are to emerge from our difficulties and the recent slight improvement is not to prove a prelude to worst disasters.

Capt. Macmillan unhesitatingly attributes the failure of the World Economic Conference to its

\* Reconstruction: a Plea for a National Policy. By Harold Macmillan. Pp. xi+131. (London: Macmillan and Co., Ltd., 1933.) 3s. 6d. net.

failure to grapple with the underlying causes rather than with their effects. Agreement on tariffs, exchange restrictions, uneconomic prices, currency fluctuations, etc., could not be secured because of the deeper conflicts arising from economic nationalism and disproportion or disequilibrium in production. The problems of growth and change to which our social, political and economic organisation must be adjusted were not really faced, and solutions to them must be sought in a spirit of world co-operation as well as of world re-habilitation.

It is important to note the spirit in which Capt. Macmillan has conceived his proposals for reconstruction. As just indicated, in contrast to many other schemes, the policy he outlines seeks to improve our position without inflicting injury on our neighbours. Too often economic policy is advocated or executed with an entire disregard of the injury it inflicts on other countries and the subsequent repercussions in our own trade. This indeed is one of the strongest points in the plea for definite planning of industry, if only to ensure that action beneficial at first sight to one industry is not detrimental to industry or the nation as a whole or in the long run to that industry itself.

The fundamental principle of planning should be beyond question at the present time. The real issue is whether economic planning—the regulation of production in accordance with effective demand—is possible on a national scale as it is within definite limits with every successful individual producer, without incurring the dangers associated with such words as 'monopoly'. Capt. Macmillan sees that, for adequate protection, regulative powers amounting to monopoly must be granted to efficiently organised and integrated national industries, but he is not intimidated by the word and considers that adequate safeguards are possible.

The essential principle of the plan advocated is the direction of production by a central authority for each industry through the grant of monopoly powers in return for the acceptance of certain social responsibilities. National industrial councils would be created for each industry or group of industries, the function of which would be to encourage and assist the efficient co-ordination of purchasing, production and research. Industry would thus become organised as a number of self-governing units enjoying sufficient authority to prevent a recalcitrant minority delaying progress or the continued erection of redundant plant by new producers where plant is already idle, of which

conditions in the canning industry provide an unhappy example.

Without some such self-governing authority it will continue to be difficult to prevent an industry from being robbed of the fruits of wise leadership, scientific management or co-operation through the disturbing influence of new producers. Co-ordination of the policies of different industries would be secured through a Central Economic Council or Investment and Development Board, representing Government and finance as well as industry. This Central Council, under the chairmanship of a Cabinet minister, would be a kind of industrial parliament, its duty being to advise the Imperial Parliament and carry out agreed industrial policies. Since its function would be that of giving expert advice and the execution of Parliamentary decisions, there is no danger in the Central Council becoming a rival to Parliamentary government; indeed, owing to the Council's knowledge of the facts Parliament should be able to devolve on the Council tasks and functions which it could not itself perform.

It is a bold claim that such a scheme, headed by a Central Economic Council on which trade unions are also represented, would provide a counterpart in the economic sphere to the political extension of the franchise. It is not, however, lightly to be dismissed. The scheme is a courageous attempt to relate more effectively knowledge and action, the hiatus between which has been responsible for so many of our ills. Everything turns on the way in which the new powers conferred by the scheme are used. If they are used to determine action in accordance with the full facts, and not in accordance with half the facts or supposed facts, the machinery might well be worth a trial.

The stress laid on social responsibility is accordingly vital. The scheme must be worked in the spirit in which it has been conceived, and it is just the anti-social and incredibly narrow attitude of certain employers' associations to the unemployment question, and to proposals to alleviate that situation, which creates the most serious misgivings about the scheme. A like attitude, a similar refusal to recognise inconvenient facts and selfish disregard of the other side would wreck the whole scheme within a few months of its being launched. Given, however, a generous spirit, a wide vision of service and minds which set themselves unhesitatingly on the full facts, it might give us all that Capt. Macmillan claims. In any event it

challenges scientific workers in all their contact with industry to promote such a spirit and atmosphere in which alone true reconstruction is possible. From their ranks must be drawn some at least of the leaders whose temper and knowledge can best serve the present occasions. Already it seems almost certain that the solution of our problems depends on the evolution of new machinery of government, in which the individual and collective conceptions of society each find a harmonious place as well as permit the right relation of knowledge and power. The violence which both conceptions alone have done to liberty and thought in recent years do not inspire confidence in their ability to lead mankind to higher levels, and science at least might be disposed to search for the truth in some such compromise as that conceived by Capt. Macmillan.

### University Progress

*History of the University of Edinburgh, 1883-1933.*

Edited on behalf of the History Committee by Dr. A. Logan Turner. Pp. xxxi+452+26 plates. (Edinburgh and London: Oliver and Boyd, 1933.) 10s. net.

THIS volume gives the record of fifty years of work in an old university—the youngest, and yet in some respects the greatest, of the Scottish universities. Its most intimate appeal must therefore be to the multitude of the teachers and alumni who have passed and repassed the great gateways during the seventh of the inter-jubilee periods. Yet in that period wide problems of university finance and procedure and progress have arisen and been solved, or have been launched on the way to solution. Questions of interest, or even of gravity, regarding the wisdom or unwisdom of steps taken, push themselves into consideration; and, with institutions as with individuals, it is the sign of the sum total which matters. On the credit side at least the total is never fully known,

“But, all the world’s coarse thumb  
And finger failed to plumb,

So passed in making up the main account,  
All instincts immature,  
All purposes unsure,

That weighed not as the work, yet swelled the  
whole amount,”

were of positive value though they can have no visible place in this volume.

The University of Edinburgh differs from all the other Scottish universities in that it originated outside Church influence; it was ‘The Town’s College’. And right well, on the whole, did the city fathers guard and nourish its infancy and youth until, in the progress of the centuries—about the middle of the last jubilee period—it stepped forth on its own path. Yet there was no complete severing of the old influence, as there could be no complete parting from the old home. ‘Town and Gown’ still go hand in hand, and the voice of the city is heard in the councils of the University. Through access to records, the present volume of the history extends, in a most interesting way, knowledge regarding the earliest stages of the development of the old College, beyond the information available fifty years ago when the first volume was issued.

Not in early days alone did poverty sit on the University benches—peer’s son and ploughman’s son together: not then alone did city fathers struggle for the common good, while fathers and mothers in the cottages went stintedly so that the lad o’ pairts might enter upon his life’s struggle with the hall-mark of a university upon him. Even to this day in Scotland (as elsewhere) there are university students who labour during long hours that they may learn in some of the rest. These conditions have been eased largely during the fifty years by the generosity of benefactors—detailed in this volume—notably through the funds administered by the Carnegie Trust. Yet this easement may be found to be not without its price. There are many who think that the loss of the brave old spirit of independence would be too great a price to pay; and that is not least the thought of the dauntless few of the needful ones who will nevertheless accept no aid. The funds of the Trust are in part supplied to students on the understanding that repayment in the future will be acceptable; but conditions do not in general work out so in practice. Another view is that the number of students who are thus encouraged to seek a university training unavoidably includes many who are not specially fitted to benefit thereby, and who would be more usefully trained in other ways. At present the whole problem is made very complicated by the adverse world conditions.

Another fear regarding trust-administered funds, when these are great, is that the trust tends to become a dictator. This condition applies even to Government administration, although there is

some safeguard in that case through Parliament. In smaller matters also, donors who have become wealthy through their own efforts have a tendency to lay down restrictions having an import which lies beyond their own horizon. Well back in the fifty years, Lord Rosebery warned the Scottish universities against the surrender of their autonomy. The compulsion of surrender is apt to arise insidiously, and perhaps even unpremeditatedly; so that all decisions regarding matters of national importance should be, even in their initiation, open to control. All allocations of important funds should, with the reasons annexed, be open to scrutiny. Yet it seems to be possible, at least theoretically, for a body such as the Carnegie Trust to come to decisions which might adversely affect individual universities. A great example is given by the Treasury itself, which regards the universities as being themselves the best judges of the right mode of spending the grants of money which it makes to them. The same wise course has been followed by several of the donors of munificent gifts which are recorded in this volume.

The Scottish universities are tied together by the condition that a desired ordinance cannot be issued for one until it has passed the scrutiny of the rest. Formerly the tie was more rigid and lay as a blight upon the possibility of individual advance. A main purpose of the tie in its present form is to make impossible a step by one which might act detrimentally on the interests of another—a quite laudable object. But a recent proposal that the University of Edinburgh should be empowered to grant an honours degree in pure science seems to have been opposed successfully by the University of Aberdeen on the grounds that the proposed degree was not of much higher standard than the present pass degree; that students who might not be capable of attaining a high standard of honours in the other honours science degrees would tend to compete for this relatively weaker degree; and that the proposal emanated from the schools. Now it may not be impossible for the standard of the proposed degree to be higher than a low standard of honours in the present more special honours science degrees; and the institution of the new degree might quite conceivably make possible the abolishment of the present third class grade of honours in science, and so raise appreciably the standard of that more special degree. Near the beginning of the present jubilee period in Edinburgh, Chrystal grudgingly

admitted the desirability of a third class grade in honours; and he did so in view of a need for an honours degree, for school teachers, which did not exact too high a standard of specialisation. If the schools recognise that the level of attainments of school teachers in general science should be greater than the level required for actual teaching; and if the proposal for such a degree came from the schools; so much the greater is the credit to them, and so much the greater is the likelihood of its wisdom. But, at any rate for the time, Aberdeen has debarred the suggestion of Edinburgh.

These are problems of a type which any university may have to face in its work for the nation; and there are other wider problems of policy of which the record in this volume gives examples. One of the most important, which arose before the beginning of the half century and was solved in its early years, was that of the admission of women students. In this matter the University of Edinburgh was a pioneer—the inevitable outcome of its pioneering work, in still earlier days, through the medium of extra mural classes for women, taught by members of the University staff. Undoubted success has attended the step. The number of students aiming at an arts degree has in consequence greatly increased; so that, in point of numbers, the Arts Faculty has now ousted the Medical Faculty from first place, and has become almost as much a Faculty for professional training. The Divinity Faculty alone, although it has opened its classes to women students, has resisted the *Zeit-Geist* so far in debarring them from its profession. The professional aspect of the problem accounts also for the great development of the young Faculty of Science within the fifty year period.

Another interesting and successful development in these years is the partial return to the early residential condition obtaining in the Toun's College, through replacement of 'lodgings' by 'hostels'. If it gives less complete conditions for study, it has other great advantages.

The teaching staff has increased nearly six-fold in the fifty years; and the increase of departments and buildings has been on an explosive scale also—so much so that some critics doubt if it should not be regarded as a gamble rather than as an example of wise forethought. But if, one hundred years ago, wisdom had foreseen the present compulsion to expansion, the huge sums recently expended on the acquirement of sites

would have been immensely lessened and the scattering of university fragments over the face of the city would have been avoided. But there was also want of prevision of the petrol motor which has made that scattering comparatively unimportant. Since all knowledge is based upon faith, the exhibition of faith in the headquarters of knowledge is appropriate.

Another, and one of the greatest, of the steps taken was the recognition of the body of students as a corporate part of the University, having a Representative Council established for the purpose of guarding the interests of the students, and empowered to express their views to the higher authorities. The wisdom and influence of this step became at once apparent; and it was followed by the other Scottish universities, by English universities, and even by some on the Continent.

Many other features of advance are recorded in the volume, and would repay study. The social work of the University of Edinburgh Settlement, shared in by students, is notable; and especially so in its originative share in the general advancement of its work through extension to the work of the newly instituted Kirk o' Field College, where unemployed men receive, at their own request, education rather than entertainment, greatly though they appreciate the latter. There, as the donor of the College building said, "The enthusiastic and generous minded student supporters of the Settlement had seen a great opportunity, a unique chance of turning apparent misfortune into co-operative effort, to further education, to revive the joy and pride of craftsmanship, and to weld the classes of the people in community of interest and ideal"; and, as the Chancellor said regarding these unemployed men, "How Scottish it was of them to do that, and how proud we ought all to be to remember that those men are Scottish; they really are our brothers. They are going to get what they want—more lectures, more instruction. All hail to them." They are worthy successors of the students of the earlier days.

Though this volume contains records of deep interest to all who study the problems of education, general or scientific, it is in the hearts of many of the world-scattered army of nineteen thousand graduates that there will be raised by its vivid recollections of two powerful impressions made upon them in the days of their youth: one upon the day when first, with awed feeling, they passed beneath the lofty arches of the great gateway which seemed to them then to be the portal of

the Temple of Destiny; the other on the day when the Alma Mater—Madam Edinburgh University, as the Chancellor called her—passed them out through the same gateway with the hall-mark of her approval upon them, and they knew it to be the gateway of the Temple of Life.

"Never for her to reach the full meridian; and yet, see, watch how she makes around her an atmosphere of light. Her eyes—her improbable eyes that you and I shall never fathom—they are fixed not on those 350 years, but on the next 350 that are now beginning. She knows very well that the rack of the tough world must still be her portion. But she is undismayed, stands full target for all the winds of the future. She says 'For a University there can be no harbour.'" So said Barrie, her Chancellor, and one of the great amongst her sons.

Good wishes go with her as she "beats out to sea".

### Mind and Brain

*The Brain and its Mechanism.* By Sir Charles Sherrington. The Rede Lecture delivered before the University of Cambridge, 5 December 1933. Pp. 36. (Cambridge: At the University Press, 1933.) 1s. 6d. net.

SIR CHARLES SHERRINGTON'S Rede lecture delivered at Cambridge last December, and now published, is an amazing compendium of conclusions covering the whole range of scientific inquiry in that field of Nature which has excited man's intensest curiosity.

Primarily a manager of muscle, nerve and brain are but a skilfully laid train of powder between the muscles it fires and the restless world outside which fires it. Some motor acts, essential but scarcely significant, as behaviour, are driven by nerve action generated within the brain itself. The dominant partner in the driving of the brain is the outside world, wherein a limited set of agents working through nerve and brain can produce a thousand and one dexterous acts.

The motor instrument is separable into a great number of small units usable individually and in many different combinations. Each unit has a single nerve thread, which springs from a wide nerve net. In the nerve nets occur at nodal points two kinds of nerve action, one which fires the nerve thread, the other which impedes or prevents this firing. Conjointly, these two kinds of action neutralise each other quantitatively. Given a

large brain net, the animal's behaviour excels in variety and nicety, but is not radically different from the behaviour of reflex action.

Life's aim is an act not a thought; albeit to refrain is no less an act than other actions. Inhibition is coequally with excitation a nervous activity. One of the processes operative within the mechanism is a travelling signal, a brief local depolarisation of the electrically polarised surface layer of the nerve thread, involving a temporary electrical leak. By repolarisation in the wake of the signal, the transmitting surface is repaired. This activity involves work. The signals can be made to occur more frequently by intensification but cannot be made bigger. In some parts of the brain the repolarisation process is rhythmic, and from such parts trains of signals start periodically.

The nerve nets are patterned networks. Junctional points provide that signals may converge and coalesce, reinforcing each other's power of excitation. The opposite process, inhibition, does not travel but is evoked by travelling signals. The nerve nets are, so to say, weighted with inhibition or with excitation. This weighting leads to variation, even reversal of response.

The brain initiates more than its fair share of acts and exerts censorship. "A shell of its immediate future surrounds the animal's head." A vast expansion of the brain has arisen here where the signals from a distance combine. Reflex action is enlarged and behaviour amplified. The new membrane is so educable as to be practically a new thing in the world. Each motor act becomes the servant of more masters, and an observer may judge that the reflex principle is departed from. May it be that in those parts of the brain which may be called mental, nerve actions exist still unknown to us, and that these may correlate with mind? "There is, so far as I know, in the chemical, physical properties, or microscopical structure no hint of any *fundamental* difference between non-mental and mental regions of the brain." Nerve inhibition must be a large factor in the working of the mind; but the events we have to correlate with the mental events are not themselves of the reflex type: they are back-watered signalings the circuits of which may long be self-maintained. Indeed we have no scientific right to conjoin mental experience with physiological events, but only the right of what "Keats with that Shakespearean gift of his, dubbed 'busy common sense'."

With the attainment of the objective of this exploration, Sir Charles Sherrington predicts that

man will certainly try to improve the brain, "restraining some parts, amplifying others, introducing short-cuts, and certainly increasing speed and aiming at economy and devising as seems to him best. We need not be prophets to foresee that then will come the long-told speedy extinction of man". This inference surely arises from data undisclosed?

### Timbers of Commerce

*A Manual of the Timbers of the World: their Characteristics and Uses.* By Alexander L. Howard. Revised edition, to which is appended an Index of Vernacular Names. Pp. xxiii + 672. (London: Macmillan and Co., Ltd., 1934.) 36s. net.

EVER since the publication of the first edition of this book in 1920, it has been widely used by timber importers and users of timber, and is looked upon as the standard work on the subject. However, many kinds of timbers, some of which are now in use or in the experimental stage—particularly kinds of Empire origin—were omitted from the first edition, and Mr. Howard has taken the opportunity of describing a large number of extra kinds in his new work. An idea of the many additions may be gained from the two hundred or more pages that have been added to the present edition, all of which are devoted to descriptions. Moreover, the whole of the pages describing the artificial seasoning of timber in the earlier work have been used for timber descriptions in the new volume.

Not all the timbers mentioned are used in the British Isles, nor are some of them likely to be used in the future, but they have come under the author's notice and he has included them in his descriptions. In some instances timbers are only known to the author by their vernacular names; whether it was wise to include them without an effort to trace their botanical origin is very doubtful, but as Mr. Howard is one of the leading timber importers in Great Britain, he doubtless has very good reasons for their inclusion, and with his very wide and varied knowledge of the uses and manufacture of timber, the correctness of the commercial side of the book should be beyond dispute.

An alphabetical arrangement of subjects is given, but it is open to criticism, for there is an indiscriminate mixing of common and botanical names which often results in some species of a genus being described with the common name most prominently placed, and in others the generic

name being given the place of honour. The following examples are illustrations:—

- Alder, *Alnus glutinosa*, Gaert.  
 Alder, Formosan. *Alnus maritima*, Nutt. var. *formosana*, Burkill [*A. formosana*, Makino].  
 Alder, Red. *Alnus oregona*, Nutt.  
 Alder, White. *Alnus rhombifolia*, Nutt.

Five other subjects are then described and are followed by *Alnus nepalensis*, Don.

On pages 145–146 three species of *Dalbergia* are described with the generic name first. On pages 457–458 other species of *Dalbergia* are described under rosewood, and on page 487, *Dalbergia sissoo* is described under sissoo. Many such examples occur. There are certainly very good indexes to both common and botanical names, but in a work of this description, where botanical names are in constant use, it would have been a better arrangement and have given a much better impression had the author kept to a proper alphabetical arrangement of botanical names. There are greater difficulties in following out a strict alphabetical

arrangement of common names, for some timbers are equally well known in commerce under several epithets and many cross references would have been necessary.

It is also regrettable that the author did not get someone well versed in botanical nomenclature to go through his manuscript, for there are numerous slips, one of which occurs on page 43. A timber is described as Avodire, and the botanical name is given as *Africana Bingeria*. The name the author had in mind was really *Bingeria africana*, A. Chev., which is actually a synonym of *Turraeanthus africana* (Welw.), Pellegrin.

The misuse of capital letters in specific names is noticeable, and a good deal can be said for the decapitalisation of all specific names in books such as the one under review, a course that would certainly be less confusing for the author.

Apart from these little defects the book has a great deal to commend it, for it is teeming with useful and interesting information, is well printed and well illustrated. It should find a place amongst the most used books of timber merchants and manufacturers of timber.

W. D.

### Short Reviews

*Industrial Chemistry*. By William Thornton Read. Pp. vii+576. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.) 31s. net.

THE four opening chapters of this volume deal with such matters as chemical organisations and literature, and the various functions of the chemist in industry. They might very well have been condensed considerably and, in parts at any rate, omitted, since they bring the author dangerously near that category of zealous exponents of the obvious which, according to his statement on p. 31, he desires to avoid. There is, however, much to be learned from the succeeding chapters on chemical economics, equipment and constructional material in spite of their pronounced American bias.

The remainder of the book is a series of brief but useful monographs on various applications of chemistry to industry, for example, the sulphuric acid, nitrogen, fertiliser, metallurgical, petroleum, electrochemical, rubber, coal, paint and explosives industries; foods, textiles and fermentation are omitted, although there are chapters on carbohydrates, proteins, oils and waxes.

Since the author has wisely recognised that no one person can write with authority on the multifarious processes of chemical industry, he has enlisted the aid of ninety different authorities, and this help is amply justified by the excellence of the monographs. It has not, however, saved the book from certain omissions, such as of stream-

line filtration, submerged flame combustion and the use of esparto in paper-making; from a number of vague statements, for example, "white paper is made from approximately pure cellulose" and "tung oil is used in varnishes in connexion with pine resin which has been esterified with glycerin"; and from a few serious errors such as in the definitions of the Reichert-Meissl and Polenske values of an oil.

Apart from such blemishes, the book may be recommended as collateral reading for students of pure science and possibly also, as the author suggests, as a reference book for business men.

J. G.

*Ronay: a Description of the Islands of North Rona and Sula Sgeir, together with their Geography, Topography, History and Natural History, etc.; to which is appended a Short Account of the Seven Hunters, or Flannan Islands*. By Malcolm Stewart. Pp. xi+73+17 plates. (London: Oxford University Press, 1933.) 7s. 6d. net.

FEW people know of the existence of three uninhabited lands off the north-west coast of Scotland almost as isolated as St. Kilda. These are North Rona, Sula Sgeir and the Flannan islands, seven in number with innumerable rocks. North Rona is a cliff-bound island rising up to 355 ft. and about 300 acres in extent; Sgeir is about 30 acres and 229 ft. high; and the Flannan 100 acres between them, with a height of 288 ft. on

Eilean Mor where there is a lighthouse. All are formed of hornblende gneiss intersected by pegmatite veins and all probably came under the influence of the quaternary ice, for many fragments of alien rock have been found on each. Sgeir has a gannetry with a population of 8,000 to the south of the island, its other birds consisting of as many razorbills and guillemots as well as puffins, kittiwakes, shags and fulmar; as on all such bird islands, vegetation is very scanty. The islands are visited every year from Lewis, Sgeir for young gannets and eggs, the others mainly for the fattening of a certain number of sheep transported from Lewis.

Formerly, all would appear to have been inhabited, for they have the remains of unmortared stone houses. These were half-sunk into the ground at Rona and were entered by crawling along passages. Often large slabs of stone were used, and these would appear to have been turfed over, the only roof-opening being the smoke hole. There is also the remains of a chapel at Rona, now scheduled as a monument. The author is not much interested, but the houses described as known to have been recently inhabited are very strikingly like the dolmen of Locmariaquer and Carnac and many other regions. In conclusion, there is a short bibliography, but there is clearly a field here for the trained archæologist.

*Gas Analysis: by Measurement of Thermal Conductivity.* By Dr. H. A. Daynes. Pp. viii+357. (Cambridge: At the University Press, 1933.) 16s. net.

THE method is based on the discovery by Andrews in 1840 that changes in the composition of gas surrounding an electrically-heated wire are reflected in changes in the electrical resistance of the wire, and may therefore be measured on a suitably calibrated electrical instrument. Thanks largely to the developmental work of Shakespear and the Cambridge Instrument Co. in England, as well as to that of certain firms in Germany and the United States, it has now attained the status of a recognised industrial method, and as such is well worthy of a monograph to itself.

The author is an authority on the subject, and his treatment of the theory, technique and applications of the method is all that could be desired. The applications include flue- and fuel-gas control and measurements in connexion with the production of liquid air, gas permeability, for example, leakage through rubber and aircraft fabrics, nitrogen fixation, etc. On account of the suitability of their thermal properties, carbon dioxide and hydrogen are frequently mentioned, and a number of useful indirect methods are described for the determination of other gases in terms of these.

Possibilities of the method in academic research, for example, in physiology, are also indicated, and it is no exaggeration to state that there is something of interest here for every scientific worker, whatever his sphere and even if he is already using the method.

J. G.

*The Gyroscopic Stabilization of Land Vehicles.* By Dr. J. F. S. Ross. Pp. vii+172. (London: Edward Arnold and Co., 1933.) 14s. net.

THIS book consists of a thesis approved for the degree of Ph.D. in the University of London, and it gives the results of an investigation undertaken with the following objects: "(i) To determine whether monorail traction is scientifically sound and definitely practicable; (ii) To show why the efforts of inventors have hitherto only met with partial success; and (iii) To place the whole subject on a more scientific footing and to give it a more complete and orderly treatment than it had yet received".

The text is, like most original papers, not easy to read; there are many places where the development would have been greatly enhanced by the insertion of explanatory paragraphs. An excellent summary of the author's conclusions with references to the text is given at the end, together with a full bibliography and list of patents.

*The Flora of the Liverpool District.* Edited by C. Theodore Green. Pp. xi+163+201 plates. (Arbroath: T. Buncle and Co., 1933.)

DR. C. T. GREEN, the editor, thirty years ago, of the first edition of the "Liverpool Flora", is to be congratulated on the completion of this new and revised edition, also under his editorship.

The general plan of this well-known flora remains unchanged. Miss Wood's admirable line drawings, which express the 'look' of each plant in a most remarkable way, are still one of its most attractive features, though their reproduction is noticeably inferior in this edition. The chief innovation is the inclusion of five special articles on areas of particular interest, such as the Southport sand dunes, with notes on their topography and flora, illustrated by photographs. There are other small alterations, while, of course, a number of additional localities and records are given. It is a volume which should be in the possession of all interested in this botanically rich area of Lancashire.

*Human Values in Psychological Medicine.* By Dr. C. P. Blacker. (Oxford Medical Publications.) Pp. viii+179. (London: Oxford University Press, 1933.) 8s. 6d. net.

THE author defines pivotal values as those which, in one way or another, unify and justify life, give it coherence and make it on the whole worth living. His conception of pivotal values is the really dominant idea of his book. After a number of chapters devoted to the discussion of values from a psychological point of view, the author studies the clinical aspects of the problem. He found that æsthetic values play a small part in the lives of working-class patients. He divides pivotal values into values which are neither religious nor philosophical. We are inclined to disagree with the statement that the majority of hospital patients have no "pivotal values". There are few people who have no pivotal values if only they can be touched on.



## Hormones of the Anterior Lobe of the Pituitary Gland

IT is now generally admitted that the functions of the pituitary gland (or hypophysis) are mediated by the secretion of a number of hormones from its different parts; although no active principle has yet been isolated in the pure state, the fractionation of extracts has led to the preparation of solutions having only a part of the physiological activity of the original extract. Differences of opinion exist as to the number of hormones actually present, which can only be settled when they are finally isolated as chemical individuals. Our knowledge of the functions of the posterior lobe preceded that of the anterior, but within the last few years, with improvement in both chemical and surgical technique, and also following the discovery that hormones regulating certain of the sexual activities of the body are excreted in the urine, great advances have been made also in our knowledge of the functions of the anterior lobe.

It appears probable that a number of different hormones are secreted by this lobe, but attention has been directed especially to those stimulating growth and the sexual glands. One of the pioneers in this work has been H. M. Evans, of the University of California; the results of his researches, carried on over the last decade, are now available for study, in the form of a detailed monograph\*. Although the association of overfunction of the pituitary with body overgrowth (gigantism or acromegaly) and of its underfunction with dwarfism has been frequently confirmed, it was not until 1921 that Evans and Long succeeded in preparing an extract of ox anterior lobes which stimulated growth in mammals. This was due to the facts that the growth hormone is a complex substance chemically resembling the proteins, is extraordinarily labile and can only be detected when administered frequently and parenterally to suitable animals. Adult female rats more than five months old (which have therefore ceased to increase in weight), are injected intraperitoneally daily for a period of 20 days; groups of four to six animals are used and they are weighed every five days. Gains in weight of 25–100 gm. can be obtained according to the dose given; the relationship between the logarithm of the dose and the gain in weight was found to be approximately linear. E. Bierring and E. Nielsen (*Biochem. J.*, 26, 1015; 1932) have compared the composition of injected growing rats with that of normal growing rats and find that the former show a greater retention of water, but that the solid matter assimilated to the body tissues contains a much greater proportion of protein and less of ash and fat than that laid down by normal animals. About three quarters of the gain in weight of the

injected animals is due to water retention, and three quarters of the dry matter deposited consists of protein.

The method of extraction recommended by Evans and his co-workers is briefly as follows: frozen ox anterior lobes are minced and extracted with water made alkaline with baryta; the mixture is centrifuged and the solution brought to pH 8 with sulphuric acid and again centrifuged. The solution is then acidified and poured into excess of acetone; the precipitate is filtered off and dried. This powder is stable but still contains the gonad stimulating hormone. On extraction with 95–98 per cent acetic acid, the latter is destroyed and the growth hormone can be precipitated from solution by acetone in the presence of quinine sulphate. Trichloroacetic acid precipitates the growth hormone and part of the gonad stimulating hormone from aqueous solutions of the powder; in the supernatant fluid the latter can be obtained free from the former by precipitation with flavianic acid, which is then removed by 80 per cent alcohol containing 1–2 per cent ammonia. The purer growth hormone preparations are highly active in a daily dose of 5 mgm.

Hypophysectomised rats show a greater response to the growth hormone regardless of age or length of time after removal of the gland. Experiments with a hypophysectomised puppy are also described; the pituitary gland was removed when the animal was 8 weeks old; the operation was followed by complete cessation of growth. Daily intraperitoneal injections of the growth hormone resulted in a marked increase in weight and size, so that the animal finally became larger than its litter mate control. Signs of acromegaly, however, did not develop. The ovarian follicles showed considerable development and the thyroid was hyperplastic. Similar injections into a normal female resulted in the development of partial acromegaly, some gigantism and diabetes mellitus. A male, however, only developed adiposity. In dachshunds, the injections increased the size of the animals owing to increase in size of the skull and vertebrae, but the achondroplastic form of the short extremities was not altered; a male developed diabetes. The only outstanding acromegalic feature was a folding of the skin of the head and extremities. These results lend strong support to the generally accepted view that gigantism and acromegaly in human beings are due to over-secretion by the anterior lobe of the pituitary gland.

The gonad stimulating hormone (or hormones) is responsible for the normal development and maintenance in a state of functional activity of the sex glands, with the accessory organs and secondary sex characters. In the female the ovaries themselves respond readily to the hormone; in the male the accessory organs show the most striking effects. Immature female rats were used by Evans

\* The Growth and Gonad-Stimulating Hormones of the Anterior Hypophysis. By H. M. Evans, K. Meyer and M. E. Simpson, in collaboration with A. J. Szarka, R. I. Pencharz, E. E. Cornish and F. L. Reichert. Memoirs of the University of California, Vol. II, Pp. 446. (University of California Press Berkeley, California, 1933.)

and his colleagues for the assay of their preparations; injections were made on three days, the vaginal orifice examined on the fourth and fifth days, smears being taken as soon as it had opened, and the animals killed and examined about 96-100 hours after beginning treatment.

The hormone was prepared from ox anterior lobe (a poor source), from the serum of pregnant mares (a good source), and from the urine of pregnant women. The acetone powder from the alkaline extract of anterior lobes is dissolved in water and the reaction of the solution adjusted to give maximum precipitation: the greater part of the hormone remains in solution and is precipitated by flavianic acid, which can be removed afterwards by use of alcohol-ammonia mixture. Alternatively, the powder may be extracted with 50 per cent pyridine, 50-60 per cent alcohol or acetone containing 2-4 per cent ammonia; the hormone is then precipitated by increasing the alcohol or acetone to 85 per cent and adding a little acetic acid or salt. Pregnant mare serum was treated directly with acidified acetone and the powder purified by the methods used in the case of preparations from anterior lobes. From the urine of pregnant women the hormone (called prolans by Aschheim and Zondek its discoverers), was precipitated by excess of alcohol. The precipitate was extracted with dilute acid and the prolans reprecipitated with alcohol; the powder was purified by extraction with acetone-ammonia mixture. The minimum dose of the purest preparations was about 0.05 mgm.

Although preparations from these different sources all stimulate the gonads, yet they show differences in their chemical properties and biological effects. Prolans, for example, is more sensitive to both acid and alkali than preparations from pregnant mare serum; the latter, but not the former, give off hydrogen sulphide on treatment with alkali. However, the differences in chemical properties may be due to differences in the associated impurities. Differences in the biological effects produced are not so easily explained. Even though the minimal doses of different preparations may be the same, larger doses may have widely different effects on the ovary: thus increasing the dose of prolans increases the size of the ovaries at most four times, whilst with preparations from pregnant mare serum, there is a rough proportionality between dose and size up to about twenty-five times the minimal dose.

Evans and his co-workers have not been able to separate the gonad stimulating hormone into follicle stimulating and luteinising factors, corresponding to the prolans *A* and *B* of Aschheim and Zondek. A solution which is predominantly follicle stimulating at one dose level may produce corpora lutea at another level or when the injections are continued beyond the usual three-day period; the predominant effect may depend on the amount of purification to which the extract has been subjected. The type of response also depends in part on the time at which the examination is made after beginning the injections. There are indica-

tions that the presence of corpora lutea inhibits further development of the ovary: the occurrence of ovulation depends on the size of the ovary and the dose given. Hypophysectomised female rats were less sensitive than normal animals and the response to prolans was much less than that to extracts of pregnant mare serum; simultaneous administration of the growth promoting hormone diminished the response. Substitution therapy failed to induce the rhythmic changes in the vagina characteristic of the oestrous cycle, a continuous oestrous reaction only being obtained. Pregnancy was not observed owing to failure of implantation, but it could be maintained in animals, hypophysectomised after implantation, by injection of mixtures of growth- and gonad-stimulating hormones.

In hypophysectomised female dogs, prolans had no effect on the genital system even in large doses, and when the system showed a marked degree of atrophy, an anterior lobe extract also had no effect. A mixture of the two preparations, however, stimulated the genitalia within ten days; the vulva increased to a size greater than that observed in normal oestrus in a litter mate control, the mammary gland and uterus showed marked development and the ovary was much enlarged and contained many corpora lutea. This result may be contrasted with some experiments on the hypophysectomised ferret recently published by M. K. McPhail (*Proc. Roy. Soc.*, B, 114, 128; 1933). Anterior lobe extract alone produced extensive theca luteinisation of small follicles, but no development of large follicles: prolans alone caused many follicles to undergo partial growth, which, however, terminated in atresia: the vulva showed partial oestrous swelling. A mixture of the two preparations produced usually only theca luteinisation.

Without referring to other work in detail, it may be stated that several workers in addition to Aschheim and Zondek have adduced evidence that the follicle stimulating and luteinising hormones from the anterior lobe are separate entities. The synergistic action with prolans may depend on the proportions of these factors present in different preparations. Apart from the chemical difficulties of preparing the hormones in a pure state, the facts that they act in succession, or if really a single entity initiate a series of reactions, introduces a complication into the evaluation of the biological tests, which only further work with a standardised technique can clarify.

In immature male rats, doses of gonad stimulating hormone sufficient to produce enlargement of the ovaries in immature females produced little or no increase in the weight of the testes, although the accessory organs grew markedly and attained the size characteristic of these organs in young adults. Larger doses of hormone, however, increased the weight of the testes. Senile males also responded by increase in weight of the accessory organs. In hypophysectomised males injections of the hormone caused regeneration of the atrophied testes, the seminal vesicles became enlarged and filled with fluid and spermatogenesis was resumed; the

replacement therapy was complete since normal litters were sired, and the testes appeared normal on histological examination.

The atrophy of the thyroid and adrenal glands after removal of the pituitary was not repaired by injection of gonad stimulating hormone, but extracts containing the growth hormone maintained or restored the weight of these organs, although histologically the normal structure was not completely regained. Evans's results do not show whether it is the growth hormone or some

other active principles in the extracts which are responsible for these effects. The cachexia commonly observed in hypophysectomised rats was also relieved by injections of the growth hormone.

The data on which the workers in the University of California base the conclusions briefly reviewed above are available in detail in the monograph now under notice. The methods described should be of value to other investigators and their results should form the basis of further research in this important field.

### The British Association Tables of Bessel Functions

IN 1888 a Committee was appointed by the British Association for the purpose "of considering the possibility of calculating tables of certain mathematical functions, and, if necessary, of taking steps to carry out the calculations, and to publish the results in an accessible form". The Committee had the late Lord Rayleigh for chairman, and 'Mr.' A. Lodge for secretary, and the other members were 'Sir W. Thomson', Cayley, Price, Glaisher, Greenhill and Hicks. Bessel functions were among the functions considered, and their calculation became the chief work of the Committee. Tables appeared in the Reports of the Association for 1889, 1893 and 1896. In 1907 the Committee reported on "The further tabulation of Bessel functions", and in 1909 stated that it was "also considering the advisability of collecting all existing tables of Bessel functions and publishing them in a form easily accessible to all students". During the next few years tables of Bessel functions of various types appeared regularly, and in 1915 it was reported that "the order of calculation is being arranged in accordance with the real urgency of the tables, and the stage is now coming in sight at which the Committee will be able, as authorised already by the Association, to publish a volume of fairly complete tables of the more important transcendental functions".

The Committee's hopeful plans, like others, were, however, hurled to emptiness, and although the Committee remained in existence and many tables were printed in its reports, it was not until after the Glasgow meeting of the Association in 1928 that the preparation of the long foreseen volume was taken seriously in hand; and when in 1931 a volume appeared, it contained no tables of Bessel functions. The reasons for this, and the problems confronting the Committee, were explained in the preface:

"... It was apparent from the first that the simple plan of reprinting existing material would produce a volume neither useful nor creditable. There were gaps in the ranges of the arguments of some of the functions, natural when the tabulation had been performed at different times for special purposes, but intolerable if tables were to be issued for general use. In the case of the Bessel functions, the functions tabulated did not form in any sense a complete collection. Lastly,

the original tables offered no facilities for interpolation. Two years ago the Committee decided that these difficulties must not impede publication indefinitely, and that, if the Bessel functions were reserved for an independent volume, definite progress could be made."

Since 1929, therefore, the work on Bessel functions has been independent both of the preparation of volumes of tables of other functions and of the computation from time to time of special tables in response to current demands. The aim of the Committee is to publish as complete and uniform a set of tables of Bessel functions as possible; the majority will be derived from the reports, but several will be new. It is estimated that the tables will extend to nearly five hundred pages, and it is proposed to issue two volumes, partly to avoid an unwieldy book and partly to expedite publication. The material for the first volume is in an advanced state, more than three-quarters of the estimated 280 pages being ready for the printer.

Unfortunately, financial difficulties have now to be overcome. It is not to be expected that an undertaking of this sort can be a paying proposition. The mathematicians concerned have given their services, but the mere cost of production will be between 30s. and £2 a page. The calls on the British Association are far more miscellaneous, far more extensive, than in the spacious days when £500 could cheerfully be voted for a single object. At the moment, a sum of £150, which includes a grant of £50 from the Royal Society for this purpose, has been set aside by the Council of the Association, but this is little more than an earnest of belief in the Committee's plan. Unless further help is forthcoming, there is a serious danger that the enterprise to which a multitude of volunteers have given their leisure during nearly half a century will be completed by the enthusiastic drudgery of the Committee which has accepted it as a heritage, only to rest—a manuscript almost too precious to be consulted—in a fire-proof safe. It ought to be sufficient, by directing attention to this possibility, to ensure that funds will be provided to enable the two volumes to be published and thus to make available the results of so many years of voluntary work on behalf of mathematical students and others.

## Effect of Low Temperatures on Metals

SINCE the year 1905, when Sir Robert Hadfield and the late Sir James Dewar described the effect of liquid air temperatures on the strength of iron and its alloys, there has been not only a very considerable advance in low temperature technique, but also many types of new metallurgical materials have been successfully developed. Many alloys which are to-day in extensive use as parts of machines and structures were quite unknown at the time of that research.

The importance of low temperature research was recognised many years earlier than 1905 in view of the severe winter conditions experienced in northern Continental lands. In research work of the future, still greater attention is likely to be paid to the study of low temperature phenomena in relation to the physical and engineering sciences.

Recently Prof. W. J. de Haas and Sir Robert Hadfield\* have described to the Royal Society the results of a further important research on the mechanical properties of these materials at the boiling point of liquified hydrogen ( $-252.8^{\circ}\text{C}$ ). This work has extended the range of study of the properties of metals a further  $60^{\circ}\text{C}$ . and thus the strength of these metals is now known at  $20.3^{\circ}\text{K}$ . At this low temperature, changes in the properties of some of the metals have occurred, but the present work does not show any marked discontinuity in general properties corresponding to the sudden fall in electrical resistivity which exists in some metals near to the boiling point of liquid helium. The possibility of the use of liquid helium has for the moment been postponed on account of the large quantities that would be needed to effect cooling. If its use is later found to be practicable, tests would be made as low as  $4.2^{\circ}\text{K}$ . On small specimens a study was made at this temperature in 1921 in collaboration with the late Prof. Kamerlingh Onnes and H. R. Woltjer. In those experiments they showed the absence of magnetic transformations in the iron-manganese alloys, whereas the iron-nickel alloys exhibited the presence of polymorphic transformations.

Prof. de Haas has designed the testing apparatus for this work, immersing the specimens in liquified hydrogen contained in a Dewar flask. The testing stress has been applied by an oil cylinder through a tension rod sliding inside a concentrically mounted tube. Into the ends of these two members the specimen holders have been fitted.

The specimens selected for examination not only included the materials which had previously been tested in liquid air, but also many recently developed alloys which exhibit a combination of high strength and ductility.

At liquid air temperatures, many ferrous

materials, including iron itself, show a marked increase in tenacity, and in general these same ferrous materials show a continued fall in ductility, which becomes negligibly small at the boiling point of hydrogen. At this temperature there is an apparent fall in strength. There are, however, some remarkable exceptions to this fact; for example, an alloy containing 6 per cent of manganese and 24 per cent of nickel shows an increase of ductility when cooled to  $-194^{\circ}\text{C}$ ., and on being further cooled to the boiling point of hydrogen, it still retains appreciable ductility. This present work thus continues the study of the iron-nickel-manganese-carbon alloys which were described in the seventh report to the Alloys Research Committee of the Institution of Mechanical Engineers in 1905.

The 'stainless steels' and 'high temperature alloys' are two classes of materials which are not adversely affected by fall of temperature; for example, the well-known alloy containing 18 per cent of chromium and 8 per cent of nickel shows the remarkable strength of 119.8 tons per square inch, accompanied by an elongation of 25 per cent.

The non-ferrous alloys which the authors have selected are all ductile at the lowest temperature of test. The earlier work had shown that nickel, copper and aluminium increased in strength without a corresponding fall in ductility. In the present tests, the copper specimens break at 29.7 tons per square inch accompanied by a ductility of 60 per cent in extension, but a bronze, containing 10 per cent of tin, shows a slight reduction in properties. Good extension occurs during test of specimens of an '80/20' nickel-chromium alloy and of the aluminium alloy known as 'duralumin'. The safety of the aluminium alloy from embrittlement will be a guidance to designers of aircraft.

A consideration of the non-ferrous alloys selected for test shows that these possess a lattice structure of the face-centred cubic type which appears to allow the retention of ductility at low temperatures, but in ferrous alloys this arrangement of the atoms is not always accompanied by ductility; for example, the toughened manganese steel and the low carbon alloy of this metal with iron, are not ductile, although their structures conform at normal temperatures to the face-centred form of the cubic system. The embrittlement of austenitic manganese steel appears to be entirely unaccompanied by metallographic change of a permanent character, for the material reverts to a ductile state at normal temperatures. On the other hand, austenitic nickel steels show a change which is irreversible.

The iron alloys of the ferritic type have a body-centred lattice and are not ductile at low temperatures. These materials contrast very strikingly with the austenitic 'stainless' and 'heat-resisting' steels, which possess a face-centred cubic structure and are not embrittled.

\* "On the effect of the Temperature of Liquid Hydrogen ( $-252.8^{\circ}\text{C}$ .) on the Tensile Properties of Forty-One Specimens of Metals comprising (a) Pure Iron (b) Four Carbon Steels (c) Thirty Alloy Steels (d) Copper and Nickel (e) Four Non-Ferrous Alloys." By Prof. W. J. de Haas and Sir Robert Hadfield. *Phil. Trans. Roy. Soc., A*, 232, 297-332; 1933.

## Obituary

PROF. ALBERT CALMETTE, For. Mem. R.S.

ALBERT CALMETTE, sub-director of the Pasteur Institute, who died on October 29, 1933 after a short illness, was born at Nice on July 12, 1863. After graduation, he entered the medical service of the navy and spent seven years in Eastern waters. As a naval surgeon, he became interested in the numerous hygienic problems of France's colonial possessions. In 1889 he was transferred to the new colonial medical service and was given permission to go to the Pasteur Institute. There he came under the influence of Pasteur, and took Roux's course of lectures in bacteriology and became one of his most enthusiastic pupils. His progress was so rapid that the next year he was chosen by Pasteur to proceed to Saigon to found the first of the daughter Pasteur institutes.

At Saigon, Calmette was occupied with the study of cholera and bacillary and amœbic dysenteries. It was here, too, that he first became interested in snake venoms. The number of deaths from cobra-bite was serious and the director of the new institute was appealed to for help by the administration.

In 1893 Calmette returned to France and continued his work on the action of cobra venom. This was followed up by experiments to ascertain whether the serum of an animal immunised against the venom contained anti-toxins and could be exploited for treatment. Sewall had shown that immunity followed repeated small injections of the venom of the rattlesnake, and Behring had a few years previously established the anti-toxic value of the serum of animals treated in a similar manner with the toxins of the tetanus and diphtheria bacillus. It seemed, therefore, not unlikely that an anti-toxic immunity would be aroused by the injection of snake venom.

Before the end of 1894 Calmette was successful in demonstrating that by patiently immunising horses with increasing doses of cobra venom they accumulated sufficient antitoxin in their serum for the latter to be used as a remedy for snake-bite. As most venoms were similar in their actions, Calmette at first supposed that serum prepared by injecting cobra venom would be of value to counteract the effects of the poisons of other kinds of snake. He was rather obstinate in adhering to this opinion in the face of experimental evidence from Australia, India and Brazil that such was not the case but that anti-venoms were highly specific.

In 1895, Calmette's enthusiasm and organising ability was again taken advantage of and he was chosen to establish a Pasteur Institute for the north of France at Lille. The new institute was to be a subsidiary centre for anti-rabic inoculation and the preparation of diphtheria antitoxin and vaccine lymph. Under Calmette's guidance, it soon became an active centre of research. From the point of view of sanitation, the industrial

town of Lille was not progressive. Its water supply and methods for the disposal of sewage were unsatisfactory. The incidence of tuberculosis was high and invalidism from hook-worm in the neighbouring coal-mines was serious. Calmette, who was appointed professor of hygiene a few years after his arrival, worked vigorously to improve the sanitary condition of the town. He instituted investigations into the bacterial treatment of sewage and various methods for the purification of water supplies. He was successful in inducing the municipal authorities to undertake some measure of improvement. He made a useful research into hook-worm, and his method for combating this disease in miners is that now usually followed elsewhere.

How to diminish the damage to health and life caused by infection with the tubercle bacillus was a more serious problem. Calmette established a tuberculosis dispensary, the first in France, for the early diagnosis of phthisis and for the education of patients in habits to minimise the familial spread of the disease. He was instrumental in providing a sanatorium for early, and a colony for advanced, cases of the disease. These measures, however, did not strike at the root of the matter and the idea of attacking the problem by some immunological procedure was always present in his mind. All efforts to produce resistance by the inoculation of killed cultures of the tubercle bacillus having proved unsatisfactory, he turned his attention to the possibility of employing a living attenuated culture as Pasteur had done in the case of anthrax. His goal was to produce a strain of the bacillus so much deprived of its virulence that it would not produce tuberculosis when introduced into animals but only a mild illness, recovery from which inevitably occurred. It was hoped that by this experience the body would acquire the power of dealing satisfactorily with a subsequent infection by virulent microbes.

In 1903, in collaboration with his assistant Guérin, Calmette began the researches which ultimately resulted in the now famous strain of bovine tubercle bacilli designated B. C. G. (*Bacillus Calmette Guérin*). This strain was produced by successive propagation of an ordinary bovine type of bacillus on potato soaked in bile. Its stabilisation took thirteen years, during which 230 successive cultivations were made. At the end of this time, the strain was found to be incapable of producing tuberculosis in animals and to remain devoid of this power as long as it was cultivated on the bile-media.

By 1914 the experiments of Calmette and Guérin had convinced them that cultures of B. C. G. could be used to induce resistance to tuberculosis in cattle. At this stage, their researches were perforce suspended by the outbreak of War. During the occupation of Lille, Calmette came under suspicion because he kept numbers of

pigeons in his laboratory. He suffered regrettable indignities at the hands of the military authorities and his wife was removed to Germany as a hostage. During this unhappy period, he occupied himself writing an interesting book on the pathology of tuberculosis, in which he presented his observations and developed his theory of the nature of acquired resistance to the disease.

On the death of Metchnikoff in 1917, Calmette was elected sub-director of the Pasteur Institute but did not undertake the duties of this office until after the War. At Paris he continued his researches on protection against infection by the tubercle bacillus with increased fervour and enlarged opportunities.

To understand the subsequent progress of these researches it is necessary to epitomise his conception of the means by which individuals acquire their resistance to the tubercle bacillus. Both evidence from post-mortems and the results of the skin reaction of von Pirquet to tuberculin indicate that the majority of individuals by fifty years of age have at some time in their life been infected, although they may not have shown symptoms of tuberculosis. Calmette believed, and had experimental evidence to support his belief, that a very small number of infecting bacilli is not, in most individuals, followed by manifest tuberculosis and is recovered from, leaving the body more capable of resisting a subsequent dose. In this manner by a succession of small infections an immunity is acquired.

Immunisation by chance is, however, a highly dangerous way of attaining resistance, for, at any time, the dose may be sufficiently large to break down the individual's resistance and tuberculosis ensue. Calmette therefore advocated that the wise procedure would be to accustom the body to resist invasion by the tubercle bacillus by giving its immunological mechanisms opportunities to obtain practice with an innocent tubercle bacillus before the nearly inevitable inroad of a virulent one took place, much as it is well to acquire expertness as a toreador with de-horned cattle. To do this he suggested that young babies should be given minute doses of his attenuated B. C. G. culture by mouth before they have had an opportunity to ingest virulent bacilli, a procedure he calls 'premunition'.

In 1922 Dr. Weill-Hallé treated 314 infants, the progeny of tuberculous mothers. The treatment was inoffensive and a comparison of the tuberculosis rate amongst treated and untreated infants from similar environment was deemed to be promising. The treatment was begun 3 days after birth to minimise the chances of the infants being infected by virulent bacilli from their mothers prior to receiving the strain B. C. G. Since then upwards of a million babies have been treated in France and elsewhere, and apart from the tragedy at Lubeck, where by carelessness at the hospital, some 250 infants were fed a dose of a culture of virulent human tubercle bacilli by mistake and 73 died, no untoward happening has

been recorded. At the present time some 150,000 infants are treated annually in France alone and the council of the Pasteur Institute has erected a vast building for the preparation and distribution of cultures of B. C. G. all over the world.

Unfortunately, the resistance obtained from one treatment is not permanent and has to be repeated after one or two years. This makes it more difficult accurately to assess the results of the treatment for some years to come. The figures recorded are susceptible of statistical criticism, but the numerous practitioners who have employed the treatment are very generally convinced that it is followed by a decline in the incidence of tuberculosis and also by a diminution of the general mortality during the early years of life. To what extent this promise is justified will emerge in a few years, when the after-history of the million infants already treated is known. Whatever this verdict is, Calmette's endeavours to mitigate the ravages of tuberculosis will remain the magnificent effort of a man who devoted his life to the pursuit of science for the service of mankind. C. J. M.

#### MR. J. B. HOBLYN

By the death on December 24 of John Bright Hoblyn, in his fifty-fourth year, the automobile engineering industry has lost one of its best known scientific personalities. During his eighteen years' association with Messrs. Vauxhall Motors Ltd., of Luton, he had become a prominent figure in the fields of metallurgy and petroleum technology, and his ready flow of witty and pungent speech—and, on occasion, of scathing criticism—made him an attractive lecturer and debater.

An old student of the Royal College of Science, Mr. Hoblyn was for eleven years science master at Luton Modern School. In 1915 he accepted an invitation to join Vauxhall Motors Ltd. as chief chemist and metallurgist, and he promptly applied himself to the chemical and metallurgical problems of automobile engineering. His publications included three papers of outstanding importance to the industry, dealing respectively with the heat treatment of steels, the oxidation of lubricating oils and the development of aluminium alloys for automobile construction. His work on lubricating oils opened up a new avenue in the testing technique of these products.

For several years past Mr. Hoblyn had been chairman of the committee set up by the Institution of Automobile Engineers for the rationalisation of automobile steel specifications, and at the time of his death he had almost seen the completion of his labours in this field. L. B. H.

WE regret to record the death of Prof. J. E. G. de Montmorency, Quain professor of comparative law in the University of London in 1920-32, whose studies of primitive law formed valuable contributions to anthropology, on March 9, aged sixty-seven years.

## News and Views

## Gottlieb Daimler (1834-1900)

ON March 17 the centenary occurs of the birth of Gottlieb Daimler, the distinguished German engineer, to whom we owe the introduction of the light high-speed spirit engine suitable for road vehicles. After a varied practical experience as a mechanical engineer, Daimler in 1872, at the age of thirty-eight years, became associated with Langen and Otto, who were then engaged on the improvement of the gas engine, and Daimler's own contribution to the progress of the internal combustion engine is but an illustration of how invention begets invention. His death took place thirty-four years ago, before motor-cars had ceased to be novelties in the streets, but of the millions of cars to-day every one owes something to Langen, Otto and Daimler and their collaborator, Maybach. Daimler was born at Schorndorf, Württemberg, and at the age of nineteen years began work in a machine tool factory. From 1857 until 1859 he was a student at Stuttgart Polytechnic; from 1861 until 1863 he worked in England and then held positions in works at Geislingen and Karlsruhe. The turning point in his career came when in 1872 he joined Langen and Otto as technical manager of the Gasmotorenfabrik Deutz A.-G., near Cologne. The firm had already achieved considerable success with its atmospheric gas engines and Otto was engaged on the experiments which led him to the invention of the four-stroke engine, patented on August 4, 1877, and to the manufacture of the world-famous 'Otto' gas engines.

In these developments Daimler played an important part, and visualising the possibility of applying internal combustion engines to vehicles, in 1882 he left the Deutz concern and with his friend and colleague, Wilhelm Maybach, set up an experimental workshop at Cannstatt. By August 1883 he had built a four-stroke engine using benzine, running at 900 r.p.m., and on December 16, 1883, he took out his patent. He next proceeded to fit high-speed engines to a form of bicycle, to a four-wheel carriage and to a boat. By this time, Karl Benz of Karlsruhe had also produced a motor-driven three-wheel vehicle, and it is thus to this group of German engineers that the world owes the birth of the motor-car. The Benz cars, the first to be made in any considerable numbers, were exploited in Paris by E. Roger, while the manufacture of Daimler cars was taken up by Panhard and Levassor, whose early design, with the engine in front, has been followed generally ever since. After selling the French rights to the use of his patents, Daimler in 1890 founded the Daimler-Motoren-Gesellschaft at Cannstatt, of which for a considerable time Maybach was the manager, Daimler acting chiefly in an advisory capacity. Daimler's death took place at Cannstatt on March 6, 1900. Two years later, the Württemberg branch of the Verein Deutscher Ingenieure placed a memorial to him in the gardens at Cannstatt where, in 1885, Daimler had driven his first automobile.

## Sir James Hector (1834-1907)

SIR JAMES HECTOR, the first director of the Geological Survey of New Zealand, a post he held from 1865 until 1905, was born at Edinburgh a century ago on March 16. The son of a writer to the signet, he was educated at Edinburgh Academy and the University and in 1856 took the degree of M.D. After acting for short periods as assistant to Edward Forbes and Sir James Simpson, in 1857 he was, through Murchison, appointed surgeon and geologist to Capt. John Palliser's expedition to British North America. During this expedition he discovered Hector Pass in the Rocky Mountains and directed attention to the evidence of glaciation and the existence of erratic blocks. In 1860 he sailed for New Zealand to take up the appointment of geologist to the Government of Otago. The services of von Haast (1824-87) and von Hochstetter (1829-84) had already been secured by the colonial authorities, and it was by these three men, together with J. W. Hutton (1836-1905), that the geology of the Islands was first unravelled. In 1865 Hector became director of the Geological Survey and of the Colonial Museum at Wellington, which remained his headquarters for the rest of his life. He was also head of the meteorological service and Chancellor of the University of New Zealand. Elected fellow of the Royal Society in 1866, he was awarded the Lyell medal of the Geological Society in 1875 and in 1887 was made K.C.M.G. In 1891 he served as president of the Australasian Association for the Advancement of Science. He died at Wellington on November 5, 1907.

## The Mentality of the African

MR. A. T. LACEY'S opening statement in the discussion on "The Genius of the African" which took place at the meeting of the Education Circle of the Royal Empire Society on March 8, gave a clear view of the fundamental factors in the problem which awaits solution in the development of African peoples. As Director of Education in Nyasaland, Mr. Lacey has had an excellent opportunity of forming an estimate of the capacity of a good, but not exceptional, sample of the Bantu peoples, and his conclusions, which recognise the native's limitations without unduly stressing his failings, deserve the careful consideration due to an opinion based on an intimate knowledge of conditions and a clear perception of the forces which make the present moment a critical period for the future of the greater part of Africa. Mr. Lacey agrees with other students of present-day tendencies in Africa in diagnosing the essential element of the problem as a conflict between the mentality of a people whose whole outlook is conditioned by group consciousness and group responsibility, and the type of mentality which is produced by the individualism of a European economic and social organisation. He pointed out that with the native's traditional outlook goes a spontaneous observance of law and order; but to maintain this disciplined attitude in changing

conditions and to meet the new individualistic attitude, the group or tribe must now find a new orientation. As an educationist, he, not unnaturally, pins his faith to the individual; and he, therefore, proceeded to demonstrate the educability of the African from the degree and character of the achievement of the natives under his jurisdiction. In rating it relatively high, he is in agreement with others whose acquaintance with the African is not less than his own.

IN view of Mr. Lacey's remarks on the place of the family and tribal group in promoting the maintenance of law and order, it is a disappointment to find that he anticipates little assistance from the home environment in the slow process of building up an educational tradition. The pre-European system of native education was largely left to the influence of the social environment, and if the group should attain the new orientation which is said to be a necessity of future development, it should be made to play its part in developing the social consciousness of the rising generations, co-operating with the more academic influence of the official system of education. It is evident that a grave responsibility will rest on the administration in guiding tribal development towards the new orientation along lines which avoid any sudden break with tradition and yet lead towards the full social and religious life which Mr. Lacey postulates as an inspiration for the full expression of the Bantu genius. In this connexion the article on "Kenya Cults" which appeared in the *Times* of March 10 is suggestive. The author of that article describes some of the strange cults which have arisen recently in Kavirondo and among the Kikuyu. Their appearance in Kenya is not unique, but can be paralleled by strange forms of belief which have been grafted on Christianity and have attracted a large number of followers from time to time in other parts of Africa; and it will be remembered that it was a dispute, similar to that now described, but on a much larger scale, between the followers of Roman Catholic and Protestant creeds which first led to European intervention in Uganda. It is suggested by the writer in the *Times* that the Kenya cults are matters for the anthropologist rather than the administrator; but against this view, it is a question whether, owing to the tendency of the African towards fanatical adherence to aberrant and anti-social cults, the attitude of the administration towards developments in native religion does not require fundamental revision.

#### 24-Hour Time System

It has been announced that the British Broadcasting Corporation will adopt at an early date the 24-hour system of expressing time. The system will be used in announcements over the microphone, in the journals issued by it and in correspondence. This decision by the B.B.C. will provide the best possible opportunity of testing whether the general public is in favour of or is opposed to the 24-hour system. Though the adoption of the 24-hour system has been widely supported by transport organisations (rail, road and air), by engineers, by the mercantile marine and in scientific circles, the Government has taken

the view that there is no very strong demand for the change and that it would be wrong to impose upon the public a system of notation which might confuse rather than assist. As was announced in *NATURE* last week (p. 354), the Postmaster-General has stated that he proposes to await the result of the B.B.C. experiment before coming to a decision. It was apparently with the same desire to see what measure of support or opposition from the general public was indicated that the House of Lords on March 7 negatived a motion introduced by Lord Lamington urging that the 24-hour system should be put into operation as soon as possible, though the House on December 7, 1933, had approved a motion for the adoption of the system.

#### Development of the Royal Air Force

PRESENTING the air estimates to Parliament on March 8, Sir Philip Sassoon, Under-Secretary of State for Air, outlined a programme of expansion of the R.A.F. which, while modest, is probably as large as can be undertaken with efficiency at the present time, remembering that previous economies have restricted both the training of personnel, and the provision of accommodation for additional squadrons. The net amount provided is £17,561,000, an increase of £135,000 over last year's figure. If grants from India and the Admiralty in respect of R.A.F. services to them are added, these figures become £20,165,000 and £527,000 respectively. Four new squadrons are to be formed, two for home defence, one flying boat squadron, and the equivalent of one squadron for the Fleet air arm. In addition, two home defence squadrons, at present forming part of an experimental station, and consequently non-effective as fighting units, are to be reconstituted as active squadrons. The principal increased expenditures are obviously to be made under Votes 3 (technical equipment), and 4 (works, buildings, lands, etc.). It is interesting to note that Vote 2 (non-technical stores) remains stationary, in spite of the expansions, due to lower prices. Vote 8 (civil aviation) stands at the highest figure for the last ten years. This includes expenditure upon the British Government part of the route to Australia, up to Singapore, the first link of the Atlantic service, New York to Bermuda, and the usual subsidies for flying activities in Great Britain. Sir Philip also gave an interesting account of the various developments of the R.A.F., including long distance communication flights, police duties and distress relief in remote lands, air surveying, etc. The use of petrol produced from British coal has been successful, and it is hoped to maintain seven squadrons upon it exclusively during the coming year.

#### Elements Old and New

In a lecture with the above title given at East London College on March 8, Prof. James Kendall, of the University of Edinburgh, traced the development of fundamental ideas on the elements from the earliest times to the modern period. The four elements of the Greek philosophers—fire, air, earth and water—expanded during the nineteenth century



into ninety-two elements of the periodic system, and all these ninety-two are recognised now to be aggregates of two simpler electrical units—positively charged protons and negatively charged electrons. Nevertheless, it is interesting to note that chemistry, in its development as a science from alchemy as an art, has passed through four distinct stages, in each of which one of the four elements of Aristotle has been dominant (see NATURE, March 10, p. 354).

JUST as atmospheric air was found by Raleigh and Ramsay to contain traces of unsuspected elements—argon, neon, krypton and xenon—so ordinary water has recently been shown to have present in it a minute quantity of a novel compound—*heavy water*. Each hydrogen atom in heavy water comprises two protons and two electrons, or twice the quota of an ordinary hydrogen atom, and this increased complexity involves a significant change in chemical as well as in physical properties. Pure heavy water, prepared by a series of fractional electrolyses, has a density more than ten per cent higher than that of ordinary water. It freezes at 3.8° and boils at 101.6° C. It retards the development of plant life, and proves fatal to certain lower species of animal life, such as tadpoles and flat-worms. What its effect, in pure and diluted form, upon the human organism may be is at present merely a matter of interesting speculation. A very interesting survey was given of the views held on the nature of the elements from the earliest period to the present day, and Prof. Kendall suggested that in the future a further phase of development, corresponding with the fifth element of Aristotle, the quintessence or the ether, which survived the other four elements by a century, might recognise the greater importance of radiant energy in chemical processes.

#### Accidents and their Prevention

A CHADWICK public lecture on "The Causes and Prevention of Human Accidents" was delivered by Dr. C. S. Myers, principal of the National Institute of Industrial Psychology, on March 12. Hitherto accidents in factories and on the road have been too often attributed merely to recklessness and carelessness and to dangerous conditions. More than 50 per cent of factory accidents (fatal and non-fatal) are found not to be due to dangerous machinery; and it has been estimated that, however much better machinery be guarded, the present factory accident rate of more than 106,000 per annum is unlikely to be seriously reduced by these measures or by more extensive use of safety-first posters. On the road, in spite of improved signals, car controls, regulated speeds of traffic and better lay-out of roads, 216,000 were injured and more than 7,000 killed in Great Britain through car accidents in 1933. At least 80 per cent of all such fatal accidents are attributable to the 'human factor', the study of which in occupational life is the concern of the industrial psychologist. Accidents are not uniformly spread over the population whose actions may give rise to them. In each of two American investigations, it was found

that about a half of the total accidents incurred by trams and omnibuses were confined to about a third of their drivers. In England, the scores obtained in selection tests for the motor driver devised by the National Institute of Industrial Psychology, have proved to be so highly correlated with the records of the safe driving of motor drivers on the roads, that one well-known insurance company has recently offered a ten per cent reduction in the annual premium for accident insurance to those who have passed these tests satisfactorily. Selection methods, however, must be supplemented by adequate knowledge, which can be obtained only by systematic training.

#### New Land in the Antarctic

CONSUL LARS CHRISTENSEN, the Norwegian whaling expert who has done much to encourage Norwegian exploration in the Antarctic, left Cape Town in the whaler *Thorshavn* in December last year for the south. He has now returned to Montevideo and, according to the *Times*, announces the discovery of a new stretch of coast line 150 miles in extent, in lat. 72° S. Unfortunately, the longitude is not given but the land would seem to lie in the unknown sector south of Bouvet Island between Princess Ragnhild Land on the east and Crown Princess Martha Land on the west. The hypothetical coastline was there drawn in approximately the latitude of the new discovery, which has been named Princess Astrid Land. A further note in the dispatch in reference to soundings in deep water on the supposed site of land suggests that some earlier discoveries may have to be moved south, but no details are yet available.

#### A New Antarctic Expedition

IT is announced in the *Times* that a British Antarctic Expedition will leave England in September for the western side of Graham Land. It will be led by Mr. J. R. Rymill, of the recent Watkins Greenland expedition, who will be accompanied by fourteen men most of whom have had experience in Greenland. They include Messrs. W. E. Hampton, Q. Riley, A. Stephenson, and E. Bingham. A vessel of about 120 tons, to be manned by the members of the expedition, will sail via Deception Island in the South Shetlands to Wilhelmina Bay in North Graham Land whence, after a reconnaissance by aeroplane, a sledge journey will be made along the east coast to Crane Channel and back. Later in the summer, the ship will be taken farther south and a base for two winters will be sought in Marguerite Bay, or farther south in Graham Land or possibly Hearst Land. If a safe harbour cannot be found, the ship will return to Deception Island leaving most of the expedition at a land station. From the southern base a sledge journey will start eastward in October 1935, returning about March 1936. It is hoped that this journey will settle the problem of the western coast line of the Weddell Sea. In the following summer, sledge journeys, supplemented by aeroplane flights, will be made westward to Charcot Island and beyond if possible. The expedition hopes to return to England in May 1937. This ambitious project, which should

solve some of the outstanding problems in Antarctic discovery, is estimated to cost no more than £15,000, of which the British Government is giving £10,000 and the Royal Geographical Society £1,000.

#### Sir Everard im Thurn Memorial Scholarship

THE council of the Scottish Anthropological Society proposes to create a permanent memorial of the late Sir Everard im Thurn by founding a lectureship in anthropology. Sir Everard im Thurn was the first president of the Edinburgh and Lothians Branch of the Royal Anthropological Institute, an office which he held from 1924 until 1932, and was one of the first to advocate the formation of a Scottish national society for the advancement of anthropological teaching and research. Sir Everard's distinction as an anthropologist has been widely recognised. He was the author of the standard work on the Indians of Guiana, contributed numerous papers on anthropological subjects to scientific journals, and was president of the Royal Anthropological Institute in 1919-21. It is intended that the Sir Everard im Thurn memorial lecture should be delivered annually on the date of the annual general meeting of the Society by an anthropologist of note. For this purpose, it is stated in an appeal issued by the memorial committee, of which Prof. H. J. Rose, president of the Society, is chairman, a capital sum of £500 will be required to meet the annual expenses. Part of this sum has already been provided, but further subscriptions are invited to make up the amount. In the meantime, arrangements have been made for the delivery of the first lecture on May 22, 1934, when Dr. R. R. Marett will lecture on "Sir Everard im Thurn as Anthropologist and as Man". Contributions to the fund should be addressed to the honorary treasurer of the Society, Mr. J. B. Mackay, 30 St. Alban's Road, Edinburgh.

#### Work of Geological Surveys

THE presidential address of Sir Thomas Holland at the annual general meeting of the Geological Society on February 16 was mainly devoted to an examination of the organisation of the geological surveys of the British Empire and the United States. He emphasised the fact that the real object of every such survey is the mineral development of the country, scientific results being obtained as by-products and used as a means to attaining the economic object in view. The work of preparing a geological map requires the co-operation of various specialists of at least seven kinds. With a director and his assistant, a curator and a chemist, the minimum number of scientific officers required for a survey like that of India, for example, is found to be about 21. Below this standard an organisation is scientifically inefficient and economically wasteful. The colonies separately might not be able, for financial reasons, to maintain this standard, but the difficulty could be partially met, as in the Federated Malay States, by a federation of officers in geographically related groups. Important functions of a survey are the classification of public lands and the

compilation and analysis of mineral statistics. The director should be well acquainted with the trend of mineral development, watching imports for indications that the country might itself produce certain minerals and by-products. He should therefore be the adviser of his Government on questions of mineral policy, whether in purely economic matters or in the development and conservation of minerals that are essential for the production of munitions of war.

#### Science and Society

THE third Hobhouse memorial lecture, on the subject, "Rational and Irrational Elements in our Society", was delivered at Bedford College for Women on March 7 by Prof. Karl Mannheim, formerly professor of sociology in the University of Frankfurt-on-Main, and now lecturer in sociology at the London School of Economics and Political Science. The main theme of the lecture was the problem created for contemporary society through the disproportion between the range of man's technical knowledge, and his moral qualities and rational insight into the social mechanism which it is the task of members of society to control. Society must break down unless this grave disproportion be remedied. Owing to the correlation of the growth of certain moral and spiritual elements with certain features in society, the problem is amenable to scientific treatment. The question to be answered is what are the elements in an industrialised society which tend to heighten rationality and at the same time to promote irrationality. Two senses of rationality must be distinguished. Substantial rationality relates to thinking and understanding, to the cogitative elements in general; functional rationality relates to the organisation of activities for the attaining of given ends calculated from the point of view of a given observer. Modern industrialised society has revealed the power to plan and control possessed by those who are emotionally primitive. Our society is faced with the problem of planning the man who has to plan men. Its future depends upon the group within society which has the ability to control, and the energy to subdue the irrational elements.

#### Birmingham Museum

THE City of Birmingham Museum and Art Gallery, which celebrates its jubilee this year with a series of special exhibitions, the first of which was opened on February 24, may be said to have had its origin in the presentation of Edward Coleman's painting, "Dead Game", by a body of subscribers in 1864, an Art Gallery formed in a room of the Free Library being opened to the public in August three years later. In 1870, £1,000 was raised towards the formation of a Museum of Industrial and Decorative Art, but the establishment of a natural history museum was not mooted until 1887. The project received little support as Dr. Sans Cox had already established a collection at Queen's College, which was later handed over to the corporation. In 1904, however, the City Council decided to allocate the upper floor of the new Art Gallery building, facing Congreve Street, for a natural history museum.

THE principal gifts that followed were the Blatch collection of Lepidoptera, presented by Sir George Kenrick; a collection of British and foreign bird-skins by Mr. Walter Chamberlain; the Scott collection of British birds and foreign Lepidoptera, from Mrs. Adrian Hope and Mrs. Farnham; the Bradley collection of Hymenoptera, Diptera, Lepidoptera, etc., from Mr. A. R. Hollinworth; the herbarium of British plants from Mr. J. E. Bagnall; a large collection of British and foreign plants from the late Sir Benjamin Stone; the Sir George Kenrick Library of entomological works; the Wilkins' ethnographical works; and numerous miscellaneous collections—a nearly complete collection of British birds (about 1,200 specimens) together with more than 14,000 nests and eggs, and one of the finest series of nestling birds in downy plumage in existence, purchased and presented in 1924 by the Feeny Charitable Trustees, is on exhibition. There is also a collection of British and foreign freshwater and marine shells, formed by the late W. H. Whitlock, and a comprehensive land and freshwater shell collection obtained by the late P. T. Deakin. The scheme for the arrangement of the specimens was drawn up by the late Prof. F. W. Gamble. In addition, weekly nature study exhibits, mainly of a botanical nature, are arranged during the summer months. In 1912, an assistant-keeper for the Natural History Department was appointed.

#### Award of the Eugenio Rignano Prize

THE committee of judges for the award of the Eugenio Rignano prize for the best essay on "The Evolution of the Notion of Time" has recently announced its decision in a "Rapport de la Commission du Jury" dated October 1933. The prize, having a value of 10,000 lire, was established in 1930 as a memorial to E. Rignano, director of *Scientia*, who died in Milan on February 9 of that year. Competing essays were submitted by the end of 1932. No limitations were imposed as to mode of treatment, so that equal scope was afforded to scientific and philosophical aspects of time. A total of 35 essays were submitted, from the following countries: Italy (7), France (6), Germany (6), India (4), Great Britain (2), United States (2), Hungary (2), and one each from Austria, Switzerland, Russia, Luxembourg, South America and Australia. As a preliminary selection of essays of outstanding merit, the committee chose the papers of the following authors: E. Klein, W. Gent, G. Giorgi, H. Mehlberg, K. Sapper, J. Sivadjan, L. von Strauss, G. Windred and S. Zawirski. Of these, Prof. G. Giorgi of the University of Palermo and Prof. S. Zawirski of the University of Poznań were finally selected as *ex æquo* recipients of the prize.

CONSIDERABLE space is devoted in the "Rapport" to a comparison of the various works submitted, and the widely varying nature of their treatment is remarked upon. The papers of G. Windred and K. Sapper receive extensive discussion in this connexion. Both papers are concerned with the historical development of the subject, but the points of view are

respectively scientific and philosophical. The former author confines his attention chiefly to the problem of time as arising in mathematics and physics, tracing the origin and development of the various concepts from the time of Barrow and Newton up to the present day. The treatment of Sapper is essentially philosophical, and mainly concerned with temporal systems such as those developed by Kant and Leibniz, having but few connexions with mathematical or physical theory. These two methods of approach are representative of the widely different points of view of science and philosophy, even upon such a universal concept as that of time.

#### Recent Advances in Inorganic Chemistry

LECTURES, delivered last year before the Institute of Chemistry by Prof. G. T. Morgan, entitled "A Survey of Modern Inorganic Chemistry" have been made available to a wider audience by their publication by the Institute as a pamphlet which extends to more than one hundred pages (London: Institute of Chemistry). The three lectures thus provide chemists with a valuable monograph on the recent advances and tendencies of inorganic chemistry. Prof. Morgan describes, *inter alia*, the discovery and preparation of 'heavy' hydrogen, which some believe will prove so different from ordinary hydrogen as to be regarded almost as a new element, "in which case the organic chemistry of compounds containing this heavy isotopic hydrogen will become a fascinating but fearful study". Mention is made of the newer fundamental units of atomic structure, and attention is given to the electronic conception of chemical valency. The periodic groups of elements are then considered in turn with reference to the experimental successes of recent years in the discovery of new elements, new types of compounds, and new properties. Co-ordination compounds, in view of their general importance and of an interest which has resulted in many contributions to our knowledge of their behaviour having been made by Prof. Morgan and his pupils, receive due examination. The survey in this pamphlet disposes adequately of the suggestion that inorganic chemistry is anything other than a progressive and rapidly growing section of the science, and it is satisfactory that there are evident signs of a renewed interest in this branch of research among British chemists.

#### North American Earthquakes

TOWARDS the end of January, two violent earthquakes occurred in North America. The first on January 28 at 2.9 p.m. (7.9 p.m., G.M.T.) caused great damage in the Mexican port Acapulco and other towns in Guerrero. From the records at eleven stations, the epicentre is placed by the U.S. Coast and Geodetic Survey in lat. 15° N., long. 99° W. As this point is 140 miles due south of Acapulco, the earthquake must have been of great strength to damage houses in that city. The second occurred on January 30 at 3.16 a.m. (8.16 a.m., G.M.T.). According to the records from seven observatories, the epicentre lay in lat. 38.8° N., long. 118.6° W. This

point is in the State of Nevada in the Walker Lake region, and is close to the epicentre of the earthquake of June 25, 1933, and about 50 miles west of that of the great earthquake of December 21, 1932, one of the most violent recorded in the United States (Wire Report, Science Service, Washington, D.C., January 30 and 31).

#### Pyrex Glass for the 200 in. Reflector

ACCORDING to a Science Service report, the 200 in. mirror of the new Californian telescope will be made of a sort of pyrex glass and will be poured very shortly. It was at one time proposed to make the mirror of fused quartz, but a superior pyrex glass, which has a small temperature coefficient of expansion, has been developed for the purpose. The glass will be taken from the furnace at a temperature of 1,500° C. and poured at about 1,000° C. The cooling and annealing processes will occupy several months. The oven for the large reflector has already been used to make a 120 in. flat which will be required to test the larger mirror. Preliminary tests for strain have shown that this flat is superior to the excellent 60 in. mirror now used at Mount Wilson. The flat is perfectly clear and almost free from bubbles. The test flat will have the same type of construction as the big mirror, namely, a hexagonal system of ribs, which gives rigidity, and in which nineteen points of support will be provided. Ten supporting levers will be attached in ball bearings so that frictional and elastic distortions will be minimised. The holders will work in any position so that the mirrors can hang upside down if necessary.

#### Work of International Polar Year Expedition

THE Symons memorial lecture of the Royal Meteorological Society will be given on Wednesday, March 21, at 7.30 p.m., by Mr. J. M. Stagg, leader of the British Expedition which occupied Fort Rae in Canada during the Second International Polar Year, 1932-33. The site of Fort Rae is of exceptional interest, as it lies near the zone of maximum frequency of aurora, and auroral photography was one of the most important objects of the expedition. Extensive studies were also made in meteorology, including upper air investigation, atmospheric electricity and terrestrial magnetism. The expedition occupied a site very near to that of the Canadian and British expedition during the first International Polar Year of 1882-83, and this gave an opportunity for obtaining valuable determinations of secular change of the magnetic elements. Mr. Stagg will also describe some of the practical difficulties and interesting or unusual experiences which the expedition met with. As the lecture this year is of unusual interest, the Council has obtained the use of the hall of the Royal Geographical Society, Kensington Gore. An additional meeting of the Royal Meteorological Society will be held on March 28, at 5.30 p.m., at 49 Cromwell Road, South Kensington, when Prof. W. Schmidt, Director of the Central Meteorological Institute, Vienna, will deliver a lecture on micro-climatological work in Austria.

#### Announcements

DR. HARLOW SHAPLEY, director of Harvard College Observatory and Paine professor of astronomy at Harvard University, will deliver the George Darwin lecture for 1934 at the ordinary meeting of the Royal Astronomical Society on May 11, taking as his subject "Some Structural Features of the Metagalaxy".

At the annual general meeting of the Society of Public Analysts held on March 2, the following officers were elected for the year 1934:—*President*, Mr. John Evans; *Vice-Presidents*, Messrs. L. Eynon, S. E. Melling, A. More, W. H. Roberts; *Honorary Treasurer*, Mr. E. B. Hughes; *Honorary Secretary*, Mr. G. Roche Lynch.

At the annual general meeting of the Geological Society of London on February 16, the following officers were elected: *President*, Mr. J. F. N. Green; *Vice-Presidents*, Prof. P. G. H. Boswell, Prof. W. S. Boulton, Sir Thomas Holland and Mr. W. Campbell Smith; *Secretaries*, Prof. W. T. Gordon and Dr. L. Hawkes; *Foreign Secretary*, Sir Arthur Smith Woodward; *Treasurer*, Mr. F. N. Ashcroft.

A CONFERENCE on "Modern Changes in the Treatment of Light Soils" has been arranged to be held at Rothamsted Experimental Station on March 20, at 11.30. Further information can be obtained from the Secretary, Rothamsted Experimental Station, Harpenden.

THE Faraday Society has arranged a general discussion on "The Determination and Interpretation of Dipole Moments" to be held at Exeter College, Oxford, on April 12-14, under the presidency of Dr. N. V. Sidgwick. The discussion, which will be introduced by Prof. P. Debye (Leipzig), will be divided into two parts, namely, determination and interpretation. Among the foreign visitors who have promised papers are: Dr. A. E. van Arkel (Eindhoven), Dr. J. L. Snoek (Eindhoven), Dr. E. Bretscher (Zurich), Prof. P. Girard (Paris), Dr. O. Hassel (Oslo), Prof. F. Horst Müller (Leipzig), Prof. W. H. Rodebush (Illinois), Prof. C. P. Smyth (Princeton), and Prof. J. W. Williams (Wisconsin). Further information can be obtained from the Secretary, Faraday Society, 13 South Square, Gray's Inn, London, W.C.1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Temporary civil engineering assistants for the London County Council—The Chief Engineer (D), County Hall, Westminster Bridge, S.E.1 (March 20). A head of the Department of Mathematics and Physics at the Municipal Technical College, Halifax—The Education Officer, Education Offices, West House, Halifax (March 23). Borough electrical engineer and manager, County Borough of Halifax—Town Clerk, Town Hall, Halifax (March 24). A demonstrator in inorganic and physical chemistry, Bedford College for Women—Secretary (April 21). A head of the Department of Building at Heriot-Watt College, Edinburgh—The Principal (April 23). A lecturer in chemistry, University of Reading—Registrar (May 7).

## Letters to the Editor

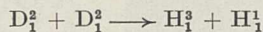
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## Transmutation Effects observed with Heavy Hydrogen

WE have been making some experiments in which diplons have been used to bombard preparations such as ammonium chloride ( $\text{NH}_4\text{Cl}$ ), ammonium sulphate ( $(\text{NH}_4)_2\text{SO}_4$ ) and orthophosphoric acid ( $\text{H}_3\text{PO}_4$ ), in which the hydrogen has been displaced in large part by diplogen. When these D compounds are bombarded by an intense beam of protons, no large differences are observed between them and the ordinary hydrogen compounds. When, however, the ions of heavy hydrogen are used, there is an enormous emission of fast protons detectable even at energies of 20,000 volts. At 100,000 volts the effects are too large to be followed by our amplifier and oscillograph. The proton group has a definite range of 14.3 cm., corresponding to an energy of emission of 3 million volts. In addition to this, we have observed a short range group of singly charged particles of range about 1.6 cm., in number equal to that of the 14 cm. group. Other weak groups of particles are observed with the different preparations, but so far we have been unable to assign these definitely to primary reactions between diplons.

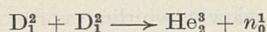
In addition to the two proton groups, a large number of neutrons has been observed. The maximum energy of these neutrons appears to be about 3 million volts. Rough estimates of the number of neutrons produced suggest that the reaction which produces them is less frequent than that which produces the protons.

While it is too early to draw definite conclusions, we are inclined to interpret the results in the following way. It seems to us suggestive that the diplon does not appear to be broken up by either  $\alpha$ -particles or by proton bombardment for energies up to 300,000 volts. It therefore seems very unlikely that the diplon will break up merely in a much less energetic collision with another diplon. It seems more probable that the diplons unite to form a new helium nucleus of mass 4.0272 and 2 charges. This nucleus apparently finds it difficult to get rid of its large surplus energy above that of an ordinary He nucleus of mass 4.0022, but breaks up into two components. One possibility is that it breaks up according to the reaction



The proton in this case has the range of 14 cm. while the range of 1.6 cm. observed agrees well with that to be expected from momentum relations for an  $\text{H}_1^3$  particle. The mass of this new hydrogen isotope calculated from mass and energy changes is 3.0151.

Another possible reaction is



leading to the production of a helium isotope of mass 3 and a neutron. In a previous paper we suggested that a helium isotope of mass 3 is produced as a result of the transmutation of  $\text{Li}^6$  under proton bombardment into two doubly charged particles. If

this last reaction be correct, the mass of  $\text{He}_2^3$  is 3.0165, and using this mass and Chadwick's mass for the neutron, the energy of the neutron comes out to be about 3 million volts. From momentum relations the recoiling  $\text{He}_2^3$  particle should have a range of about 5 mm. Owing to many disturbing factors, it is difficult to observe and record particles of such short range, but experiments are in progress to test whether such a group can be detected. While the nuclei of  $\text{H}_1^3$  and  $\text{He}_2^3$  appear to be stable for the short time required for their detection, the question of their permanence requires further consideration.

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## Magneto-Caloric Effect in Supraconducting Tin

IN connexion with experiments on persistent currents in spheres, and in continuation of previous work on the energy content of superconductors<sup>1</sup>, measurements were carried out on the adiabatic magnetisation and demagnetisation of superconducting tin.

We used a cylinder of 2 cm. diameter, 5.5 cm. long, with a phosphor-bronze resistance thermometer which was calibrated both with and without a field. The experiments were carried out in the temperature range 2.5°–4.0° K., and both longitudinal and transverse fields were used. The field strength was always considerably higher than the magnetic threshold values of tin.

We observed a cooling effect on magnetisation and a heating effect on demagnetisation. The heating was always greater than the corresponding cooling, as in both cases, when the field was above the threshold value, an additional heating due to eddy currents was produced. Measurements were mainly carried out on the cooling effect, which was found to increase from zero at the normal transition point (3.7° K.) to the lowest temperatures reached. The effect appeared to be the same for longitudinal and transverse fields within the limits of experimental error.

The cooling observed at the various initial temperature indicated was: 0.05° at 3.3° K.; 0.11° at 3.0° K.; 0.21° at 2.7° K.; 0.33° at 2.5° K. Still greater cooling could be obtained by using a magnetic field exactly equal to the magnetic threshold value corresponding to that temperature, as this would eliminate the heating effect of eddy currents.

The theoretical discussion of these results and their connexion with recent calculations by C. J. Gorter and others may be postponed until further experimental material is available.

Experiments are being carried out to investigate this cooling effect at lower temperatures and with different substances. It will perhaps be possible to use the adiabatic magnetisation of superconductors as a simple method (as the fields necessary are small) of producing very low temperatures.

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## Kinetics of Photosynthesis and Allied Processes

THE photosynthetic process in the living plant consists of two separate reactions, namely, the primary photosynthetic reaction which has no temperature coefficient, and the dark or Blackman reaction which restores the conditions disturbed by the primary reaction and has a temperature coefficient. The velocity of the primary reaction is proportional to the concentration of the chlorophyll on the irradiated surface, the intensity of light and the concentration of the hydrated carbon dioxide. If these factors be denoted by  $a$ ,  $I$  and  $P$ , respectively, the initial velocity will be expressed by  $k_1 a I P$ , and the velocity at time  $t$  will be  $k_1 I P (a - x)$ . The dark reaction is known to be unimolecular, and its velocity at time  $t$  will be  $k_2 x e^{-Q/RT}$ . It is obvious that a photo-stationary state will be established when the velocities of the primary and Blackman reactions become equal, and if this state be established at time  $t$ , then the observed rate of photosynthesis will be given by

$$y = k_1 I P (a - x) = k_2 x e^{-Q/RT} \quad (1)$$

Dividing by  $k_1 I P x$  we have

$$\frac{y}{k_1 I P x} = \frac{a - x}{x} = \frac{k_2}{k_1 I P} e^{-Q/RT}$$

But  $k_1 I P x = k_1 I P a - y$ , where  $k_1 I P a$  is the initial rate of photosynthesis, and for any one set of conditions is a constant, and if this be denoted by  $K$  we have:

$$\log \frac{y}{K - y} = \log \frac{k_2}{k_1 I P} - \frac{Q}{T} \quad (2)$$

where  $Q^1 = Q/2.303 R$ .

This formula expresses with great accuracy Emerson's four series of observations of the variation with temperature in the rate of photosynthesis with *Chlorella*<sup>1</sup>. The value of  $K$ , as indicated by the formula, decreases with the chlorophyll concentration, and the four values of  $Q$  are 30,105, 29,309, 29,959, 29,905 calories, respectively, with a mean value of 29,819 calories.

The formula also explains the fact, first discovered by Blackman and more recently observed by Warburg<sup>2</sup>, that the temperature coefficient becomes unity when the intensity of light is small.

By the elimination of  $x$  from (1) we obtain

$$y = \frac{k_1 I P a k_2 e^{-Q/RT}}{k_1 I P + k_2 e^{-Q/RT}} \quad (3)$$

from which may be derived

$$\frac{I}{y} = \frac{1}{k_1 a P} + \frac{I}{a k_2 e^{-Q/RT}} \quad \text{and} \quad \frac{P}{y} = \frac{1}{k_1 a I} + \frac{P}{a k_2 e^{-Q/RT}} \quad (4)$$

These equations indicate linear relations between  $I/y$  and  $I$ , and between  $P/y$  and  $P$ , when the temperature is constant. Warburg's observations<sup>2</sup> of the relations between the rate of photosynthesis and the intensity of light and the hydrated  $\text{CO}_2$  concentration, respectively, at constant temperature are expressed by the above linear equations.

Let the case be postulated of heterogeneous catalysis in which the primary catalytic reaction is effected by the de-activation of the catalyst, and the de-activated catalyst is re-activated by a thermal reaction. If  $a$  be the initial concentration of the active catalyst,  $c$  the concentration of the catalyte, and  $d$  the concentration of the substance which re-activates

the catalyst, then, if  $c$  and  $d$  be large and sensibly constant, equation (2) becomes

$$\log \frac{y}{K - y} = \log \frac{k_2 d}{k_1 c} - \frac{Q}{T},$$

where  $K = k_1 a c$  and  $y$  is the observed rate of catalysis. Equation (3) now becomes

$$y = \frac{k_1 a c k_2 d e^{-Q/RT}}{k_1 a c + k_2 d e^{-Q/RT}} \quad (5)$$

whence we have

$$\frac{c}{y} = \frac{1}{k_1 a} + \frac{c}{k_2 d e^{-Q/RT}}$$

which indicates a linear relation between  $c/y$  and  $c$  when  $d$  and  $T$  are constant. Under these conditions, equation (5) may be written in the form

$$y = \frac{k^1 a c}{c + K_m}$$

which is the well-known Michaelis equation for enzyme action when  $a$  and  $c$  are the concentrations of enzyme and substrate, respectively. The wide applicability of the Michaelis equation and the close analogy between it and the equations expressing the rate of photosynthesis suggest that enzyme action is also a cyclic process, in which the primary catalytic reaction is effected by the de-activation of the enzyme, and the de-activated enzyme is re-activated in a thermal reaction, possibly by the co-enzyme.

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<sup>1</sup> *J. Gen. Physiol.*, **12**, 623; 1929.

<sup>2</sup> *Biochem. Z.*, **100**, 258; 1919.

## Formation of Vortex Rings from a Liquid Drop

A DROP of liquid heavier than water, for example blue or red ink, submerged quietly into still water, encounters the resistance of the medium and becomes flatter in its form in the course of its descending motion. The central part of the disc thus formed soon disappears, and consequently a ring form results.

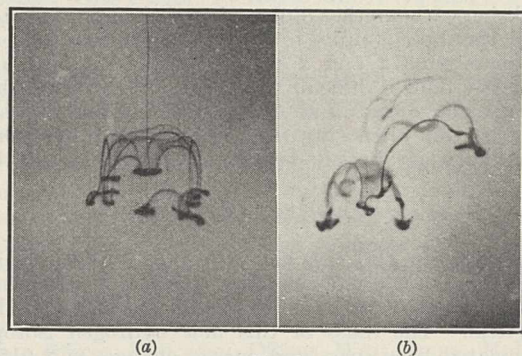


FIG. 1.

This is a very slowly whirling vortex ring. As it proceeds, the radius of the ring is augmented, and it begins to disintegrate into several minor vortex rings. Each of the secondary vortex rings proceeds in the same manner as the primary one, and disintegrates as well. The process of disintegration may be continued so far as the material remains ample.

This phenomenon has been described by Fr. Ahlborn and shown diagrammatically<sup>1</sup>. I also studied this process of disintegration a few years ago, and several photographs were taken. Those photographs were not published, and the matter has been forgotten. Ahlborn's description is, however, diagrammatic and not photographic: these photographs of mine, I think, might have some scientific interest. Two of them are reproduced here (Fig. 1). (a) is one of the most beautiful examples, and represents the first disintegration stage and the beginning of the second disintegration. (b) shows a further developed stage, but not a continuation of (a).

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<sup>1</sup> "Dynamik des Regens", *Phys. Z.*, **32**, 139; 1931.

### Scattering of Hard Gamma Rays by Lead, and the Annihilation of Positive Electrons

THE following experiment was carried out to make a further test of the hypothesis, proposed by Blackett and Occhialini, that the 'nuclear' scattering of hard  $\gamma$ -rays by heavy elements is due to the annihilation of positive electrons produced by the  $\gamma$ -rays<sup>1</sup>.  $\gamma$ -rays from an emanation tube were used, the source being placed at *S* (Fig. 1). Observations were made on the ionisation produced in the chamber *I* due to the introduction of a thin lead foil (0.1 mm.) into the position *BB'*, first, *with* an aluminium sheet (3 mm. thick) at *AA'*, secondly *without* the aluminium sheet. According to the above hypothesis, the ionisation should be greater in the first case, because the positive electrons which are produced in the lead foil and escape from it in the forward direction, are stopped in the aluminium sheet. In the second case they are

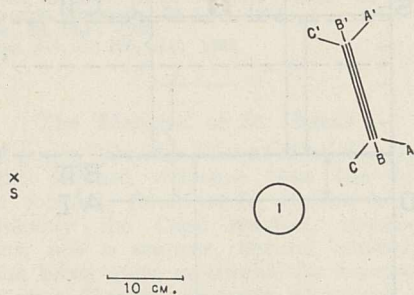


FIG. 1.

practically lost from the neighbourhood of the ionisation chamber, and therefore also their annihilation radiation. Apart from this, the only difference between the two cases is that, in the first, the lead foil absorbs some of the radiation scattered by the aluminium. This tends to make its effect smaller than in the second case, and is therefore in the *opposite* direction to the above positive electron effect. Quantitatively, the absorption effect is, however, quite small, being only 2 per cent of the total effect of the lead foil.

The results of several observations showed that the effect of the lead foil was greater when the aluminium sheet was present than when it was away, the difference being  $25 \pm 3$  per cent. The result provides direct evidence for the positive electron hypothesis. Quantitatively it is difficult to say whether the fraction 25 per cent is consistent with

the supposition that *all* the 'nuclear' radiation from lead is due to the agency of positive electrons. Two factors detract from a 100 per cent effect. In the first place, a certain fraction of the positive electrons produced in the foil will not be able to escape from it in the forward direction, owing to insufficient range and to scattering in the foil. Secondly, the wax sheet placed at *CC'* (which absorbs in all cases the positive electrons escaping backwards from the foil) is also a source of positive electrons, and the stopping of these by the lead foil further reduces the effective number which escapes from it.

Accurate analysis is difficult, and to find, by this method, if some of the 'nuclear' radiation from lead consists of other radiation than that associated with positive electrons, observations with different thicknesses of foil and different degrees of filtering must be made. The above observations were made with 1 cm. lead filter in the path of the scattered rays. This was sufficient to absorb the Compton radiation, the angle of scattering being about  $140^\circ$ .

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<sup>1</sup> Since the present results were obtained, papers by Joliot and Thibaud (*Comptes rendus*, Dec. 18, 1933) have appeared, which also report direct evidence for the annihilation of positive electrons, a magnetic field being used to deflect positive electrons so as to be stopped close to an ionisation chamber.

### Determination of Dipole Moments in Solution

SUBSTANCES the molecules of which contain a large permanent dipole give a marked decrease in the measured values of the molecular polarisation  $P_2$  in solution as the concentration of the solution increases. This effect has been ascribed to dipole association; it appears to be much too large to be due to association in the chemical sense of the term since, for example, nitrobenzene, which from many of its physical properties would be classed as a nearly normal liquid, shows a considerable fall in  $P_2$  in benzene over the concentration range 0.5–2 per cent.

If  $P_2$  is plotted against the volume polarisability  $(\epsilon - 1)/(\epsilon + 2)$  for solutions of benzonitrile, nitrobenzene and chlorobenzene in a number of non-polar solvents, the points for each substance all lie near a straight line through the entire range of solutions to the pure liquid (Fig. 1). The values of  $\infty P_2$  found by Horst Müller for chlorobenzene and those recently given by Jenkins for nitrobenzene all lie close to the appropriate curve.

This regularity appears to apply only to solutions in solvents with small or zero moments. Thus solutions of benzonitrile in chlorobenzene measured by me give points which lie well below the line in Fig. 1. Highly associated liquids, for example alcohols, may also be expected to deviate from the linear law.

A crude picture of the phenomenon underlying the relationship shown in Fig. 1 may perhaps be drawn as follows. The permanent dipole of a molecule in a solution may be regarded as surrounded by an 'atmosphere' of dipoles of opposite sign produced partly by induction in the polarisable solvent molecules and partly by orientation of adjacent permanent dipoles. The measured polarisation therefore appears to be less than the true value. The correction for the opposing atmosphere of dipoles should be a

function of the volume polarisability of the solution, and the true value of  $P_2$  should be obtained by extrapolating the curve to  $(\epsilon - 1)/(\epsilon + 2) = 0$ . It is clear from the large slopes of the curves for benzonitrile and nitrobenzene that the value for  $\infty P_2$  in any solvent will be lower than the extrapolated value since even for hexane  $(\epsilon - 1)/(\epsilon + 2) = 0.228$ .

The other end of the curve also appears to be of interest. When  $(\epsilon - 1)/(\epsilon + 2)$  becomes unity

benzene,  $\mu = 4.4$ . These results are of a preliminary character and may be modified by further work; they seem, however, to confirm the view that dipole moments calculated from  $\infty P_2$  in a solvent may be seriously in error when the dipole moment is large.

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Feb. 5.

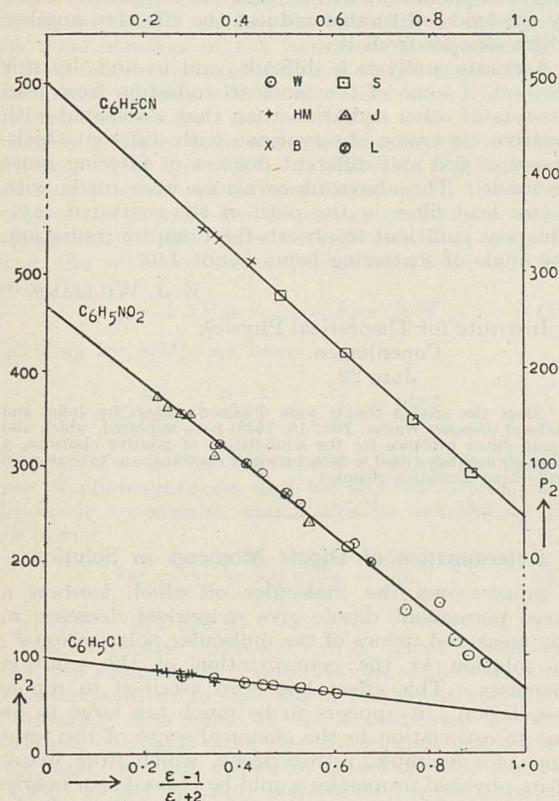


FIG. 1. Relation of volume polarisability to molecular polarisation.

W: Williams and Ogg, *J. Amer. Chem. Soc.*, **50**, 94; 1928.  
HM: Horst Müller, *Phys. Z.*, **33**, 732; 1932.  
B: Bergmann *et al.*, *Z. physikal. Chem.*, **B**, **10**, 397; 1930.  
S: Sugden, unpublished data.  
J: Jenkins, *NATURE*, **133**, 106, Jan. 20, 1934  
L: Lange, *Z. phys.*, **33**, 169; 1925.

( $\epsilon = \infty$ ) the atmosphere of dipoles should neutralise the permanent dipole and only the distortion terms  $P_A + P_B$  should be effective. If the curve is linear, its slope should then give  $P\mu$ ; if it has a more complicated form, then the difference between the extrapolated values of  $P_2$  for zero and unit volume polarisability should give  $P\mu$ . From the data in Fig. 1, the best line through the observed points (calculated by the method of zero sum) gives the following values of  $\mu$  in the usual units: benzonitrile 4.7, nitrobenzene 4.4, chlorobenzene 1.7. In benzene solution the first two substances give lower moments, 3.9 and 4.1 respectively, whilst chlorobenzene gives 1.52.

There are no data available in the literature for the dipole moments of these substances in the vapour state. Mr. L. G. Groves and I have recently measured the dielectric constants of the vapours of these and other substances with a high dipole moment and find for benzonitrile  $\mu = 4.3$ , and for nitro-

### Predissociation in the First Positive Group of Nitrogen

THE electronic level diagram of the normal  $N_2$  molecule is shown in Fig. 1. The horizontal full lines represent the different electronic levels, the dotted lines the dissociation states; known transitions between the different molecular levels are represented by vertical arrows, whereas the electronic levels are connected by brackets with the atomic states into which they dissociate. As the position of the singlet levels relatively to the triplet ones is still rather uncertain, the zero of the scale of volts has been put at the triplet level  $A^3\Sigma$ . The dissociation states of the different molecular levels have already been given by various workers, of whom especially J. Kaplan must be named<sup>1</sup>. By his observation of the predissociation in the  $B^3\Pi$ -level of the first positive group (transition  $B^3\Pi \rightarrow A^3\Sigma$ ) at

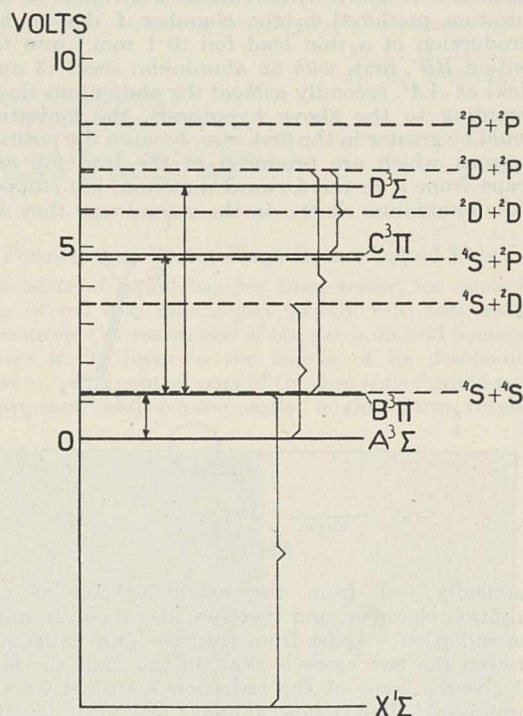


FIG. 1.

$v' = 12$  and  $v'' = 20$ , he was able to give strong evidence in favour of the diagram. Predissociation in the  $C^3\Pi$ -level was first observed by G. Herzberg<sup>2</sup> and studied in detail by D. Coster, F. Brons and A. v. d. Ziel<sup>3</sup>. They interpreted this predissociation as due to the  ${}^2D + {}^2D$  dissociation state, as was also done by Kaplan.

I am now able to bring forward new and strong evidence in favour of the diagram given above from a detailed investigation of the  $12 \rightarrow 8$  transition of



the first positive group ( $B^3\Pi \rightarrow A^3\Sigma$ ) in which according to Kaplan the predissociation should occur. In this investigation, the work done by Naudé<sup>4</sup> on the  $5 \rightarrow 2$  and  $6 \rightarrow 3$  transitions of the same band system was of great value. Naudé has pointed out that the structure of the first positive group agrees with a  $^3\Pi \rightarrow ^3\Sigma$  transition. Twenty-seven branches are to be expected, nine strong branches and eighteen weaker branches. If the  $B^3\Pi$  state were in Hund's case *b*, only the nine strong branches should occur. But the  $B^3\Pi$  state is in case *a* for the lower *J* values and proceeds to case *b* for higher *J* values. A rotational analysis of the  $12 \rightarrow 8$  band showed that the band lines suddenly become much less intense. This happens at  $J = 32$  for the  $^3\Pi_2$  level,  $J = 33$  for  $^3\Pi_1$  and  $J = 34$  for  $^3\Pi_0$ , and in the *R* and *P* branches at the same place as in the *Q* branches.

This cannot be explained by assuming that the state causing this predissociation is  $^4S + ^4S$ . This level gives rise only to  $\Sigma$ -states.  $\Sigma$ -states are in Hund's coupling case *b*. For such high rotational levels we are certainly also for the  $\Pi$ -states nearly in case *b*. Each one of the three  $\Sigma$ -states forming a triplet perturbs only one of the  $\Pi$ -triplet states. These  $\Pi$ -triplets are double because of the  $\Lambda$ -doubling;  $\Sigma$ -states are not. Therefore only one of these  $\Lambda$ -doubling components of the  $\Pi$ -states should predissociate, whereas on the contrary I observed the predissociation in both the  $\Lambda$ -doubling components (*P*- and *R*- as well as *Q*-branches predissociate). We thus may conclude that the perturbing level in this case is certainly not  $^4S + ^4S$  but that it may be  $^4S + ^2D$ , as was formerly assumed.

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Jan. 10.

<sup>1</sup> *Phys. Rev.*, **37**, 1406; 1931. **38**, 1079; 1931. **41**, 114; 1932.  
<sup>2</sup> *Ergebn. exakt. Naturwiss.*, **10**, 207; 1931.  
<sup>3</sup> *Z. Phys.*, **84**, 304; 1933.  
<sup>4</sup> *Proc. Roy. Soc. A.*, **136**, 114; 1932.

### The 'Manatee' of St. Helena

In my paper "On the 'Manatee' of St. Helena"<sup>1</sup> I brought forward evidence that the so-called 'manatee' formerly found at St. Helena was a sea-lion, probably the Cape sea-lion, *Arctocephalus antarcticus*, not a sea-cow, natural conditions at St. Helena being quite unsuitable for sea-cows.

Sir Charles Harper, formerly Governor of St. Helena, to whom I sent a copy of my paper, has very kindly directed my attention to a passage in Dampier's "Voyages" (ed. by Masefield, publ. by Grant Richards, London, 1906), which has a very important bearing on this question.

Dampier, who visited St. Helena in June 1691, also mentions the 'manatee', stating: "I was also informed that they get Manatee or Sea Cows here, which seemed very strange to me. Therefore inquiring more strictly into the matter, I found the Santa Hellena Manatee to be, by their shapes, and manner of lying ashore on the Rocks, those Creatures called Sea-lyons; for the Manatee never come ashore, neither are they found near any rocky Shores, as this Island is, there being no feeding for them in such places. Besides, in this Island there is no River for them to drink at, tho' there is a small Brook runs into the Sea, out of the Valley by the Fort" (I, p. 526).

Dampier gives (I, p. 64-67) an excellent description of the manatees and their mode of life from his own observations in the West Indies, the Philippines and Australia. Thus he knows what he is speaking about. His direct statement concords with the result reached indirectly through my own observations. The evidence is accordingly now conclusive that the much discussed St. Helena 'manatee' is a sea-lion, and the conclusions in regard to former land connexions drawn from the existence of the 'manatee' at St. Helena are without foundation.

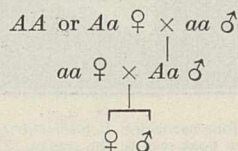
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Copenhagen.  
Feb. 18.

<sup>1</sup> *Vidensk. Medd. Dansk Naturhist. Forening.*, **97**; 1933.

### Possibility of Incomplete Sex Linkage in Mammals

In a paper shortly to be published, Koller and Darlington find that, in the first meiotic division of *Rattus norvegicus* males, one or two chiasmata are formed between the X- and Y-chromosomes. If chiasma formation corresponds with the crossing-over of genes, it follows that where the chiasma lies between the locus of a gene and the region in which X- and Y-chromosomes differ, such a gene will exhibit crossing-over with sex. On the basis of the cytological observations, genes in a certain region of the chromosome should show about 5 per cent crossing-over with sex, in another about 45 per cent. These latter genes would behave in very nearly the same manner as autosomal genes. It thus follows that some genes regarded as autosomal may in reality be incompletely sex-linked. Such linkage would show up in a pedigree of the following type:



The progeny in the third generation would be in the proportions

$$55 Aa \text{ } \text{♀} : 45 aa \text{ } \text{♀} : 45 Aa \text{ } \text{♂} : 55 aa \text{ } \text{♂}$$

in a case involving 45 per cent crossing-over. A glance through the literature shows that data must be available which would enable this hypothesis to be tested, but that they have not been published since the progeny of such matings are not usually classified for sex.

We wish to appeal to authors to give data in future communications which will enable the above hypothesis to be tested, and, where possible, to examine for partial sex-linkage the data on which former publications have been based. It is most likely that such cases would be found in mammals, including man, where the Y-chromosome is often fairly large as compared with the X-chromosomes, but they are perhaps also possible, *mutatis mutandis*, in birds and other groups.

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London, S.W.19. Feb. 28.

### The Floating Barnacle on the North Cornish Coast in the Summer of 1933

THE occurrence of the pelagic and planktonic floating barnacle, *Lepas fascicularis*, on the shore at New Train Bay, Trevone, near Padstow, Cornwall, in the summer of 1933, is an event sufficiently rare to be worthy of record along with other unusual marine events of that outstanding year.

About fifty individuals (with capitula 13–32 mm. in length) were taken alive on August 22 at about the time of high water (a.m.) at the beginning of a set of spring tides and within an hour or so of being stranded; some yielding living larvæ later. No others were found in the locality in the following week even after careful searching. In water most of them floated freely by means of their spherical peduncular secretion (diameter 11–20 mm.) containing gas-bubbles and vesicles, either singly, or in groups of two to five with their floating apparatus fused into one spherical mass (see Fig. 1). Two small ones with capitula 21 mm. and 22 mm. were attached—along with the tropical barnacle, *L. pectinata*—to floating fronds of *Fucus*, or to cinders, solely by means of a small

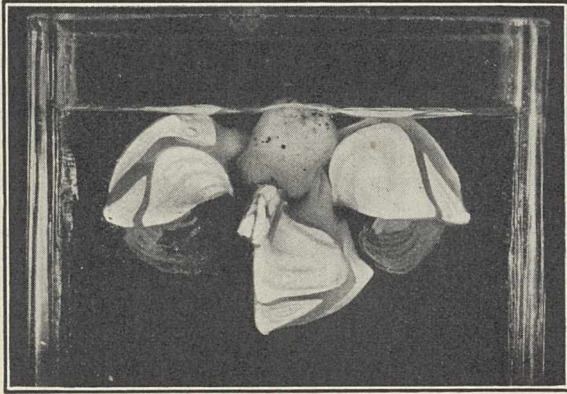


FIG. 1. A group of four barnacles, *L. fascicularis*, attached by short stalks to the common float seen in the centre. The group is photographed floating but held slightly submerged.  $\times$  about  $\frac{1}{16}$ . (Photo: P. Bond.)

flattened adherent expansion of the peduncle (thus confirming Ellis's original figure made in 1786), whereas others smaller and unattached (with capitula 14–20 mm.) had well-developed floats. Some of the larger individuals were attached to floating fronds of the seaweeds, *Fucus* and *Ascophyllum*, by extensions of the spherical float in such a way as to suggest that this organ may be adhesive and capable of expanding secondarily around a strange object, but simple experiments made under conditions normal for the species are required for further information. Darwin<sup>1</sup> has shown that the larval peduncle is always attached to some floating object, around which the float is formed later, presumably—we suggest—when the animal develops a tendency to sink and perhaps in response to increased pressure.

At various times the barnacles have been recorded as attached to a great variety of flotsam and jetsam, but the mode of attachment is rarely given. It would seem that a secondary attachment of the float would give a single animal greater mechanical efficiency in its feeding stroke, as no energy is required for or dissipated in maintaining a stable system; two animals on opposite sides of a free float with a body-

beat synchronised would, however, appear to give efficiency. In this regard it may be that the special form of the keel plate is correlated with modified muscular requirements in a floating habit of life.

This peculiar barnacle occurs in the open ocean and is recorded from all temperate and tropical waters<sup>2</sup>, whence it is said to be blown ashore in various parts of the world by persistent winds. Damas<sup>3</sup>, however, has shown that it is carried normally into the Norwegian seas from the Atlantic along with other Atlantic plankton at about mid-summer. In a similar way Schmidt followed the gradual extension of the planktonic *Salpa* from the North Atlantic into the North Sea in 1905<sup>3</sup>. In some years, therefore, Atlantic plankton may be carried in the invading summer water, apparently independently of wind drift, into the North Sea, and there is evidence for a similar invasion of Atlantic water into the English Channel<sup>4</sup>. Whether the presence of the floating barnacle on the Cornish coast is an indication of an unusual offset of Atlantic water along the Cornish coast in the summer of 1933, or to a prevalent set of westerly winds, may perhaps be revealed later by hydrological observations.

Since 1786 only seven or eight records appear to have been made of the occurrence of *L. fascicularis* on the south coasts of England, and the same number for the west and north of Ireland<sup>4,5,6</sup>. It has been found on the Northumberland coast on three occasions in the period between 1857 and 1894<sup>7</sup>. In the latter cases the barnacles would appear to have followed the route of *Salpa* mentioned above from the Atlantic and have been afterwards blown ashore; they are not infrequently found in the North Sea<sup>10</sup>.

*L. pectinata* has been recorded only about five times since 1803 from the coasts of the British Isles<sup>1,8,9</sup>.

It would seem that the interesting floating barnacle may often serve as a useful indicator of important physical events, and is therefore worthy of being more widely known.

J. H. ORTON.

RUTH RAWLINSON.

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Jan. 18.

- <sup>1</sup> Darwin, "Monograph of the Cirripedes. Lepadidae", 1851.
- <sup>2</sup> Gruvel, "Monographie des Cirripèdes ou Thécostracés", 1905.
- <sup>3</sup> Murray and Hjort, "Depths of the Ocean", pp. 711 and 710, 1912.
- <sup>4</sup> Matthews, Int. Fish. Invest. Mar. Biol. Assoc., Cmd. 4641, 1909.
- <sup>5</sup> Vallentin, *J. Roy. Inst. Cornwall*, 55; 1907.
- <sup>6</sup> Nichols, *Irish Nat.*, 24, 10; 1915.
- <sup>7</sup> Norman and Brady, *Trans. Nat. Hist. Soc. Northumb., Durh. and Newcastle, N.S.*, 3, 2; 1909.
- <sup>8</sup> Cocks, Ann. Rep. Cornwall Poly. Soc., 1849–50.
- <sup>9</sup> Pilsbury, *Bull. U.S. Mus.*, 60; 1907.
- <sup>10</sup> Schaper, *Wiss. Meeres.*, Kiel, 19, 1919–22.

### Travel of a Pulse of Stress in a Steel Wire

A BRIGHT drawn steel wire  $\frac{1}{4}$  in. diameter and 459 ft. long was arranged with one end lying in a solenoid which was excited with direct current. This end of the wire passed through a search coil placed near the central part of the solenoid, the search coil being connected through a valve set to an oscillograph. The other end of the wire was firmly clamped. When the clamped end was struck a sharp blow a pulse of stress was started and travelled along the wire with the speed of sound. On reaching the search coil the changes of permeability of the wire due to the changes of stress gave rise to an E.M.F. which was recorded by the oscillograph. This pulse of stress was reflected from the end of the wire near the search coil and travelled back to the clamped

end, was again reflected and once more reached the search coil end and again developed an E.M.F. which was recorded by the oscillograph. An inspection of the oscillogram (Fig. 1) shows that, in addition to the original pulse of stress which has travelled the full length of the wire before reaching the search coil, three successive reappearances of this pulse can be detected, each pulse being due to the reflection of the previous pulse at the clamped end of the wire.

The distance on the oscillogram between two successive records of the E.M.F. is a measure of the time taken for the pulse to travel twice the total length of the wire. The speed at which the pulse travels has been found in this way to be given by

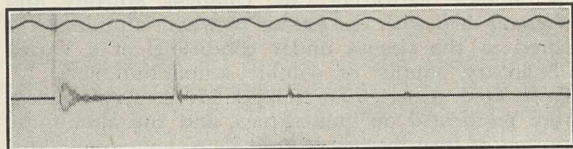


FIG. 1.

$c = 5.04 \times 10^5$  cm. per second; or since  $E = c^2 \rho$ , it follows that  $E = 1.99 \times 10^{12}$  dynes per sq. cm., or,  $29 \times 10^6$  lb. per sq. in.

The rate of decay of the amplitude of the pulse due to its passage to and fro along the wire is a measure of the damping.

One purpose of the investigation is to examine the influence of work hardening on this rate of decay, and thus to find out whether the effect can be used as a practical method for the detection of work hardening in the wires of wire ropes.

T. F. WALL.

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Feb. 10.

### Chemistry of the Brown Alga

OUR attention has been directed to a recent paper by Bergmann and Johnson<sup>1</sup> in which they describe the isolation of a sterol, m.p. 126–127°, from *Microcystis Prolifera*, a deep red sponge from Long Island Sound. According to these authors, the sterol is a singly unsaturated compound of formula  $C_{27}H_{46}O$ , different in properties from either spongosterol isolated by Henze<sup>2</sup> or from cliosterol, described by Dorée<sup>3</sup>.

We are at present engaged on a detailed survey of the marine brown alga, and during the course of this work have isolated both from *Fucus vesiculosus* and *Pelvetia canaliculata* a sterol different in properties from the above mentioned sterols for which we propose the name 'fucosterol'.

Fucosterol melts at 124° (acetate m.p. 119°; propionate m.p. 104°) and gives analyses in good agreement with either a formula,  $C_{29}H_{48}O$  or  $C_{30}H_{50}O$ . The presence of two ethenoid linkages in the molecule has been demonstrated by bromine absorption, perbenzoic acid titration and quantitative catalytic hydrogenation. A detailed account of the chemistry of this new sterol will be published elsewhere.

I. M. HEILBRON.  
R. F. PHIPERS.  
H. R. WRIGHT.

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Manchester.  
Feb. 28.

<sup>1</sup> *Z. physiol. Chem.*, **222**, 220; 1933.  
<sup>2</sup> *Z. physiol. Chem.*, **41**, 109; 1903. *ibid.*, **55**, 427; 1908.  
<sup>3</sup> *Biochem. J.*, **4**, 92; 1909.

### Cosmic Rays under 600 Metres of Water

IN October 1933, further work was done to investigate the hardest cosmic rays first found in the salt-mine of Stassfurt (Berlepschschacht der Preussischen Bergwerks- und Hütten A.-G.)<sup>1,2</sup>. The new observations were made in the same manner, and at the same levels, as in July, that is, under 500 m. and 1,000 m. of water; but this time they were extended to the second level (600 m. of water) and with two sets of double counter coincidence apparatuses operating simultaneously. They showed conclusively that these hardest cosmic rays penetrate also to 600 m. of water, as already expected from the 500 m. level measurements<sup>1</sup> and the earlier ionisation chamber observations<sup>2</sup>. From the July experiments<sup>3</sup> the apparent mass absorption coefficient  $(\mu/\rho)_{H_2O}$  was deduced as being less than  $5 \times 10^{-5}$  gm.<sup>-1</sup> if the penetrating power can be characterised by such a figure, which is of small value as compared with distinct specification of the absorbing screens penetrated.

The new measurements in the 500 m. and 600 m. levels confirm this coefficient as being less than  $5 \times 10^{-5}$  gm.<sup>-1</sup> and show the upper limit to be  $1.8 \times 10^{-5}$  gm.<sup>-1</sup>. Full details of this, and of the other investigations such as the 'law of straight line', 'ω-effect' and directional distribution of these hardest rays, will be given elsewhere.

It is very interesting that Corlin<sup>4</sup>, performing ionisation chamber observations in the iron ore mine Kiirunavaara near Kiruna (Northern Sweden) in a manner similar to that which I used in 1928 in Stassfurt, now deduces from his measurements at a depth of 52–86 m. of iron ore (215–430 m. of water) the existence of such hard rays with  $(\mu/\rho)_{H_2O} = 11 \times 10^{-5}$  and  $3 \times 10^{-5}$  gm.<sup>-1</sup>.

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Potsdam.  
Jan. 20.

<sup>1</sup> W. Kolhörster, *Berl. Ber.*, **23**, 689; 1933.  
<sup>2</sup> W. Kolhörster, *Ber. Pruss. Met. Institut*, 1931, p. 34; Berlin, 1932.  
<sup>3</sup> W. Kolhörster, *NATURE*, **132**, 407, Sept. 9, 1933.  
<sup>4</sup> A. Corlin, *NATURE*, **133**, 63, Jan. 13, 1934.

### A New Hard Component of the Cosmic Ultra-Radiation

PROF. KOLHÖRSTER has kindly directed my attention to a possible misunderstanding of the statement "a hitherto unknown component" in my communication entitled "A New Hard Component of the Cosmic Ultra-Radiation"<sup>1</sup>. This statement, which referred to the harder Kiirunavaara component, was not intended in any way to dispute Kolhörster's earlier discovery of a very hard radiation capable of penetrating more than 500 m. of water. I had, however, overlooked that Kolhörster has also mentioned<sup>2</sup> a small decrease of the ionisation even down to 700 m. of water found by him so early as 1928 in the Stassfurt mines; it is evident that the whole radiation found by him should not be identified with the softer Kiirunavaara component alone.

AXEL CORLIN.

Observatory, Lund.  
Feb. 1.

<sup>1</sup> *NATURE*, **133**, 63, Jan. 13, 1934.  
<sup>2</sup> *Berlin Ber.*, No. 23, July 19, 1933.

## Research Items

**Maize in China.** In the annual report of the Librarian of Congress for 1933 (Washington, D.C.) Dr. Walter T. Swingle of the United States Department of Agriculture comments in the report of the Division of Orientalia on certain acquisitions in Chinese literature which refer to maize and other natural products. What would appear to be the earliest reference to maize in China is found in a work entitled *Liu-ch'ing jih-cha* by T'ien I-hêng, who was born in 1524. The title of the work literally translated is "Preserved Green Daily [notation] Tablets", it being so called from the fact that it consisted of notes which had been scratched on the leaves of a bamboo grove by the author in his daily walks and meditations. Maize is here described in detail. It is called *yü mai* (Imperial grain) and is said to have come in through *Hsi fan*, literally the western barbarian region, a term which often was used to mean Tibet. Its old name is said to have been *fan mai*, literally barbarian wheat. It is thus clear that maize had been cultivated for some time before the publication of this work in 1573. Three further references to maize occur in Chinese literature between 1573 and 1590, of which at least one was copied from T'ien I-hêng's account. Wang Shih-mou in 1587 gives a different name for it and says it was boiled and eaten. These accounts make it clear that within eighty years of the discovery of America by Columbus, maize had reached China. As the records are unanimous that it came from the west, Dr. Swingle suggests that it was not introduced by the Portuguese through Goa as is usually thought, but by the Arabs, who carried it from Spain to Mecca, whence Moslem travellers would have brought it to China through Central Asia. Tobacco, on the other hand, it would appear from a reference in another work, was not planted in China until the third decade of the seventeenth century.

**Incubation of Mound-builders.** Three papers in the *Victorian Naturalist* (50, Jan. 1934) discuss the habits of the mallee fowl or lowan (*Leipoa ocellata*), the most southern representative of the mound-builders. Each mound is the work of a single female, and although in confinement as many as 29 eggs have been laid, in natural conditions 20 or fewer is the rule. The old ideas that the mounds were placed in water-tracks and that the eggs developed because of heat generated by the fermentation of leaves in the mound, must be given up; the mounds are dry and largely composed of loose soil, and development is due to sun heat. The purpose of such vegetation and sticks as are included in the mound is believed to be the prevention of the packing of the soil which would check access of heat and air. But the parent birds assist the process of incubation by scratching away and then replacing the sand on the top and about the rim of the mound, so that during the day the sun's rays may penetrate to the eggs, and that freshly warmed layers of sand may be piled upon the eggs to keep up the temperature during the night. The young when hatched are thus able to find their way to the surface through the loose soil, although when Mr. L. G. Chandler had the good fortune to see a chick emerge at the surface, it appeared at the spot where the old bird had been scratching. The writers differ in opinion about the future of the

mallee fowl; one regards it as "doomed to extinction", because of interference with it and its habitat, another says "the extensive range of this most interesting species is my reason for stating that there is no need yet to say that it will soon be extinct".

**Extent of the Retention of Ingested Aluminium.** In a recent research report, one of a series on the hygienic aspects of aluminium cooking utensils issued by the Mellon Institute of Industrial Research, Pittsburgh, Pa., Messrs. Schwartze, Cox, Unangst, Murphy, and Wigman deal with the extent to which aluminium is stored in the tissues under conditions of a varied alimentary supply of soluble aluminium salts (*J. Amer. Med. Assoc.*, 101, 1933, p. 1722). Experiments were performed on guinea pigs, and the aluminium content of fresh tissues of animals receiving no added aluminium was found to be about 0.4 part per million. Feeding with large amounts of soluble aluminium salts produces a barely detectable deposition of aluminium—less than 0.5 per million in the soft tissues, and 0.5–1 part per million in the whole carcass. No ill effects were observed as a result of these feeding experiments, which in some cases were continued for 570 days, and it is concluded that no harmful effects are likely to occur from soluble aluminium naturally present in foods or introduced by utensils into a diet having a normal phosphorus content.

**Plant Disease and Manurial Treatment.** A definite correlation between the incidence of a plant disease and the type of manurial treatment applied is not of frequent occurrence, but it appears to be the case with a wilt, *Fusarium vasinfectum*, Atk., of the pigeon pea, *Cajanus indicus*, Spreng. This plant, commonly known as *rahar* in northern India, is included in the crop rotation grown on the permanent manurial plots at the agricultural farm at Pusa. W. McRae and F. J. F. Shaw have made a statistical study of the incidence of wilt on these and a number of other plots at the farm, and their results are published as Scientific Monograph No. 7, issued by the Imperial Council of Agricultural Research, Delhi. The disease was found to cause an average loss of 10 per cent of the plants, but neither the moisture content nor the hydrogen ion concentration of the soil was found to be the controlling factor. Manuring with superphosphate or with cattle manure, on the other hand, resulted in an increase in wilt, whereas green manuring (*Crotalaria juncea*) had the reverse effect and reduced the disease. A combination of superphosphate and green manure, however, brought about an increase in the number of plants affected. Several types resistant to this disease have been isolated, the factor for resistance showing no correlation with any of the morphological characters studied. An interesting feature in this breeding work was the discovery that resistance was lost in a field which had been under *rahar* for a number of years. Such a loss, however, was not transmitted to the next generation, only the soma of the plant being affected.

**Estimation of Fungus Disease Intensity.** A very interesting report of a "Symposium and Discussion on the Measurement of Disease Intensity" appears in

Part 2, vol. 18 of the *Transactions of the British Mycological Society* (pp. 174-186, Nov. 1933). Three papers on the problems of measurement of intensity of particular diseases were delivered by Messrs. A. Beaumont, R. W. Marsh and H. B. Bescoby, whilst a section on statistics was contributed by Dr. A. R. Clapham. Prof. W. B. Brierley opened the discussion, and pointed out that there is usually no correlation between the intensity of disease in the plant and its extent in the crop. Mr. W. Buddin outlined the difficulties of estimating disease intensity encountered by an advisory officer, and suggested that such estimation was only possible for purposes of research. Mr. M. H. Moore showed how different methods of estimating disease intensity gave varying results of spraying trials.

**Minerals of Clay and Bauxite.** A statistical study of clay and bauxitic minerals has recently been published by S. I. Tomkeieff (*Min. Mag.*, 463-482; 1933) which leads to a classification of these minerals on a purely chemical basis. All the available analyses are plotted on two triangular diagrams and frequency curves are constructed for certain cardinal ratios, such as  $H_2O : Al_2O_3$ . The suggestion is offered that among substances that have been claimed as minerals only a few can be regarded as definite species, and that the others are probably mixtures of the latter, or their hydration products, or colloids of variable composition. The distinct crystalline minerals recognised are

pyrophyllite	.. ..	$H_2O$ .	$Al_2O_3$ .	$4SiO_2$
kaolinite and its isomers		$2H_2O$ .	$Al_2O_3$ .	$2SiO_2$
diaspore	.. ..	$H_2O$ .	$Al_2O_3$	
gibbsite	.. ..	$3H_2O$ .	$Al_2O_3$	

Probable species, of which, however, the statistical evidence is not clear, include termierite, anauxite and allophane.

**Study of Winds in the United States.** Supplement No. 35 to the *Monthly Weather Review*, dated November 13, 1933, contains a great mass of statistical information of the kind that is apt to be very unpalatable to the ordinary student of meteorology, but is of value to aviators. The work, which is by Loyd A. Stevens, of the Aerological Division of the Washington Weather Bureau, is entitled "Upper-Air Wind Roses and Resultant Winds for the Eastern Section of the United States". The information was provided by the network of pilot balloon stations of the U.S. Weather Bureau, which has for some years given a fairly detailed picture of upper winds over the United States from day to day, but it has to be remembered that bad weather often makes soundings with balloons impracticable. There are wind roses showing the frequency of winds from different directions and the average velocity from each direction, and also wind roses giving resultant winds, for heights of 750, 1,500, 3,000 and 4,000 metres, for each month and for the year. The stations number fourteen, the most northerly being Sault Ste. Marie, Michigan, nearly in latitude  $47^\circ N.$ , and the most southerly Key West, a little south of latitude  $25^\circ N.$ ; consequently they range from the westerlies of middle latitudes down to regions under the influence of the trade winds, and allow instructive comparisons to be made between the upper winds in the two major wind zones. Laborious statistical work of this kind is, of course, necessary before simple generalisations can be made with confidence about the general

circulation of the atmosphere. The labour of compilation in this case must have been particularly heavy, for the number of individual observations at some of the stations numbered more than 300 for a single month, even at 4,000 metres, where they are least numerous, and more than a hundred thousand observations were used altogether.

**The Ionisation of Cæsium Vapour by Light.** The ionisation of the cæsium atom by absorption of light is apparently one of the simplest photo-ionisation processes. Kunz (*Phil. Mag.*, Supplementary Number, Feb.) has measured the amount of ionisation produced per unit of energy by light of different wave-lengths, using cæsium vapour at very low pressures (down to the vapour pressure of cæsium at  $25^\circ C.$ ). He finds that the probability of ionisation falls from the series limit at  $\lambda 3184$  to a minimum at  $\lambda 2800$  and rises again at shorter wave-lengths. Braddick and Ditchburn have also published (*Proc. Roy. Soc.*, A., Jan.) their measurements of the absorption of light in cæsium vapour (already announced in a letter to NATURE of January 28, 1933). They find that the absorption falls to a minimum about  $\lambda 2800$  and rises again at shorter wave-lengths. In order to investigate the short-wave rise, they made careful experiments at different vapour pressures of cæsium, and showed that the absorption varied linearly with vapour pressure throughout the wave-length range. The absorption therefore appears to be attributable to the cæsium atom and not to molecules. The absolute value of the absorption coefficient at the longer wave-lengths leads to a value for the photo-ionisation which agrees with experiment. Taking these results in conjunction with the photo-ionisation experiments of Kunz and of former workers, it seems almost certain that the absorption is practically entirely due to the atomic photoelectric process and that the probability of this process increases in the shorter wave part of the ultra-violet. This result is in sharp antagonism to existing wave-mechanical calculations, which predict a monotonic fall in the probability on the short wave side of the series limit.

**A New Theory of Valency.** A paper on "A Theory of Valency Based on Wave Mechanics and Band Spectra" by Profs. R. F. Hunter and R. Samuel was read at a joint meeting of the Chemical and Physical Societies of Aligarh Muslim University on February 21. It was shown that assumptions such as those of the co-ordinate link and the singlet linkage are physically inadmissible, and that Lowry's theory of the semipolar double bond, although physically more sound than Sidgwick's theory of co-ordination, is impossible for energetic reasons. It was also suggested that Sidgwick and Bayliss's later contention with regard to the expansion of the valency group of hydrogen, that a second quantum group is permissible on Pauli's principle (*J. Chem. Soc.*, 2027; 1930) has no physical meaning, since wave mechanics have proved that it is impossible for electrons to enter the  $2s$  group while the  $1s$  group already possesses its maximum number of electrons; the curve of the potential energy of the third electron having no minimum and exhibiting only *repulsion* from the system. Pauling's recent deductions with regard to the structure of carbon monoxide (*J. Amer. Chem. Soc.*, 54, 988; 1932) were held to be neither correct on the basis of his assumed value of 3 volts per covalency, nor from the electronic configuration of the terms and their dissociation.

## Boston Meeting of the American Association

THE ninety-third meeting of the American Association for the Advancement of Science was held in Boston on December 27-January 2. Harvard University and the Massachusetts Institute of Technology, with which other colleges in the metropolitan area co-operated, were sponsors and furnished rooms and other facilities for most of the sessions, which were thus admirably provided for. The Boston area is a centre of outstanding interest. Its educational and scientific features were placed at the disposal of visiting men of science and added in significant fashion to the effectiveness of the meeting.

The local committee, with Dr. A. L. Lowell, president of Harvard University as honorary chairman and Dr. K. T. Compton, president of the Massachusetts Institute of Technology as honorary vice-chairman, provided well for the needs of the occasion. Despite the violent attack of historical New England winter on the first day, the programme was carried through successfully, due to the work of Prof. S. C. Prescott, chairman, and his associates. The attendance numbered more than 3,200 scientific workers and the programme included 1,475 papers. All fifteen sections of the Association were active and 34 of its affiliated societies held meetings. In addition, the Academy Conference brought together official representatives of 19 State academies of science on Wednesday. These affiliated academies are active agencies in the advancement of science in their particular regions and meet annually with the Association to discuss problems involved in their co-operation and to agree on plans for future work.

Most secretaries of sections and of affiliated societies remained for a study of organisation problems on the day following adjournment.

A noteworthy event, not on the official programme, was the dinner given to Dr. J. McKeen Cattell. On December 27, before the opening session, one hundred and thirty representative members and friends gathered to show their appreciation and pay respect to him for distinguished services to the Association. The feature of the programme was an address by Prof. John Dewey on "The Supreme Intellectual Obligation".

The first formal session on December 27 was opened with the president, Prof. H. N. Russell, in the chair. After customary addresses of welcome and response, the retiring president, Dr. John J. Abel, of Johns Hopkins University School of Medicine, addressed the audience on "Poisons and Disease". He discussed the chemical nature of disease as demonstrated adequately for certain diseases such as lock-jaw and diphtheria and strongly suggested in many other cases, hence the current trend towards the view that all diseases are due to poisons. As he said, "Nature has not affixed a poison label to any particular substance or class of substances; the pharmacist does that." Dr. Abel further pointed out that many materials in the human body, and even the vitamins, though necessary and helpful in limited quantities, become poisons in larger doses. "I incline to the belief," he stated, "that no living cell exists whose contents or metabolites are not toxic to some other living cell."

The second Hector Maiben lecture, an endowed annual event, was given by Prof. W. M. Davis on the topic, "The Faith of Reverent Science". In

this he set forth his concept of the views of reverent science and the hope of the future in the growing co-operation between thinkers in the fields of science and religion.

On December 28 the general session was in charge of Sigma Xi, the Society for the Promotion of Research. The speaker, Prof. Henry E. Sigerist, addressed the Society and guests on the topic, "The Foundations of Human Anatomy in the Renaissance".

The Sedgwick memorial lecture, which was established by the Biological Department of the Massachusetts Institute of Technology, was given on December 29 by Dr. Henry Fairfield Osborn. The magnificently illustrated lecture was an effective presentation of the subject "Aristogenesis, the Creative Principle in the Origin of Species".

On the same day, the Chemistry section and the North-Eastern Section of the American Chemical Society meeting jointly were addressed by Prof. Lafayette B. Mendel on "The Challenge of Nutrition to the Chemist".

The general session on Agriculture and Engineering on December 29, arranged with co-operation also of the section on Social and Economic Sciences, portrayed vividly the trend of the times. The Secretary of Agriculture, the Hon. Henry Agard Wallace, spoke on "What can Engineering do for Agriculture?" His address was an appeal to engineers to forsake *laissez-faire* philosophy and to join in building up a co-operative State. He charged scientific workers with failure to weigh social consequences and challenged the widespread self-centred attitude of the past. "To-day when the industrial nations of the world have skimmed most of the cream off the backward nations and the backward classes and when there are no longer any challenging geographical frontiers to be conquered, it becomes apparent", he said, "that we must learn to co-operate with each other instead of joining together in the exploitation of someone else."

On December 30 the American Academy of Arts and Sciences, meeting jointly with the Association, presented the Rumford medal for distinguished research in physics to Prof. Harlow Shapley, director of Harvard College Observatory and Paine professor of astronomy at Harvard, after which he addressed the meeting on "The Anatomy of a Disordered Universe". He elaborated the view that while the universe as a whole may be expanding, that part of it closest to man shows the opposite tendency.

A series of well-organised joint sessions and symposia formed an important feature of the programme. Indeed the entire three-day programme of the section of Medical Sciences consisted of a series of such features. Of particular general interest were the symposia on "The Chemical Revolution" by the sections of Chemistry and Social Sciences, on "National Economic Policy in its Relation to Our International Policy" by the section of Social and Economic Sciences, on "New England Dialect and Colonial Culture", by the section of Historical and Philological Sciences, on the "Development and Growth of the Nervous System", by the section of Zoological Sciences, on the "Positron" by the section of Physics, on "Engineering and the Farm Problem" by the sections of Engineering, Agriculture, and Social and Economic Sciences.

Four of the prominent affiliated societies, namely, the American Society of Naturalists, the American Society of Zoologists, the Botanical Society of America, and the Genetics Society of America, held a joint session on December 30 on the theme "Biology and Society". Prof. W. M. Wheeler spoke on "Animal Societies", Prof. E. A. Hooton on "Primitive Human Societies", and Prof. F. H. Hankins on "Development of Modern Social Organization". The American Society of Parasitologists and the section of Medical Sciences in joint session presented a programme on the "Typhus Group of Organisms", with demonstrations which aroused great interest. Other joint sessions of affiliated societies on plant physiology, ecology, entomology, phytopathology, parasitology and dental research would merit special comment if space permitted.

On December 30 the American Society of Naturalists celebrated its semi-centennial anniversary. Prof. S. H. Gage was honorary chairman. After dinner the anniversary address was delivered by Prof. E. G. Conklin on "Fifty Years of the American Society of Naturalists". Prof. B. E. Livingston read his presidential address on "Environments".

The addresses of the retiring vice-presidents, given at various times, included the following: *Mathematics*, Prof. H. H. Mitchell, "Linear Groups and Finite Geometries"; *Physics*, Dr. D. L. Webster, "Current Progress in X-Ray Physics"; *Chemistry*, Dr. Frank C. Whitmore, "Some General Aspects of the Polymerization and Depolymerization of Olefins"; *Astronomy*, Dr. P. W. Merrill, "Invisible Star Light"; *Geology and Geography*, Dr. William H. Hobbs, "The Glaciers of Mountains and Continents"; *Zoology*, Prof. A. S. Pearse, "Ecological Segregation"; *Botany*, Dr. H. L. Shantz, "Botanical Research"; *Anthropology*, Dr. C. H. Danforth, "Genetics and Physical Anthropology"; *Psychology*, Dr. Walter S. Hunter, "The Stimulus Control of Behavior during and after Learning"; *Education*, Prof. Stuart A. Courtis, "Differential Testing as a Method of Psychological Analysis"; *Social and Economic Sciences*, Prof. William F. Ogburn, "Recent Trends in Social Sciences"; *Historical and Philological Sciences*, Dr. Waldo G. Leland, "Recent Trends in the Humanities"; *Engineering*, Prof. Dugald C. Jackson, "The Origins of Engineering"; *Medical Sciences*, Dr. C. R. Stockard, "Internal Secretions and Genetic Quality in Structural Development"; *Agriculture*, Prof. Joseph H. Gourley, "Plant Anatomy as a Tool in Agricultural Research".

The Science Exhibition, now a regular feature of the annual meeting, was, despite adverse economic

conditions, the most successful yet undertaken. Colleges, private and Government research laboratories presented new and important work, both in pure and applied science; commercial exhibits of apparatus and products were extensive; among the displays of publications in science those of university presses were conspicuous, and the exhibits made by associations of teachers in biology, physics and mathematics attracted marked attention.

The Committee on the Place of Science in Education had arranged a special conference in which relations between teaching and the advancement of science were discussed from diverse points, and the results of new experiments in laboratories, science clubs and State academies reported.

The American Association prize of 1,000 dollars was awarded by the Committee on Awards to Dr. Reuben L. Kahn, bacteriologist of the University of Michigan, for his paper on "Tissue Reactions in Immunity: the Specific Reacting Capacities of Different Tissues of an Immunized Animal". By a method of measuring the degree of immunity acquired by different tissues, as shown by the author's investigations, warfare against germ diseases may be more successfully conducted.

The British Association was represented at the meeting by Prof. Arthur E. Kennelly of Harvard and Prof. F. E. Lloyd of McGill; the French Association by Prof. W. M. Davis of Harvard, and the Bohemian Royal Society by Prof. Henry B. Ward of Illinois. Special delegates were also appointed by many American institutions.

The following officers were elected for the year 1934: *President*, E. L. Thorndike of Columbia University; *Council Members*, F. K. Richtmyer of Cornell University, J. C. Merriam of Carnegie Institution; *Members of the Executive Committee*, K. T. Compton of the Massachusetts Institute of Technology, E. G. Conklin of Princeton University; *Trustee of Science Service* for three years, to April 1937: J. McKeen Cattell; *Vice-Presidents of the Sections*, 1934: R. D. Carmichael, mathematics; H. G. Gale, physics; Joel H. Hildebrand, chemistry; Frederick Slocum, astronomy; Jas. B. Macelwane, geology and geography; George L. Streeter, zoological sciences; B. O. Dodge, botanical sciences; M. J. Herskovitz, anthropology; John E. Anderson, psychology; Carl Snyder, social and economic sciences; Solon J. Buck, historical and philological sciences; C. E. Skinner, engineering; Cyrus C. Sturgis, medical sciences; J. G. Lipman, agriculture; Guy T. Buswell, education; *Secretary of Section I*, John A. McGeoch. HENRY B. WARD.

### Invention and Legislation

AT the sixth annual general meeting of the Television Society held at University College, London, on March 14, an address was given by the president, Sir Ambrose Fleming, on "Invention in Relation to National Welfare and its Legislative Control". Sir Ambrose referred to progress in television as an instance of one of the most interesting of the technical applications of science. It fulfils the same function with regard to the eye that radio-telephony does for the ear. It annihilates distance and enables us to see living and moving objects which would otherwise be invisible. In short, it enables us to be in two places at the same time.

We are then led to consider the question how such an achievement can be made to contribute to national welfare, apart from its interest as a mere scientific novelty or amusement.

The great advances made in the use of short electric waves and closer scanning, and in photoelectric cells and cathode ray tubes, have made corresponding advances possible in television, and we can now transmit images of pictures, diagrams, or living persons and reproduce them on screens 3-4 ft. square, visible to large audiences at the receiving stations. We have in this ability a valuable means of education. Lectures and school lessons can be

given by radio speech and illustrated by television diagrams or pictures. Botany, astronomy, physiology and other sciences can thus be taught by visible diagrams. A critic might say that this will diminish the demand for science teachers. On the other hand, it would render possible the services of very able men and women of special knowledge and teaching power. This particular application of television has scarcely yet been touched. Where mere entertainment is desired, it will before long be possible to transmit special films of moving objects and, as it were, to bring the cinema into every home.

These replacements which invention brings about force us into consideration of the question how far mechanical invention at the present day is responsible for the large scale unemployment which afflicts the world? Different answers are given to this question. Some hold that the replacement of manual power and skill by machine power which does ten or hundred times as much in the same time, is a fundamental cause of present distresses. Others think that a primary reason is the deficient organisation in business, and that our methods of production have outrun our power of distribution. Probably a still more basic cause is the enormous waste of world wealth and natural resources in wars and preparation for wars. Humanity has not yet learnt how to live as one family or society and not as a collection of enemies and contesting rivals.

Invention, however, requires guidance and control, and it is difficult to introduce new methods and ideas when any one branch of activity has become centralised in a few hands or petrified by becoming a Government monopoly. This makes it necessary to point out how many disadvantages arise from erroneous or premature legislation intended to control invention. This may be illustrated by the history of telegraphy, telephony, electric lighting and wireless telegraphy. When after 1837 electric telegraphy became practicable by numerous inventions, public companies were formed to exploit it. About 1866 or so, an opposition began to be raised to the growth of what was called another 'monopoly'. The British Government of that day then passed Acts of Parliament in 1868-69 to enable it to buy out the telegraph companies and to place electric telegraphy under the control of the General Post Office.

These Acts were, however, drawn with such skill that even ten years later when the telephone was invented and exchanges established, telephony was held to be subject to the above Acts. Unfortunately, this decision rested merely on a judgment given in a court of first instance and was never confirmed by a higher court. The General Post Office offered the telephone companies a licence for thirty years in exchange for a royalty of 10 per cent on their receipts. During those thirty years it took nearly a million and a half sterling from the telephone, but it blocked the way to advances in the art during all that time.

The same story was repeated with electric incandescent domestic lighting. In 1882 the Government passed an Act ironically termed an Act to 'facilitate' it, but in fact it simply 'throttled' it for six years until an amending Act was carried in 1886. A similar fate attended wireless telegraphy. In 1904 it was placed under the control of the Postmaster-General. In 1926, when broadcasting of speech and music had become an important service, a charter committed it to the domination of the B.B.C. and its small group of governors. Television is now also in the control of the same power and the only chance given

to prove its utility is at 11 p.m., when few people have use for it.

Accordingly it is clear that premature legislation can easily cripple a nascent industry and bind it in bandages of red tape. It is beyond defence that an invention which was not dreamt of at the date of a certain Act of Parliament should be controlled by that Act.

In conclusion, Sir Ambrose Fleming advocated an extension of the period of patent protection, which at present is fourteen years in Great Britain, unless specially extended. An invention is no use to the public until it becomes practically available or commercialised, and this generally requires time and great expenditure. It is not possible to secure this without some reasonable prospect of return upon the capital, and in most cases a large part of the period of patent protection has elapsed before the point of commercial success is reached.

### University and Educational Intelligence

CAMBRIDGE.—Dr. R. Stoneley, lecturer in applied mathematics in the University of Leeds, and Dr. H. M. Taylor have been appointed University lecturers in mathematics.

The Vice-Chancellor has appointed Dr. A. H. Gardiner to the Frazer lectureship in social anthropology for the year 1934-35.

Dr. W. H. Thorpe and Dr. W. H. Mills have been appointed to represent the University at the Eighth International Ornithological Congress to be held in Oxford on July 2-7.

Prof. E. B. Verney, professor of pharmacology at University College, London, has been appointed to the Sheild readership in pharmacology as from October 1.

EDINBURGH.—The Senatus Academicus of the University has resolved that the honorary doctorate in laws be offered to the following, among others, for conferment at the graduation ceremonial to be held on June 28: Dr. R. Hutchison, physician to the London Hospital; Sir John Stirling-Maxwell, formerly chairman of the Forestry Commission and of the Royal Fine Art Commission for Scotland, chairman of the Ancient Monuments Board (Scotland); Prof. R. Robinson, Waynflete professor of chemistry in the University of Oxford; Prof. D'Arcy W. Thompson, professor of natural history in the University of St. Andrews.

APPLICATIONS, which must be received not later than April 15, are invited for the following scholarships awarded by the Council of the Institution of Electrical Engineers. Inquiries for full particulars and nomination forms (specifically mentioning the name of the Scholarship) should be addressed to the Secretary of the Institution, Savoy Place, London, W.C.2: Duddell scholarship (£150 per annum for 3 years), for candidates less than nineteen years of age on July 1; Ferranti scholarship (£250 per annum for 2 years), for candidates less than twenty-six years of age on July 1; Swan memorial scholarship (£120 for 1 year), for candidates less than twenty-seven years of age on July 1; Silvanus Thompson scholarship (£100 per annum and tuition fees, for 2 years), for works employees less than twenty-two years of age on July 1.



## Science News a Century Ago

## University Tests

In the spring of 1834 there was, wrote Airy, who was then Plumian professor at Cambridge, "a furious discussion about the admission of Dissenters into the University". The repeal of the Corporation and Tests Acts in 1828 had removed many of the disabilities under which Dissenters laboured, but they were still unable to obtain degrees at either Oxford or Cambridge. Efforts to bring the matter before the Senate at Cambridge having failed, on March 21, 1834, Earl Grey, the Prime Minister, presented a petition in the House of Lords from certain members of the Senate praying for the abolition by legislative authority of "every religious test exacted from members of the University before they proceed to degrees, whether of bachelor, master or doctor, in arts, law and physic". In praying for the removal of these restrictions, the petition said, they were only asking for "a restitution of their ancient laws and laudable customs. These restrictions were imposed on the University in the reign of James I, most of them in a manner informal and unprecedented, and grievously against the wishes of many of the members of the Senate, during times of bitter party animosities. . . ." In a speech on the occasion, the Duke of Wellington remarked that the petition was nothing more than the petition of a dissatisfied minority though consisting of most respectable individuals, praying the House to interfere with the regulation of the University, in defiance of the immense majority of the Senate.

On March 24, the same petition was presented in the House of Commons by Mr. Spring Rice, but the petition was vigorously opposed by Mr. Goulburn, one of the members for the University of Cambridge. On April 17, Col. Williams moved that an address be forwarded to the King "requesting His Majesty to signify his pleasure to the Universities of Oxford and Cambridge respectively, that these bodies no longer act under the edicts or letters of James I, 1616". It was, however, determined to proceed by bill, and by 185 votes to 44 leave was given to bring in a bill to grant His Majesty's subjects generally the right of admission to the English universities, and to equal eligibility to degrees therein, notwithstanding their diversities of religious opinion, degrees in divinity alone excepted. The second reading of the bill was passed on June 20 by 321 votes to 174 and the third reading on July 28 by 164 votes to 75. When the bill was sent to the House of Lords, it was nevertheless rejected.

Among the most notable speeches in its favour was that of Lord Brougham, then Lord Chancellor. He supported the bill because it removed a practical grievance. "Surely," he said, "it was a great practical grievance, that instead of being admitted into one of the most illustrious, most ancient, and justly renowned seminaries of public learning, he should be forced to seek for education in another country. . . . Was it nothing that as a professional man he should not be admitted to the degree of a doctor of medicine, because he was not a member of the Church of England, and that to practise the faculty of medicine he must go to Berlin, or Paris, or Edinburgh or Glasgow? This was a law which savoured of oppression and was a practical grievance of great weight." He could not understand, he said, the consistency of those who gave the Dissenter

admission to both branches of the legislature which must control the universities, and yet refused him admission to those very universities.

## Discovery of the Tea Plant in India

Towards the end of the eighteenth century the difficulties which attended trading with China compelled the East India Co. to consider the possibility of growing various commodities, notably tea, in India. Sir Joseph Banks advised the Company that parts of Bengal would probably be suitable for the purpose. In 1826, the Commissioner in Assam had sent to Calcutta leaves of a shrub indigenous to that area which he believed to be a wild tea plant. This was not immediately accepted by the authorities, and it was not until the spring of 1834 that it was established that the genuine tea plant was native to India. Thereafter, the cultivation of tea became more and more extensive in India, the monopoly of the East India Co. was abolished, and India became ultimately the main tea-growing country in the world.

In an article in Loudon's *Gardener's Magazine* of August, 1835, Dr. Wallich gives some details of the discovery made the year before. A commission, of which he was chairman, had been appointed to investigate the situation and reported "that we are enabled to announce that the tea shrub is, beyond all doubt, indigenous in Upper Assam. . . . We have no hesitation in declaring this discovery, which is due to the indefatigable researches of Captain Jenkins and Lieutenant Charlton, to be by far the most important and valuable that has ever been made in matters connected with the agricultural or commercial resources of this empire. We are perfectly confident that the tea plant which has been brought to light will be found capable, under proper management, of being cultivated with complete success for commercial purposes. . . . We are acquainted with the fact that the late ingenious Mr. David Scott sent down from Munipore specimens of the leaves of a shrub which he insisted was a real tea." By 1835 tea nurseries had been established in various parts of Northern India and the beginnings of the tea industry firmly established.

## Improved Apparatus for Making Ship's Biscuits

In 1834, food scales in naval and merchant ships were unbalanced and rough. The subjoined statement by the Society of Arts relates to the award of a special premium during the session 1833-34, for an improved industrial process for the making of ship's biscuits.—"The large gold medal has been voted to Thomas R. Grant, of Weovil, near Portsmouth, for his improved apparatus for the manufacture of ship's biscuits. The apparatus was first erected at Weovil in 1832, under the immediate superintendence of Sir John Rennie. In Mr. Grant's apparatus the greater part of the labour is performed by steam power; the nine ovens in use are heated by one continuous fire-place, the flame of which is admitted by means of a register into each oven as soon as the previous charge has been withdrawn, and in five minutes brings it to a sufficient heat. The advantages claimed are superior economy and expedition, and better quality in the article. The present mode of making ship's biscuits involves, amongst the first operations, the mixing, by a man, of meal and water in due proportions; the kneading the dough for half an hour with his naked arms plunged

up to the elbows, finishing by jumping into the dough and kneading with his feet. A perfect and uniform mixture cannot result, shown later in some ship's biscuits being thin, some thick and scaly" (*Trans. Soc. Arts*, 50, 7, 1834-35). The Society inspected an installation of this apparatus set up by a firm at Wapping.

## Societies and Academies

### LONDON

Royal Society, March 8. J. CHADWICK, P. M. S. BLACKETT and G. OCCHIALINI: Some experiments on the production of positive electrons. The emission of positive electrons has been observed under different experimental conditions: (1) from a lead target exposed to the  $\gamma$ -rays of thorium active deposit; (2) directly from a source of thorium active deposit; (3) from a lead target exposed to the radiations ( $\gamma$ -rays and neutrons) emitted by beryllium, boron, and fluorine when bombarded by polonium  $\alpha$ -particles. The measurements of the energies of the positrons ejected from lead by the thorium  $\gamma$ -rays support the view that a positron and an electron are produced simultaneously by the interaction of a  $\gamma$ -ray and an atom, and that the mass of the positron is the same as that of the electron. The positron and electron are probably created in the electric field outside, rather than inside, the nucleus. The observations show that when  $\gamma$ -rays of high frequency pass through an appreciable fraction (about one fifth for a  $\gamma$ -ray of  $h\nu = 2.6 \times 10^6$  volts) of the energy absorbed is used in this process of creating a positron and an electron. G. TEMPLE: The quantum theory of the neutron. This paper develops a theory of the neutron on the basis of the second order wave equation for the hydrogen atom,  $(F^2 + m_0^2 c^2) \psi = 0$ , where  $F$  is Dirac's wave operator. This equation possesses two types of solutions for which  $\int_0^\infty \psi^{*2} dr$  is finite—the type  $H$  which yields the accepted wave functions of the hydrogen atom, and the type  $N$  which is here identified with the wave functions of the neutron. Certain properties of the neutron are deduced from the form of the  $N$  solutions.

Physical Society, Jan. 19. E. O. WILLOUGHBY: The measurement of the inductance of iron-cored chokes carrying direct current. A method for measuring, by means of a reflecting dynamometer ammeter, the inductance of an iron-cored coil is described. The coil is connected in series with a capacity and the ammeter, and then the junction of the inductance and capacity and the junction of the fixed and moving coils are connected to an a.c. supply. For a constant applied voltage the deflection of the dynamometer ammeter is proportional to the square root of the reciprocal of the inductance. This is also true when a direct current is superimposed on the alternating current flowing through the inductance. Advantages of the method are the simplicity of the instruments and of the observations taken, the small value of the alternating current used and the independence of the method within wide limits of the frequency and wave-form of the supply. G. A. WHIPPLE: A high-vacuum leak device. The device described was designed for the control of pressure in the discharge tube of cold-cathode cathode ray oscillographs. It operates on a diffusion principle, and in this case permits of continuous variation of

discharge tube pressures from 0.5 mm. mercury to 'black' vacuum at 70 kilovolts. C. H. COLLIE: The use of charcoal in maintaining high vacua. Measurements have been made of the limiting pressures reached by charcoals and silica gels cooled with liquid air or liquid hydrogen when a small, constant stream of gas is admitted into the apparatus. R. A. FEREDAY: On some measurements of magnetic susceptibilities at high temperatures. Details are given of an electromagnet which has been specially built for carrying out measurements of small susceptibilities by a method, previously described by the author, in which specially designed pole-pieces are used. The method is applicable whether the pole-pieces are or are not saturated. An apparatus for the determination of susceptibilities at high temperatures is described in detail. J. S. PRESTON and L. H. McDERMOTT: The illumination-response characteristics of vacuum photoelectric cells of the Elster-Geitel type. The authors deal with the present status of the vacuum photocell as regards proportionality of photoelectric current to incident illumination, and give a series of observations which show that while excellent cells are obtainable, their employment for precise work without a previous test is unsafe. A theory is developed which accounts for the observed results. Attention is directed to the dependence of the illumination characteristic upon the colour of the light employed.

### PARIS

Academy of Sciences, January 22 (*C.R.*, 193, 294-408). The president announced the death of Pierre Bazy, member of the Section of Medicine and Surgery. JULES DRACH: The quadratic integrals of the equations of dynamics and the conjugated systems of Euclidian space of  $n$  dimensions. J. COSTANTIN: New ideas in connexion with potato disease (*Enroulement*). On repeating the experiments of Newton on the effects of altitude on potato diseases, it is concluded that high altitude does not cure such diseases, but causes them to become less virulent. These results suggest the possibility of realising true vaccinations of plants. PIERRE WEISS: A series of coefficients intervening in certain phenomena depending on thermal agitation. LOUIS ROY: The apparent diameter of the stellar discs. J. CABANNES and J. DUFAY: The spectral analysis of the light of the nocturnal sky at the Pic du Midi. Besides a continuous spectrum, with dark Fraunhofer lines, there are present a large number of emission bands and lines, the most intense of which is the green line of the polar aurora. A list of these lines is given. These are shown to be emitted in the upper atmosphere. EDOUARD CHATTON: The peridinian origin of the Radiolaria and the parasite interpretation of anisoprogenesis. ANTONIN GOSSET was elected a member of the Section of Medicine and Surgery. E. J. GUMBEL: The moments of the final distributions of the  $m$ th value. PAUL ALEXANDROFF: The Betti groups at a point. B. DE KERÉKJÁRTÓ: The topological character of conformal representations. A. ROSENBLATT: The biharmonic equation with two independent variables. CHADENSON: Mean square functions capable of summation. MANDELBROJT: A new quasi-analytical class of indefinitely derivable functions. V. A. KOSTITZIN: The mathematical study of the problem of glacial periods. L. PONTRJAGIN: Continued Abelian groups. J. DELSARTE: Mean periodic functions. ARY J. STERNFELD: A

method of determination of the trajectory of a body in movement in interplanetary space by an observer connected with the mobile system. L. SANTON: A supersonic blower with a high velocity coefficient. L. COUFFIGNAL: The mechanical balancing of rotating masses. A. MARTINOT-LAGARDE: An anemometer insensitive to changes in the direction of the wind. A modification of the Dines anemometer. V. GROUITCH: Occultations of stars by the moon observed at Strasbourg from 1925 until 1932. Reductions and discussion. EMMANUEL GAMBETTA: The measurement of small light intensities by means of the photoelectric cell. RENÉ AUDUBERT and JEAN ROULLEAU: The influence of water in certain rectifying contacts. Rectifiers containing powders of metallic salts are affected by the presence of moisture in the powders. QUINTIN: The rôle of the barrage layer in rectification by imperfect contact. J. MERCIER: The possible different types of electrical oscillations. M. PAUTHENIER and MME. MOREAU-HANOT: The influence of isolated conductors on the coronal discharge. TH. V. IONESCU: The propagation of energy in tubes containing ionised gases. NY TSI-ZÉ and VOO SHUEH-LING: The continuous spectrum of neon. D. SÉFÉRIAN: The spectrum of atomic nitrogen (N I) in ammonia and in mixtures of hydrogen and nitrogen. MAURICE CURIE and F. JOLIOT: The radioactivity of samarium. About a year ago Hevesy and Pahl showed that samarium emitted  $\alpha$ -rays. The authors, using another method, obtain results confirming the radioactivity of samarium. LA GOLDSTEIN: Recoil atoms in gaseous media. PIERRE AUGER: On the  $\gamma$ -rays produced by the passage of neutrons through hydrogenated substances. The author has studied the curvature of the trajectory of the particles in a magnetic field of 7000–8000 gauss. The results are not in accord with the interpretation by Lea of these phenomena. P. SAVEL: The complex radiation excited in aluminium by the  $\alpha$ -particles. W. BRONIEWSKI and K. WESOLOWSKI: The structure of the gold-copper alloys. Curves are shown for melting points, electrical conductivity, temperature coefficient of the electrical conductivity, thermoelectric power, and linear coefficient of expansion. Different curves were obtained in some cases when slowly cooled or tempered alloys were taken. No indication of the existence of the compound  $\text{Au}_2\text{Cu}_2$  was obtained. ERNEST and MARCELLE KAHANE: A general method for the determination of sulphur in organic substances. The oxidation is carried out with a mixture of nitric and perchloric acids in the presence of a small proportion of iodic acid. R. PAUL: Bromine derivatives of tetrahydropyrene. MARCEL CASTERAS: The tectonic of the north slope of the Pyrenees. L. DUBERTRET: The deposits of mineral hydrocarbons in Syria and Liban. J. GUBLER: The stratigraphic value of the Fusulinidae of the Permian. PAUL GUÉRIN: Hydrocyanic acid in the Gramineae: *Melica* and *Gynerium*. H. COLIN and MLE. J. PAYEN: The sugar of *Rivularia bullata*. A. and R. SARTORY, J. MEYER and ERNST: The inhibiting influence of radium on the growth of the rootlets of *Lens esculenta*. Modifications of the minimum hindering dose under the influence of favourable ions. ANDRÉ KLING, J. FROIDEVAUX and FÉLIX DUBOIS: The rôle of the fatty material contained in flours. A. MAUBLANC and ROGER: Phthiriosis of the coffee plant. MARCEL BAUDOIN: The age at which birds can migrate. From the experiments described it would appear that birds can migrate when six months old. MME. LUCIE RANDOIN

and ROGER NETER: A avitaminosis and the utilisation of lipids. J. DONATO, R. JACQUOT and H. PENAU: The influence of vitamins A and D on the humoral reactions in human tuberculosis. NILS STENDAL: The presence of salicylic acid and of phenylacetic acid in the acetone-soluble fat of the tubercle bacillus. RAYMOND HOVASSE: Ebriaceae, Dinoflagellae and Radiolaria. MLE. BERTHE BIECHELER: A dinoflagellan with perinuclear capsule, *Plectodinium nucleovolvatum* and on the relations of the peridinians with the Radiolaria.

## VIENNA

Academy of Sciences, November 23. OTTO BRUNNER and ROLF WÖHRL: Chemistry of bark substances (2); components of hazel bark. This bark contains a hydrocarbon, lignoceryl alcohol, sitosterol and a resinol  $\text{C}_{30}\text{H}_{50}\text{O}_2$ , which is identical with the betulin of birch bark. The coryl and the sterol of m.p.  $200^\circ$  found by Zellner and Feinberg (1923) are merely mixtures of betulin and sitosterol. OTTO BRUNNER and FRANZ GROF: Synthesis of 1-ethyl-6-methyl- and 1-ethyl-7-methyl-naphthalene. These synthesised hydrocarbons are both different from that obtained on dehydrogenation of amber; for the latter the constitution 1:2:5-trimethylnaphthalene is thus confirmed. HANS MAYERHOFER: Conditions for the production of thorium B + C preparations. The best metallic precipitant, time of activation, temperature, etc., for obtaining Th C and Th B + C have been determined. KASIMIR GRAF: Brightness of comet 1932n (Dodwell-Forbes). Photometric observations during two months at the Porto Cristo station in Mallorca show that, apart from occasional short deviations, this comet shows a smooth brightness curve which may be represented satisfactorily by the reduced brightness 7.83 mag. and by the exponent 5.8 in the radius vector. WALTER BERNHEIMER: Intensity of ultra-violet solar radiation ( $\lambda$  3200) between April 1925 and June 1933. This radiation varies with the time, but during two thirds of the whole time of observation the variation was absolutely opposed to the sunspot periodicity. The positive correlation between the solar constant and the ultra-violet radiation, required by theory, was not observed. ALEXANDER TORNQVIST: The mineral deposits of the Dolomites and Venetia (1): the pyrites mass of Agordo. K. HEINZ: Observations on the cytology of the species *Polygonatum* and *Convallaria*. L. ŠLADOVIČ: Attack of metals by liquid, binary, organic systems. Iron and aluminium were not attacked by the systems examined. Copper, however, was acted on more rapidly by the systems aniline-phenol, aniline-nitrobenzene, and pyridine-phenol—all of which form compounds in the liquid phase—than by the separate components. On the other hand, benzene-aniline, which forms no molecular compound, is less corrosive than its constituents. GUSTAV GÖTZINGER and VILHELM MILTHERS: The northern quaternary of Silesia and Moravia. KARL HÖLZL: Recent investigations in East Salzkammergut.

November 30. FRANZISKA SEIDL: Action of radium radiation and X-rays on piezo-quartz. Experiments with a number of quartz plates show that increase of the piezo-constant by radioactive radiation or X-rays apparently depends on the magnitude of this constant in the non-irradiated state, and that the increase in conductivity caused by the irradiation must also be considered. ERNST BEUTEL and ARTUR

KUTZELNIGG : Sorption of iodine by fibrous materials (1): vegetable fibres. ERNST BEUTEL, HERBERT HABERLANDT and ARTUR KUTZELNIGG : Coloration of marble in iodine vapour and the nature of the polished layers. When exposed to dry iodine vapour, marble assumes a yellow or reddish-brown coloration, the intensity of which is greatest for sawn surfaces. Polished surfaces also are deeply coloured, but those etched by acid, grinding or sand-blasting are coloured to less extents. It is considered that the polished surface-layers consist of crystallites of colloidal dimensions, their marked sorptive capacity resulting from the accumulation of granule-boundaries. ARTUR KUTZELNIGG : (1) Change in certain properties of zinc oxide in consequence of mechanical demands. Subjection of zinc oxide to grinding or pressing produces marked alteration of the colour and luminescence effects. (2) Fluorescence of zinc oxide at the temperature of liquid air. The fluorescent properties of various zinc oxide preparations are greatly enhanced when the oxides are cooled in liquid air. OTTO BRUNNER and FRANZ GROF : Synthesis of 1-methyl-2-ethyl- and 1-ethyl-2-methylnaphthalenes. ANDREAS THURNER : Explanation of the stratigraphic relationships in the mountain region around Murau.

### Forthcoming Events

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

Monday, March 19

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—Capt. Guy Dollman: "Animals Recommended for Protection in Africa".\*

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Miss Mildred Cable: "The Bazars of Tangut and Trade Routes of Dzungaria".

Tuesday, March 20

EUGENICS SOCIETY, at 5.15 (in the rooms of the Linnean Society, Burlington House, Piccadilly, W.1).—Prof. R. J. A. Berry: "Some Modern Views of the Human Mind and its Disorders" (Lantern Demonstration).\*

Wednesday, March 21

ROYAL METEOROLOGICAL SOCIETY, at 7.30 (in the hall of the Royal Geographical Society).—J. M. Stagg: "The British Polar Year Expedition to Fort Rae, Canada, 1932-33".

ROYAL SOCIETY OF ARTS, at 8.—D. S. Richards: "Wireless Communications with the Mount Everest Expedition, 1933".

ROYAL ENTOMOLOGICAL SOCIETY OF LONDON, at 8.—K. R. S. Morris: "Entomological Excursions in West Africa". (Film.)

K. Mellanby: "Factors Causing Insect Death".

Friday, March 23

ROYAL ASTRONOMICAL SOCIETY [GEOPHYSICAL MEETING], at 4.30.—Discussion on "Oceanic Circulation" to be opened by D. J. Matthews.

INSTITUTION OF PROFESSIONAL CIVIL SERVANTS, at 5.45 (at the Royal Society of Arts).—J. M. Stagg: "The British Polar Year Expedition to Fort Rae, Canada, 1932-33".\*

ROYAL INSTITUTION, at 9.—Lord Rutherford: "The New Hydrogen".

INSTITUTION OF NAVAL ARCHITECTS, March 21-23.—Annual meeting at Royal Society of Arts.

SOCIETY FOR EXPERIMENTAL BIOLOGY, March 23-24.—Thirtieth annual conference to be held at Oxford.

### Official Publications Received

#### GREAT BRITAIN AND IRELAND

The Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 41: The Trees of Ireland, Native and Introduced. By H. M. Fitzpatrick. Pp. 597-656. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 3s.

Reports on the Museums of Ceylon, British Malaya, the West Indies, etc. Pp. 58. Directory of Museums in Ceylon, British Malaya, Hong Kong, Sarawak, British North Borneo, Fiji, the West Indies, British Guiana. Pp. 67. (London: Museums Association.) Reports, with Directory, 5s.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1551 (T. 3377): The Radially Braced Airship Ring. By Prof. L. Baird. Pp. 28+3 plates. 1s. 6d. net. No. 1559 (T. 3427): Use of Networks to Introduce Turbulence into a Wind Tunnel. By E. Ower and Dr. R. Warden. Pp. 8+4 plates. 6d. net. No. 1560 (T. 3346, revd.): Heat Transmission through Circular, Square and Rectangular Pipes. By A. Bailey and W. F. Cope. Pp. 11+8 plates. 9d. net. No. 1561 (T. 3430): Flow near a Wing which Starts Suddenly from Rest and then Stalls. By Aeronautics Laboratory, Cambridge. Pp. 9+8 plates. 1s. net. (London: H.M. Stationery Office.)

Directory of Museums and Art Galleries in Australia and New Zealand. Compiled by S. F. Markham and Dr. H. C. Richards. Pp. 115. (London: Museums Association.)

Beer. By H. F. E. Hulton. (Sixteenth Streatfield Memorial Lecture, 1933.) Pp. 34. (London: Institute of Chemistry.)

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#### OTHER COUNTRIES

Records of the Indian Museum. Vol. 35, Part 2: Notes on Fishes in the Indian Museum. 20: Loaches of the Genus *Nemachilus* from Baluchistan; 21: On a New Species of *Nemachilus* from Kohat, N.W.F. Province. By Dr. Sunder Lal Hora. Pp. 183-191+plate 5. Vol. 35, Part 3: Remarks on Tonnoir's Theory of the Evolution of the Ventral Suckers of Dipterous Larvæ. By Dr. Sunder Lal Hora. Pp. 283-286. Vol. 35, Part 4: Silurid Fishes of India, Burma and Ceylon. 1: Loach-like Fishes of the Genus *Amblyceps* Blyth. By Dr. Sunder Lal Hora. Pp. 607-621. (Calcutta.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 100: The Lift Acting on a Flat Plate in a Stream bounded by an Infinite Plane Wall. By Susumu Tomotika. Pp. 115-156. 30 sen. No. 101: The Lift on a Flat Plate placed in a Stream between Two Parallel Walls and some Allied Problems. By Susumu Tomotika. Pp. 157-227. 45 sen. (Tôkyô: Koseikai Publishing House.)

Southern Rhodesia. Meteorological Report for the Year ended 30th June 1933. Pp. 59+1 plate. (Salisbury: Government Printer.)

Southern Rhodesia. Geological Survey. Bulletin No. 26: The Larger Gold Mines of Southern Rhodesia. Compiled by B. Lightfoot. Pp. 106. (Salisbury: Geological Survey.) 1s. 3d.

South Australia: Department of Mines. Mining Review for the Half-Year ended June 30th, 1933. (No. 58.) Pp. 62+6 plates. (Adelaide: Government Printer.)

Dominion of Canada. Report of the Department of Mines for the Fiscal Year ending March 31, 1933. (No. 2338.) Pp. iii+43. (Ottawa: King's Printer.) 25 cents.

Canada: Department of Mines: Geological Survey. Economic Geology Series. No. 15: Oil and Gas in Western Canada. By G. S. Hume. Second edition. (No. 2128.) Pp. v+359. (Ottawa: King's Printer.) 75 cents.

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Bulletin of the Department of Indian History and Archaeology, No. 1: Some Aspects of the Vāyu Purāna. By V. R. Ramachandra Dikshitar. Pp. iii+52. (Madras: The University.) 1 rupee; 2s.

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Carnegie Institution of Washington. Publication 447: Contributions to Palaeontology; Marine Animals. By Earl L. Packard, Remington Kellogg and Ernst Huber. Pp. iii+136+8 plates. (Washington, D.C.: Carnegie Institution.)

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